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Impact of Green HRM Practices on Green Innovation in KP Universities: Empirical Testing of a Moderated Mediation Model

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Abstract

This study examines the moderated-mediation model on direct and indirect role of Green Human Resource Management (GHRM) practices in fostering Green Innovation (GI) amongst KP Universities' faculty members. In addition, this study measures the moderating role of Employees Environmental Responsibility (EER) in the relationship of GHRM with GI via Green Transformational Leadership (GTL). Utilizing SPSS PROCESS Model 7 to conduct a moderated mediation analysis, the study draws on data collected from 373 faculty members in universities of KP, Pakistan. A combination of descriptive and inferential statistical techniques was employed to test the proposed hypotheses. The findings demonstrate that GTL partially mediates the relationship between Green Human Resource Management (GHRM) and GI. Furthermore, EER significantly moderates the association between GHRM and GTL. In the context of moderated mediation, EER serves as a moderator in the pathway linking GHRM to GI through GTL. Grounded in the Social learning theory and Resource-Based View (RBV) theory, this study underscores the strategic role of human resource practices in fostering green innovation within academic institutions. The findings highlight the importance of integrating GHRM practices, promoting environmental responsibility among employees, and leveraging green transformational leadership to cultivate a sustainable organizational culture and drive green innovation in universities. The paper concludes with an in-depth discussion of the study's theoretical contributions and practical implications.

keywords: Green HRM Practices, employees' environmental responsibility, green transformational leadership, Green innovation.

Introduction

In an era characterized by escalating environmental challenges and an intensified global emphasis on sustainability, organizations across various sectors are increasingly compelled to integrate environmentally responsible practices into their operational frameworks. Higher education institutions, as pivotal agents of societal development and knowledge dissemination, are equally obligated to embrace this imperative. The interplay between human resource practices, green innovation, and the role of employees within university settings represents a critical domain

warranting nuanced exploration and empirical investigation (Jehangir et al., 2024, Merlin & Chen, 2022; Gomes, Sabino & Antunes, 2023; Mukherjee, Bhattacharjee, Paul, & Banerjee, 2020). In addition, the relationship between human resource practices and organizational outcomes has been extensively studied (Guest, 2017; Huselid, 1995). However, the integration of human resource management with green innovation, particularly within the unique context of universities, remains an underexplored area of inquiry. Universities, as complex institutions engaged in teaching, research, and societal engagement, bear the responsibility of fostering green innovation as they educate and prepare the future workforce (Jehangir et al., 2024, Noonari, Junejo & Ahmed, 2021; Goel, Mehta, Kumar & Castaño, 2022; Mtembu, 2017; Kuo et al., 2022). Ergo, to address the multifaceted relationship between human resource management practices and green innovation within universities, this study employs a comprehensive approach. Two critical factors, employees' environmental responsibility (EER) and green transformational leadership (GTL), are explored as potential conduits influencing this relationship. Employees' environmental responsibility pertains to the individual commitment and accountability of staff members toward sustainable practices (Jackson & Ruderman, 1999), while green transformational leadership refers to leadership behaviors that inspire and guide teams toward environmentally conscious decisions and practices (Ding et al., 2018). Simultaneously, Universities, as proponents of sustainability, are expected not only to educate on environmental issues but also to exemplify best practices in their operations (Cheng & Monroe, 2012). Previous research has underscored the role of Green Human Resource Management (GHRM) in fostering sustainability (Jackson et al., 2019; Ren et al., 2020). However, the mechanisms through which GHRM influences green innovation, particularly with EER as a moderator and GTL as a mediator, remain underexplored in university contexts, especially in Pakistan. Studies argued that EER significantly influences pro-environmental behaviors in organizations (Lamm et al., 2018), while GTL has demonstrated potential in advancing environmental initiatives in institutional settings (Zhu et al., 2021). Despite these insights, the interaction between EER and GTL and their combined impact on green innovation within the unique socio-cultural and educational landscape of universities in Khyber Pakhtunkhwa (KP) remains largely unexamined (Merlin & Chen, 2022; Gomes et al., 2023). Furthermore, Green Human Resource Management (GHRM) practices in universities face distinct challenges across Western and non-Western contexts. In Western institutions, aligning HR strategies with sustainability objectives involves embedding eco-friendly principles in recruitment, training, and retention practices (Jabbour et al., 2018). Conversely, universities in non-Western countries, such as Pakistan, encounter barriers related to socio-cultural diversity, resource limitations, and varying institutional support for sustainability initiatives (Renwick et al., 2016). To bridge these gaps, this study employs a cross-sectional research design, utilizing survey data to quantitatively examine the perceptions and behaviors of university employees and leaders regarding GHRM, EER, GTL, and their collective influence on green innovation. The research adopts the conditional process of moderated mediation, as developed by Preacher and Hayes (2008), to explore the dynamic interactions among these variables. According to Preacher and Hayes (2008), moderated mediation refers to the interactive influence of an independent variable (X) and a moderator (W) on a dependent variable (Y), mediated through an intermediary variable (M). The primary objective of this study is to address methodological and theoretical gaps by empirically investigating the relationship between GHRM and green innovation (Yafi et al., 2021; Merlin & Chen, 2022; Gomes et al., 2023). Specifically, it examines the mediating role of green transformational leadership in this relationship and the moderating influence of employees' environmental responsibility (Yafi et al., 2021; Jehangir et al., 2024; Merlin & Chen, 2022; Gomes et al., 2023). By offering comprehensive insights into these interactions, this research contributes to academic discourse and provides practical guidance for fostering sustainable strategies within educational institutions. The findings are anticipated to inform policies and practices aimed at advancing green innovation, both within Pakistan and globally.

