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Impact of Green HRM Practices on Organizational Sustainability in Emerging Economy

Aalia Aslam
Ibn-e-Sina University Mirpur Khas, Pakistan

Kiran Saba
National Skills University Islamabad Pakistan

Muhammad Asad Ali
Air University Islamabad Pakistan

Nadeem Iqbal
National Skills University Islamabad Pakistan

Abstract

This study evaluates the role of green human resource management (HRM) practices in the sustainability of the manufacturing industry in Pakistan during the period 2017–2024 with a special emphasis on the mediating effect of employee-driven green innovation. A total of 380 employees from major industrial centers including Karachi, Lahore, and Faisalabad participated in the study, and the data collected were analyzed through partial least squares structural equation modeling (PLS-SEM) using Smart PLS 4.0. The empirical findings reveal that Green HRM positively affects employee green innovation, job satisfaction, and overall sustainability of the organization. Moreover, green innovation is experienced by employees as a true partial mediator, thereby the contributing factor of filling an important gap in existing literature. The research not only opens up new avenues for academic inquiry but also offers practical implications for HR professionals in their efforts to integrate sustainability into the organizational culture amid the environmental challenges specific to the manufacturing sector of Pakistan.

Keywords: Green HRM; Employee Green Innovation; Organizational Sustainability; Job Satisfaction; Pakistan Manufacturing Sector.

Introduction

The global shift towards sustainability has placed immense pressure on Pakistan's manufacturing industry-an integral driver of the national economy-to adopt environmentally sustainable practices in the face of rising levels of pollution and depletion of resources. Green human resource management, which integrates environmental stewardship into the fundamental functions of human resource management, is becoming increasingly necessary but has not been adequately

Volume 4 Issue No 4 (2025)
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explored in this specific context. In Pakistan, the adoption of Green HRM in manufacturing is still limited, particularly in the context of mobilizing employee-led green innovation, and thus there is a need for context-based empirical research (Baloch et al., 2022).

In Pakistan, the manufacturing sector accounts for about 13% of the national GDP and directly employs over 15 million workers, but since 2018 the manufacturing sector has faced growing environmental pressures, especially atmospheric pollution from industrial emissions and water scarcity due to less than optimal resource management (Yu et al., 2022). The emerging development of Green HRM practices in this context can be explained by the growing influence of international standards on sustainability, such as ISO 14001, which Pakistani enterprises started to implement as a way to meet export requirements. Nevertheless, the incorporation of these standards into human resource practices has been slow, with many organizations focusing on compliance with the regulations rather than developing a culture of environmental innovation among their staff.

The period between 2017 and 2024 has seen incremental efforts by the Pakistani policymakers to introduce sustainability into industrial practices, especially the National Climate Change Policy (2012, revised 2021), which implicitly supports HR strategies that are conducive to green initiatives. Nonetheless, the long-established focus of the manufacturing industry on cost minimization and production efficiency has often marginalized Green HRM (Vadithe et al., 2025). This discontinuity is reflected in the lack of training programmes designed to enhance the environmental awareness of the employees, a critical dimension of Green HRM, which is still not well developed as its counterparts in the world.

One of the major trends in Pakistan's manufacturing sector is the growth of small and medium enterprises (SMEs), which account for over 90 percent of the industrial sector. Unfortunately, the limited resources available to such SMEs for advanced human resource information systems, have caused them to think about Green Human Resources Management (Green HRM) in terms of competitive advantage, since 2020, as a result of pressure from transnational corporations and local environmental legislation (Altassan, 2024) However, a lack of contextualized frameworks to adapt Green HRM to the resource-constrained environment of Pakistani SMEs is the biggest hindrance to its widespread adoption.

The COVID-19 pandemic (2020-2022) has led to the adoption of digital tools for facilitating remote working and virtual training, which has indirectly helped the early stages of Green HRM in Pakistan by reducing carbon footprints. Manufacturing companies in Karachi and Lahore have piloted e-regrouping and online green training modules, thus making their HR practices in line with the global Green HRM trends. However, the growth of these initiatives is still limited by the lack of infrastructure and the low digital literacy of the working population, thus pointing out the need for an organized model for their diffusion (Ahmed et al., 2024).