Review of Literature

The Resource-Based View (RBV) theory, introduced in the early 1980s and widely recognized during the 1990s, plays a crucial role in shaping Green Human Resource Management (HRM) practices. These practices are considered effective when they align with the attributes of being "valuable," "rare," "imperfectly imitable," and "non-substitutable." Simultaneously, the Social Learning Theory emphasizes the cognitive dimensions of human behavior, facilitating interactions that support environmental awareness. These interactions are often driven by the Human Resources department and top management through targeted environmental awareness campaigns within organizations. Both RBV and Social Learning Theory converge in their focus on leveraging rare, valuable, and unique resources. Additionally, the integration of rewards and compensation mechanisms strengthens the relevance of these theories in advancing organizational learning, raising environmental awareness, and enhancing motivation, as highlighted by (Kuo et al., 2022; Yafi et al., 2021; Jehangir et al., 2024).

The Contribution of GHRM to Universities on a Global Scale

Green Human Resource Management (GHRM) plays a significant role in advancing sustainability practices within universities in developed nations across the globe. By aligning HRM functions with environmental priorities, this approach fosters a culture of environmental responsibility and corporate social responsibility (CSR) in academic settings. Researchers highlight that GHRM supports sustainable development by embedding environmental concerns into HR activities, including recruitment, training, and performance evaluation (Renwick, Redman, & Maguire, 2013; Jackson & Rudolph, 2019). For example, universities in developed countries often implement eco-conscious hiring processes, prioritizing candidates with expertise in sustainability. Training programs aim to boost environmental awareness, while performance evaluations may incorporate metrics related to sustainable contributions. These efforts not only reduce the ecological footprint of such institutions but also nurture environmental stewardship among students, faculty, and staff, promoting a comprehensive approach to sustainability in higher education (Renwick et al., 2013; Jackson & Rudolph, 2019). Moreover, human resource management has undergone substantial evolution, significantly influencing societal quality of life. Over the past century, developed nations have witnessed remarkable economic progress. Innovations and advanced technologies have driven unprecedented improvements in manufacturing, agriculture, and higher education. This growth has allowed developed countries to achieve global advantages in production and distribution. As these nations pursue desired reforms, the role of human involvement remains critical alongside technological advancements. There is an increasing demand for skilled professionals, including engineers, technicians, financial and marketing experts, resource procurement specialists, and logistics professionals. Human resource management in industrialized countries recognizes employees as vital resources, ensuring organizations operate effectively across all levels, from entry-level workers to top management. HR departments assess the skills and knowledge required for specific roles, address training and career development needs, and oversee succession planning for senior management positions, reflecting their pivotal responsibility (Jehangir et al., 2024; Rawat & Singh, 2021).

The Limited Integration of GHRM Practices in Pakistani Universities

In recent years, the lack of Green Human Resource Management (GHRM) practices in Pakistani universities has emerged as a significant issue. Despite the global focus on sustainable development and environmental responsibility, the integration of GHRM into the organizational frameworks of universities in Pakistan has been notably slow. The absence of sustainable HR initiatives, such as eco-friendly training programs, active employee participation in green activities, and the inclusion of environmental considerations in HR policies, represents a missed opportunity to cultivate an environmentally responsible culture within academic institutions. Current evidence indicates that

research on GHRM within the Pakistani context remains scarce, emphasizing the need for in-depth studies to analyze the existing situation and develop strategies to embed green practices into human resource management in the country's universities (Khan et al., 2021; Jehangir et al., 2024; Ahmed et al., 2022; Yafi et al., 2021; Ali et al., 2022). Moreover, various studies have highlighted the positive relationship among Green Human Resource Management (HRM) practices, employees' environmental responsibility, and green transformational leadership with environmental performance in organizations. Green HRM practices, which incorporate environmental considerations into HR functions, are recognized for enhancing environmental performance by fostering a culture oriented toward sustainability (Renwick, Redman, & Maguire, 2013; Kuo et al., 2022). Employees' environmental responsibility is a pivotal element in this dynamic, as environmentally aware employee are more likely to adopt eco-friendly behaviors at work, thereby positively influencing overall environmental performance (Ramus & Steger, 2020). Additionally, green transformational leadership, defined by leaders who inspire and motivate employees to achieve sustainability objectives, has been shown to significantly improve environmental performance by driving environmental initiatives and nurturing a green mindset among staff (Zhu, Liu, & Fan, 2019; Jehangir et al., 2024; Ren et al., 2021; Yafi et al., 2021; Jackson & Ruderman, 2019).

H1: Green HRM practices, employees' environmental responsibility, and green transformational leadership have a positive relationship with green innovation.

Green Transformational Leadership as a Mediator

Transformational leadership is widely recognized for its positive impact on firm performance; however, the mechanisms connecting these two constructs remain ambiguous and continue to intrigue researchers (Para-González et al., 2018; García-Morales et al., 2012). This curiosity about the link between transformational leadership and firm performance gains even more relevance in contexts where firms strive to innovate in processes and products to maintain competitiveness and achieve superior outcomes (e.g., Della Peruta et al., 2018; Donate and de Pablo, 2015). In this study, green transformational leadership (GTFL) is characterized as a leadership style that provides a clear vision, inspiration, and motivation to employees while addressing their developmental needs to fulfill the organization's environmental goals (Mittal and Dhar, 2016; Chen and Chang, 2013). GTFL inspires employees to acquire new knowledge (Le and Lei, 2018; Han et al., 2016) and actively engage in green innovation in processes and products, thereby enabling firms to introduce eco-friendly offerings to the market (Andriopoulos and Lewis, 2010) and improve their environmental performance (Dranev et al., 2018; Jehangir et al., 2024; Martinez-Conesa et al., 2017).

Consequently, prior research has emphasized the need for deeper investigation into factors mediating the relationship between transformational leadership and innovation (Le and Lei, 2019; Para-González et al., 2018; Xiao et al., 2017; Gumusluoglu and Ilsev, 2009), as well as between HRM practices and firm performance (Para-González et al., 2018; Heffernan et al., 2016; Singh et al., 2020). Empirical studies also highlight a strong positive association between Green HRM practices and enhanced environmental performance in organizations (Ren et al., 2021). Transformational leaders play a pivotal role in cultivating a workplace culture that encourages environmentally responsible behaviors among employees, thereby strengthening the effectiveness of Green HRM practices in achieving environmental objectives (Zhang et al., 2021; Jehangir et al., 2024; Sun et al., 2022). Hence, the mediating role of transformational leadership in the link between Green HRM practices and environmental performance underscores the essential contribution of leadership in driving sustainability initiatives within organizations (Jehangir et al., 2024).

Employees' Environmental Responsibility as a Moderator

Environmental orientation represents the extent to which both employees and employers commit to achieving environmental sustainability. It arises from their willingness to recognize and incorporate environmental concerns into their business operations (Banerjee et al., 2003). According to Paillé et al. (2014, p. 455), environmental orientation can be classified into two types: 1) "External environmental orientation refers to how external stakeholders such as customers, commercial partners, or the broader community may be impacted by a firm's decisions," and 2) "internal environmental orientation pertains to the emphasis placed by employees and employers on environmental issues. This is evident through a firm's clear policy statements, established values supporting environmental preservation, or managerial efforts to assist employees in protecting the environment." Therefore, an employee's environmental orientation is conceptualized as their self-awareness or interpersonal involvement with environmental issues. Studies indicate that employees may possess strong value orientations that align with environmentally responsible employers and societal well-being (Bustamante et al., 2020). Moreover, to understand how GHRM practices influence employee performance, it is essential to identify which employees are more responsive to these practices. Research highlights that individual values significantly influence attitudes and behaviors (Choe and Kim, 2018; Hansen et al., 2018). Within this context, it is suggested that employees are more likely to display green attitudes and behaviors when their environmental and social values align with the organization's green values. Since GHRM practices reflect the organization's environmental values, it is proposed that employee environmental orientation moderates the relationship between GHRM practices and employee environmental performance. Based on the attraction-selection-attrition model, it is also posited that employees are drawn to employers who share similar characteristics, interests, personalities, and values (Schneider, 1987; Ren & Hussain, 2022). As a result, when employees' values align with those of an environmentally focused organization, they are expected to demonstrate superior performance. Although numerous researchers have explored the moderating role of personal environmental orientation, their findings are inconclusive. For example, Paillé et al. (2014) reported significant moderation in the relationship between strategic human resource management and organizational citizenship behavior toward the environment, while Chaudhary (2019) found similar results concerning the link between GHRM and job pursuit intentions. However, Dumont et al. (2017) found no evidence of moderation in the relationship between psychological green climate and in-role green performance. Based on these discussions, we posit that.