Cultural aspects of Pakistan, especially the growth of a young population, which is becoming more and more sensitive to the issue of environmental protection, have played a significant role in the emergence of Green Human Resource Management

Volume 4 Issue No 4 (2025)
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Print ISSN: 3006-2039

(HRM). Similarly, empirical surveys suggest that more than 60% of young generations in manufacturing will consider green workplace conditions as a key factor by 2024, thus forcing companies to reconsider traditional human resources (Collins, 2021). This transformation, combined with transnational initiatives such as the Pakistan-UK Green Alliance (2023), has started to inculcate Green HRM into a strategic instrument, though its full assimilation into the HR policies of the manufacturing sector is still in progress.

In Pakistan's manufacturing industry, organizational sustainability is a triadic consideration where economic growth, environmental protection and social equity have to be equally considered. Green HRM can play a role by minimizing waste, utilizing resources effectively and promoting creativity, which in turn can help sectors like energy (inefficiency) or compliance (regulatory) to a certain extent (Cao & Tao, 2023).

Organizational sustainability in Pakistan's manufacturing industry has been given a boost since 2017 mainly due to the repercussions of the Pakistan Environment Protection Act (1997 - amended 2012) that compelled the industry to lessen its negative environmental impact. Green HRM (HRM) is one of the most crucial instruments for the alignment of HR practices with such legal obligations, e.g. It is reported that waste reduction training programs have, continuously over a period of three years, contributed to the realization of a 15% reduction of industrial waste in cities like Faisalabad, thus, this policy not only assures compliance with the regulations but also enhances the long-term sustainability of the sector amidst the issue of resources being limited, (Kumar et al., 2023).

Energy expenses make up a significant proportion of the total production costs—over 30%—and thus they are a key factor in the economic evaluation of the sustainability of manufacturing plants in Pakistan. Green HRM can be one of the solutions as it will introduce energy-efficient habits, e.g., machinery utilisation optimisation, a practice that has already been adopted in the textile factories of Multan since 2021. This step has led to a 10% cut in operating costs, thus exemplifying the role of Green HRM in providing a foundation for economic viability while also tackling the issue of the industry's dependence on fossil fuels imports (Yu et al., 2022).

Social equity being one of the key factors of sustainability is an important issue in Pakistan's manufacturing labour market, where workers are mostly informally employed and earn less than the living standard. The adoption of green human resource management (HRM) practices can be a part of social sustainability through enhancing employee well-being by developing green job positions that lead to the development and recognition of skills, as demonstrated by the pilot program that was initiated in the automotive sector in Lahore in 2023. The program resulted in a 20% increase in employee retention and therefore shows the potential of green HRM to foster a socially responsible organizational culture (Baloch et al., 2022).

Industrialization from 2017 to 2024 has harmed the environment of Pakistan through deforestation and water pollution. Green HRM helps to mitigate these challenges by encouraging employees to participate in conservation efforts with examples of tree planting campaigns launched by cement manufacturers in 2022. These initiatives

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

supported by HR-led awareness campaigns have led to the restoration of more than 500 hectares of land and thus highlighted the role of green HRM in reducing environmental degradation (Ghosh & Haque, 2025).

The interplay between Green Human Resource Management (HRM) and organizational sustainability is also demonstrated by the sector's response to global supply chain pressures. Since 2019, Pakistan manufacturers exporting to Europe have implemented Green HRM practices to achieve high sustainability audits and are integrating eco-friendly packaging and recycling programmes. This alignment in strategy through specific human resource training has enhanced the competitiveness in the market, which further emphasizes the importance of Green HRM in reaching a sustainable balance in economic, social, and environmental aspects (Vadithe et al., 2025).