H2: Green transformational leadership acts as a mediator between Green HRM practices and green innovation.

H3: The indirect impact of green HRM practices on green innovation through green transformational leadership is moderated by employees' environmental responsibility.

Conceptual Framework of the study

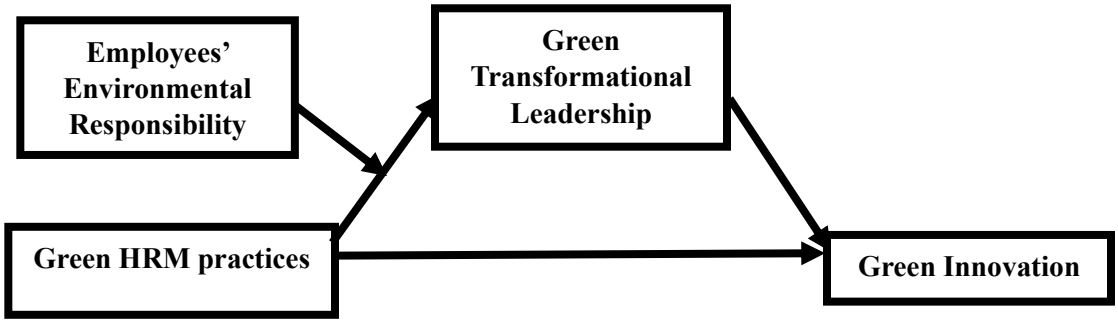

Figure 2.1 Hayes Model 7 for the current study

Research Methodology

The population of a study encompasses all the elements relevant to the research, serving as the foundation for drawing conclusions (Blumberg et al., 2014). In this research, the population includes all faculty members from 32 universities in Khyber Pakhtunkhwa (KP). Based on HEC statistics (2017-2018), the total number of faculty members is 4,913, which falls below 5,000. Consequently, an appropriate sample size of 373 was determined. KP spans a geographical area of 101,741 km² (39,282 sq mi). A response rate of 78.25% was achieved, with 373 usable questionnaires out of the 475 distributed.

Sampling Technique and Sample Size

This study employed a convenience sampling technique, a non-probability method, for data collection. A sample size of 377 respondents was calculated using Yamane's (1967) formula. This study employs a quantitative research approach, utilizing numerical data analysis to achieve the research objectives (Taylor, 1998). The data collection was conducted using a structured questionnaire designed on a 5-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree), in accordance with the framework proposed by (Mowday, Steers, & Porter, 1979). Statistical analysis to evaluate the relationships between variables was carried out using SPSS software.

Table 1 Study Scale

Construct (Items)	Variables (Items)	References
Green HRM Practices (44)	Independent	Renwick et al. (2013); Sun et al. (2007); Haldorai et al., (2022)
Employees' environmental responsibility (7)	Moderator	Etheredge (1999).
Green transformational leadership (5)	Mediator	Chen and Chang (2013).
Green Innovation (6)	Dependent	Chang, (2011).

Results And Analysis

Descriptive Tools

"The main aim of this research is to address a particular problem by presenting data in a clear and comprehensible manner. To achieve this, various visual tools, including graphs, charts, and tables, will be employed for effective data representation. Similarly, Bannigan et al. (2015) demonstrated the use of diverse visualization techniques in their study, effectively conveying insights into employees' perspectives and demographic information through the use of multiple tables".

Table 2 Reliability Statistics

Variables	Items Deleted	Cronbach Alph
Green HRM Practices	0	.932
Green transformational leadership	0	.798
Employees' environmental responsibility	0	.720
Green Innovation	0	.707

Table 2 presents the Cronbach's alpha scores for the various measures of GHRMP, GTL, EEP and GI. The alpha score for GHRMP stands at a robust 0.932, as highlighted in column 3. Additionally, the green transformational leadership and employees' environmental performance scores are 0.789 and 0.702, respectively. The Green Innovation measure yielded a score of 0.707. These findings

collectively suggest that the employed tool exhibits satisfactory internal consistency and reliability in capturing responses. Notably, all obtained results surpass the minimum threshold value, reinforcing the tool's credibility in effectively measuring the intended constructs.

The Data Normality

Verifying data normality is a crucial prerequisite for performing regression analysis. Before applying parametric tests, including regression and correlation, it is vital to evaluate and confirm the dataset's normal distribution. Failing to undertake this step may compromise the validity and reliability of the findings derived from these analyses. Hence, ensuring data normality is essential for producing accurate and meaningful results. This process involves examining measures such as skewness, kurtosis, and standard deviation, as well as employing statistical tests like the Kolmogorov-Smirnov test (Warrick et al., 2017).

Table.3

	N	Minimum	Maximum	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error of Skewness	Statistic	Std. Error of Kurtosis
GHRMP	373	3.32	4.98	.331	.126	-.958	.252
EER	373	3.57	5.00	.240	.126	-1.055	.252
GTL	373	2.40	5.00	-.285	.126	.870	.252
GI	373	3.50	5.00	.551	.126	-.994	.252
Valid N (listwise)	373						

After evaluating the internal consistency of the instrument, it is essential to assess the normality of the collected data. This can be achieved through various statistical techniques, including skewness, kurtosis, and Cronbach's Alpha. In this study, which utilized cross-sectional data, the analysis was performed using SPSS version 25. Among the methods applied, skewness and kurtosis were key in determining the normality of the data. The results indicate that all skewness and kurtosis values fall within the acceptable range of -3 to +3, confirming the data's normal distribution.

Table.4 Correlation Analysis

Correlations							
		Mean	SD	GHRMP	EER	GTL	GI
GHRMP	Pearson Correlation	4.1104	.38677	1	.338**	.608**	.779**
	Sig. (2-tailed)				.000	.000	.000
EER	Pearson Correlation	4.3627	.39754	.338**	1	.327**	.508**
	Sig. (2-tailed)			.000		.000	.000
GTL	Pearson Correlation	4.2885	.47406	.608**	.327**	1	.607**
	Sig. (2-tailed)			.000	.000		.000
GI	Pearson Correlation	4.3164	.36947	.779**	.508**	.607**	1
	Sig. (2-tailed)			.000	.000	.000	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4 of correlation analysis reveals significant positive relationships among Green HRM Practices (GHRMP), Employees' Environmental Responsibility (EER), Green Transformational Leadership (GTL), and Green Innovation (GI). A moderate positive correlation between GHRMP

and EER (r = 0.338, p = 0.000) highlights the role of Green HRM practices in fostering employees' environmental responsibility. The strong correlation between GHRMP and GTL (r = 0.608, p = 0.000) suggests that sustainable HRM practices contribute significantly to the development of green transformational leadership. Furthermore, the strongest correlation, observed between GHRMP and GI (r = 0.779, p = 0.000), emphasizes the critical influence of HRM strategies on driving green innovation within organizations. The relationships between EER and GTL (r = 0.327, p = 0.000) and EER and GI (r = 0.508, p = 0.000) indicate that employees' environmental responsibility is positively associated with both leadership and innovation. Additionally, GTL and GI are significantly correlated (r = 0.607, p = 0.000), reflecting the importance of transformational leadership in fostering innovative environmental solutions. These findings highlight the essential role of Green HRM practices and leadership in enhancing employee environmental responsibility and fostering green innovation as the primary organizational outcome, thereby supporting H1.

Table 5 Mediation analysis Model summary

	R Square	MSE	F	DF1	DF2	P	Outcome
.3381	.1143	.0446	47.8805	1.0000	371.0000	.0000	**GTL**
.8216	.6750		384.2948	2.0000	370.0000	.0000	**GI**
.7793	.6074		573.8985	1.0000	371.0000	.0000	**GI**

Table.6 Mediation Analysis Coefficients

Model	Coeff	Se	t	P	LELCI	UELCI	Outcome
Constant	2.9343	.2073	14.1527	.0000	2.5266	3.3420	**GTL**
GHRMP	.3475	.0502	6.9196	.0000	.2488	.4463	**GTL**
Constant	1.2563	.1283	9.7917	.0000	1.0040	1.5086	**GI**
GHRMP	.7445	.0311	23.9562	.0000	.6834	.8056	**GI**
Constant	.5024	.1450	3.4643	.0006	.2172	.7876	**GI**
GHRM	.6552	.0301	21.7809	.0000	.5960	.7144	**GI**
GTL	.2569	.0293	8.7778	.0000	.1993	.3144	**GI**