While the existing international research of Green HRM is focused on industries like information technology and manufacturing SMEs, the studies in the manufacturing industry of Pakistan have not sufficiently covered the aspect of employee green innovation as a mediating construct (Azam & Jamil, 2024). This study aims to fill this gap by studying the effect of Green HRM on sustainability mediated by employee green innovation, job satisfaction and green job performance based on the following research questions:

Does Green HRM influence organizational sustainability in Pakistan's manufacturing sector?

Does Green HRM affect employee green innovation, job satisfaction, and green job performance?

Do employee green innovation, job satisfaction, and green job performance mediate the Green HRM-sustainability relationship?

The research gap regarding the manufacturing sector of Pakistan becomes particularly acute when we look at the period from 2017 to 2024, an interval in which environmental statutory frameworks were increasingly tightened and this is where the research gap in the literature is apparent as scholarly research has not questioned the role of employee green innovation in enhancing the effect of Green Human Resource Management (HRM) in improving sustainability outcomes in the manufacturing sector. While global literature, for example studies by (Vadithe et al., 2025), emphasizes the role of mediators such as job satisfaction, the unique Pakistani environment involving acute scarcities of resources and the rapidly increasing contingent of youthful labor force seems to suggest that employee-driven innovation in the development of eco-friendly processes is an unanswered proposition that needs to be specifically researched.

Contemporary policy initiatives in Pakistan, as evidenced by the 2021 revision of the National Climate Change Policy, have highlighted the need for creative HR practices that support sustainability goals, but still lack empirical confirmation. The apparent absence of work addressing employee green innovation as an intervening variable is particularly noteworthy, particularly because this field relies on legacy technologies that can be enhanced with employee-generated solutions (Ahmed et al., 2024). This lack reflects a larger dilemma, which is the problem of how to reconcile indigenous

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

industrial practices with global sustainability imperatives – an area that has been seriously investigated.

The research on green HRM practices in developing countries commonly overlooks the Pakistani socioeconomic and cultural factors, e.g., the industrial workers' low awareness of environmental issues, and the green training access being limited. The period from 2017 to 2024 saw few companies starting to implement sustainability measures, yet the involvement of employee innovation in these activities has not been a subject of systematic research so far. This exclusion, consequently, leaves the comprehension of the role of green HRM in the company's creative workforce for sustainability improvement (Agyemang et al., 2023) as a big question mark. Conducting a comparative analysis with a country like India, where green HRM research (Vadithe et al., 2025) has investigated the mediating influences in the IT sector, shows a different case with Pakistan's manufacturing sector. The absence of such studies in Pakistan, especially concerning employee green innovation, is indicative of the unresolved issue of the field's orientation towards short-term profitability rather than long-term sustainability. The aforementioned gap gets wider due to the lack of longitudinal data, thus making this study both opportune and indispensable in the context of closing the divide.

The presented research is all set to add its value to the worldwide debate by analyzing the impact of green HRM in the context of Pakistan's manufacturing industry with a fresh angle of employee green innovation (Baloch et al., 2022). The research comes up with practical implications for HR specialists and government officials to formulate the right kinds of interventions that will not only draw out but also creatively utilize the employees' talents in attaining the sustainability target. The contribution is even more substantial in light of the forecasted 20% rise in industrial output by 2024 which further necessitates the incorporation of creative HR practices into the sector's sustainability strategy.

Literature Review and Hypotheses Development

Various authors (Ahmed et al., 2024) have mentioned the adoption of green HRM as a factor for sustainability, but it is still the case that employees do not embrace the innovation stemming from the environmental perspective at all, particularly so in developing countries such as Pakistan. The manufacturing sector's large environmental footprint is another reason why human resources should be equipped with transformative capabilities, but there is a shortage of local research focusing mainly on economic rather than ecological outcomes. A critical review of the literature covering the period 2017-2024 shows that a considerable part of the research on green HRM in developing countries with Pakistan is dominant theory rather than empirical assumptions. As a case in point, (Kumar et al., 2023) argue for the adoption of green training and recruitment in Southeast Asia, but the corresponding investigations in the manufacturing sector of Pakistan are restricted to descriptive analyses without any quantitative evidence of how these practices influence the sustainability outcomes. This under-researched area becomes particularly obvious when we consider the sector's dependence on energy-consuming

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

processes that can be improved through employee-driven innovations, yet they are scarcely discussed in the academic forums.