Note: GHRM: Green HRM Practices, GTL: Green transformational leadership, GI: Green Innovation

The hypothesis exploring the directional pathways and causal impact of Green HRM Practices (GHRMP) on green innovation (GI) through green transformational leadership (GTL) was examined through a simple mediation analysis. To analyze the mediation effects, the PROCESS Model 4 developed by Hayes (2013) was utilized. Table 5-6 of mediation analysis reveals that Green HRM Practices (GHRMP) significantly influence Green Transformational Leadership (GTL) and Green Innovation (GI). GHRMP explains approximately 11.43% of the variance in GTL, with a significant positive relationship (β = .3475, p = .0000). Furthermore, GHRMP accounts for 67.50% of the variance in GI, with a strong direct effect (β = .7445, p = .0000). When GTL is included in the model, it partially mediates the relationship between GHRMP and GI, contributing an additional .2569 units to GI for every unit of GTL (p = .0000). While GHRMP still directly influences GI (β = .6552, p = .0000), indicating partial mediation, the results suggest that Green Transformational Leadership enhances the impact of GHRMP on GI. Therefore, the study has a partially mediated effect, where both GHRMP and GTL work together to drive green innovation within organizations. These findings underscore the importance of both GHRMP and GTL in promoting green innovation within organizations. Therefore, it is concluded that GTL is acting as a mediator on the impact of GHRMP on GI. Hence **H2** is accepted.

Moderated mediation analysis

Table 7 Model Summary

R	R-sq	MSE	F	df1	df2	P	Outcome
.6318	.3991	.1361	81.7026	3.0000	369.0000	.0000	**GTL**
.7971	.6354	.0500	322.3693	2.0000	370.0000	.0000	**GI**

Table 8 Coefficients

Model	Coeff	Se	T	P	LELCI	UELCI	Outcome
Constant	4.2677	.0205	208.3200	.0000	4.2274	4.3080	**GTL**
GHRMP	.6516	.0541	12.0336	.0000	.5451	.7580	**GTL**
EER	.1952	.0523	3.7307	.0002	.0923	.2981	**GTL**
Int_1	.4006	.1427	2.8075	.0053	.1200	.6812	**GTL**
Constant	3.6119	1327	27.2283	.0000	3.3510	3.8727	**GI**
GHRMP	.6221	.0378	16.4709	.0000	.5478	.6963	**GI**
GTL	.1643	.0308	5.3312	.0000	.1037	.2249	**GI**

Table 9 Direct effect of X on Y

	Effect	SE	T	P	LELCI	UELCI	Mediator	EER	Effect	Boot SE	Boot LELCI	Boot UELCI	Index
DirectEffect	.6221	.0378	16.4709	.0000	.5478	.6963							
Indireteffect							**GTL**	-.3627	.0832	.0225	.0421	.1296	
							GTL	.0770	.1020	.0253	.0555	.1536	
							GTL	.4944	.1396	.0364	.0738	.2175	
Index							**GTL**			.0290	.0211	.1354	.0658

The hypothesis of moderated mediation was evaluated by utilizing the PROCESS macro for SPSS, as outlined by (Hayes, 2013). To examine the impact of green HRM practices (GHRMP) on green innovation (GI) through the mediation of green transformational leadership (GTL), the analysis included the moderating effect of employees' environmental responsibility (EER) within a more comprehensive model. To ensure the reliability of the results, bias-corrected 95% bootstrap confidence intervals for the indirect effects were calculated using 5,000 bootstrap samples. Table 7-9 results of the moderated mediation model further validate the relationships among Green HRM practices (GHRMP), green transformational leadership (GTL), employees' environmental responsibility (EER), and green innovation (GI), confirming **Hypothesis 3 (H3).** Specifically, H3 proposed that the indirect effect of Green HRM practices on green innovation through green transformational leadership is moderated by employees' environmental responsibility. The findings from the analysis, conducted using the PROCESS macro Model 7, demonstrate that GHRMP significantly influences both GTL ($\beta = 0.6516$, $p < 0.0001$) and GI ($\beta = 0.6221$, $p < 0.0001$), thus confirming that GHRMP directly impacts leadership and innovation outcomes. Additionally, employees' environmental responsibility (EER) plays a critical role in enhancing the effect of GTL, as indicated by the significant positive relationship between EER and GTL ($\beta = 0.1952$, $p = 0.0002$). Likewise, the most compelling evidence in support of H3 lies in the significant interaction effect

between GHRMP and EER (β = 0.4006, p = 0.0053), which moderates the relationship between Green HRM practices and green transformational leadership. This moderation suggests that employees' environmental responsibility strengthens the effect of GHRMP on leadership practices, further reinforcing the positive impact of GTL on green innovation. Furthermore, the moderated mediation analysis confirms that EER not only moderates the relationship between GHRMP and GTL but also moderates the indirect effect of GHRMP on GI through GTL. The bootstrap confidence interval for the indirect effect (Boot SE = 0.0290, Boot LELCI = 0.1354, Boot UELCI = 0.0658) does not contain zero, indicating a statistically significant moderated mediation effect. This suggests that the process by which GHRMP influences GI via GTL is contingent upon the level of employees' environmental responsibility. When employees exhibit higher levels of environmental responsibility, the mediation effect of GTL on the relationship between GHRMP and GI is stronger, leading to greater green innovation outcomes. In conclusion, the findings demonstrate that the indirect influence of Green HRM practices on green innovation via green transformational leadership is moderated by employees' environmental responsibility, which supports **Hypothesis 3 (H3).** This moderated mediation effect emphasises the necessity of taking into account both leadership practices and employees' environmental responsibilities as significant drivers in developing green innovation, which contributes to more sustainable organisational practices.

Discussion

Modern educational institutions (EIs) are making efforts to transform into green institutions, yet the rate of transformation remains low. This is evident from the gaps in existing literature, which highlight the challenges EIs face in adopting Green HRM (GHRM) practices and the need to recognize its importance as a foundational platform. Limited efforts have been made to address these challenges (Jehangir et al., 2024; Goel et al., 2022). In addition, the empirical findings of this study indicate a positive relationship between Green HRM practices, employees' environmental responsibility, green transformational leadership, and green innovation. These findings are consistent with the work of (Kuo et al., 2022, Zhu; Shah and Soomro, 2023; Liu & Fan 2019; Ren et al., 202; Jackson & Ruderman, 2019). Putting green HRM strategies into practice, encouraging employees to be environmentally conscious, developing green transformational leadership, and giving green innovation top priority may all contribute to a positive atmosphere at work. A sustainable and eco-friendly culture is promoted in the workplace, dedication is increased, and employee performance is enhanced. Furthermore, the findings also show a significant association between Green HRM practices and green transformational leadership, which aligns with the work of (Sun et al., 2022). Universities that adopt Green HRM practices and encourage a positive environmental ethos through green transformational leadership contribute to sustainable organizational development and ecological responsibility (Zhang et al., 2021; Sun et al., 2022; Para-González et al., 2018). Furthermore, the study demonstrates a positive influence of Green HRM practices on green innovation, supporting the findings of (Shah and Soomro, 2023; Kuo et al., 2022). Moreover, the study also emphasises the mediation of green transformational leadership in the relationship between green HRM practices and green innovation. The findings demonstrate the necessity of green transformational leadership in connecting Green HRM practices to innovative outcomes. This leadership promotes congruence between Green HRM practices and staff performance, hence encouraging green innovation. The study's findings reveal an important link between green HRM practices, green transformational leadership, and green innovation. Fostering strong commitment through green transformational leadership at public institutions in KP is expected to boost both organisational dedication and innovation in promoting green practices. Likewise, in the next phase of the study, the moderated mediation effect of employees' environmental responsibility and green transformational leadership on the relationship between Green HRM practices and green innovation was examined. The results reveal the significance of these factors in the overall model fit. The findings emphasise the need of implementing Green HRM practices across

universities to lay the groundwork for encouraging employees' environmental responsibility. Green transformative leadership is crucial for aligning employees' behaviours with Green HRM principles in university settings (Singh et al., 2020; Alnaqbi et al., 2024). In the same token, incorporating green HRM methods strengthens institutions' capacity to accomplish green innovation by improving recruitment, satisfaction, commitment, and effective performance in addition to their organisational climate. According to Kuo et al., (2022), universities can adjust to change primarily to the adaptability of Green HRM practices, which encourages employees to perform well and take part in creative activities that support organisational goals. This study's focus on Green HRM practices emphasises both their impact on other factors influencing employee outcomes and their essential role in organisational advancement. In nutshell, it is clear that university administration must base planning and decision-making on modern HRM methods, integrating Green HRM into the processes of hiring, selection, training, retention, and green innovation. Furthermore, by addressing the gaps in Green HRM practices within the academic sector, managers' awareness of HRM practices in universities can improve strategies, expand university objectives, improve development planning, build social capital, and raise the results and accomplishments of KP universities.

Conclusion

In conclusion, this research examines the complex interplay among Green Human Resource Management (HRM) practices, employees' environmental responsibility, green transformational leadership, and green innovation within universities in KP. An extensive literature review highlights the moderating roles of employees' environmental responsibility and green transformational leadership in shaping the effectiveness of green HRM initiatives. By incorporating recent studies, this research adds valuable insights to the growing body of knowledge on sustainable practices in higher education. The findings emphasize the need to foster a culture of environmental responsibility among employees and implement transformative leadership approaches to maximize the impact of green HRM strategies. Given the pivotal role of universities in nurturing future leaders and changemakers, the implications of this study extend beyond organizational contexts, offering guidance for institutions aiming to promote green innovation. Advancing such initiatives not only aligns with international sustainability objectives but also supports a holistic approach to building an environmentally conscious and responsible workforce, benefitting both academia and society at large.

Implications

Theoretically: The study offers several theoretical implications. First, grounded in theories such as social learning theory and the resource-based view (RBV), the findings indicate that green HRM practices and employees' environmental responsibility positively influence environmental performance through the mediating role of green transformational leadership. Second, while much of the academic research on RBV has been conducted in industrialized countries, limited attention has been given to its application in other contexts (Jehangir et al., 2024; Vargas-Halabí et al., 2017; Kuo et al., 2022). This research expands the understanding of RBV by applying it to environmental performance and green transformational leadership in a different context. It also highlights new avenues for integrating theories from green transformational leadership, HRM, and environmental science, contributing to bridging theoretical gaps among these domains. Additionally, the integration of social learning theory with RBV, green HRM concepts, green transformational leadership, and green innovation represents a significant theoretical contribution and advancement.

Practically: The study offers valuable insights for policymakers and practitioners regarding green transformational leadership within academic institutions. It emphasizes green innovation as a critical element in understanding environmental performance, particularly in alignment with green Human Resource Management (HRM) practices. This perspective is relevant for university administrators and academic leaders who increasingly focus on fostering environmentally conscious practices in

educational settings. Additionally, the study highlights the necessity for top management in academic institutions to prioritize environmental performance. Green Human Resource Management (GHRM) significantly contributes to environmental sustainability in universities by incorporating eco-friendly practices into HRM policies and procedures. Transformational leadership, characterized by inspirational motivation and individualized consideration, plays a vital role in promoting organizational commitment to environmental goals and fostering a positive environmental culture. Employees' environmental responsibility, encompassing their awareness and dedication to sustainable practices, serves as a driving force for achieving environmental objectives in academic institutions. The integration of GHRM, transformational leadership, and employees' environmental responsibility facilitates enhanced green innovation in universities, as evidenced by studies such as (Shahzad et al., 2023; Ren and Tang 2019; Jehangir et al., 2024; Shah and Soomro, 2023; and Singh et al., 2020).

Future Contribution

With the rising emphasis on environmental performance, adopting eco-friendly practices, commonly referred to as "going green," has become a significant focus for many organizations. Achieving strong environmental performance requires attention to green factors such as managerial support and intangible green resources. Despite the strengths of this study, certain limitations must be acknowledged and considered for future research. Firstly, the study is limited to universities in KP, Pakistan. Generalizing the findings would require examining a broader sample that includes various industries, such as food, fabric, and hospitality, and engaging users or consumers from these sectors. Secondly, the cross-sectional nature of the study poses limitations in establishing causal relationships. Employing longitudinal research designs in future studies could help develop more reliable insights into causal links. Future research could also explore the integration of Green Human Resource Management (GHRM) practices, Transformational Leadership (TL), Employees' Environmental Responsibility (EER), and their combined impact on green innovation. Transformational leadership, which inspires environmental consciousness, has the potential to enhance employees' commitment to environmental responsibility. Examining the mediating role of EER in the relationship between TL and environmental performance may provide a deeper understanding of how leadership drives sustainable outcomes. Existing studies, such as those by Kuo et al. (2022) on GHRM, Bass and Riggio (2006) on transformational leadership, and Zhang et al. (2018) on employees' roles in environmental responsibility, offer a foundation for advancing this area of research. Moreover, future studies could include dimensions of sustainable economic and social performance alongside environmental performance to create a more comprehensive framework. Finally, since the current study focuses on a specific population within a developing country like Pakistan, comparative studies exploring green HRM practices in both developing and developed contexts could reveal valuable insights into how socio-economic conditions influence the implementation of environmentally conscious practices.

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