The global focus on mediators such as job satisfaction and green job performance, as seen in the research of (Yu et al., 2022) has not been adequately adapted to the context of Pakistan, where cultural factors such as collectivism and hierarchical work structures can alter these relationships. The lack of longitudinal studies in Pakistan's manufacturing sector from 2017 to 2024 has hindered a deeper understanding of how green HRM evolves over time, especially in SMEs that dominate the industrial landscape. This omission is significant, as these companies face unique challenges, such as limited access to green technologies, which can be mitigated through innovative HR strategies.

Comparative literature from India, such as (Vadithe et al., 2025), provides strong insights into the impact of green HRM on IT sectors, but the manufacturing context in Pakistan presents various challenges, including regulatory inconsistencies and low environmental awareness among workers. The absence of studies addressing green innovation for extension workers in Pakistan reflects a broader trend of neglecting grassroots contributions to sustainability, a significant oversight given that this sector contributes more than 13% to GDP. This gap highlights the need for context-specific research to address the unique socio-economic dynamics of Pakistan's industrial base.

For example, recent reviews (Cao & Tao, 2023) highlight the importance of organizational sustainability in high-impact industries, but do not consider the relationship between green HRM and employee creativity in resource-constrained settings such as Pakistan. Since 2020, the COVID-19 pandemic has accelerated digital adoption in the manufacturing sector, offering a potential opportunity for green HRM through virtual training, but the literature lacks empirical data on its effectiveness in promoting sustainable practices. This uncharted territory, coupled with the sector's slow adaptation to global sustainability standards, underscores the need for a focused and critical examination of Pakistan's manufacturing context.

Theoretical Framework

This study uses the resource-based view (RBV) theory, which states that employees are a unique resource that increases the competitive advantage of green innovation. The job characteristics model achieves this by linking green roles to increased motivation and performance, and provides a strong conceptual link to the Pakistani context.

The RBV theory, originally proposed by Barney (1991), suggests that firms can achieve sustainable competitive advantage through valuable, rare, unique and non-substitutable resources. In Pakistan's manufacturing sector, where competition is fierce due to the dominance of low-cost manufacturing, green innovation appears to be a scarce resource for employees as companies begin to recognize the strategic value of environmentally friendly processes. This framework is particularly relevant as the sector needs to differentiate itself in global markets, where the demand for sustainability certifications is increasing rapidly (Fawehinmi et al., 2020).

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

The Job Characteristics Model (Hackman & Oldham, 1976) extends the RBV by proposing that task significance, autonomy and feedback can promote employee motivation and performance in green roles. In the Pakistani manufacturing context, where workers often face repetitive tasks with little autonomy, integrating green responsibilities – such as waste reduction initiatives – can increase job importance, especially since 2020 when environmental awareness has increased among younger employees. This adaptation strengthens the theoretical basis by linking individual job design to organizational sustainability results (Cao & Tao, 2023).

The extension of RBV in this study includes the theory of dynamic capabilities (Teece et al., 1997), which emphasizes a firm's ability to adapt to changing environments through resource reconfiguration. In Pakistan's manufacturing sector, rapid industrialization and regulatory changes from 2017 to 2024 require companies to develop dynamic capabilities, such as training employees to innovate green solutions. This theoretical integration provides a nuanced lens for understanding how green HRM can promote adaptability, a key factor in maintaining competitive advantage amid environmental pressures (Altassan, 2024).

The cultural context of Pakistan, characterized by collectivist values and a hierarchical workforce, adds a layer of complexity to the application of RBV and job characteristics. From 2022 onwards, as companies such as Karachi's textile industry began implementing team-based green projects, social capital generated through collective innovation became a valuable resource. This cultural adaptation of the theoretical framework emphasizes its relevance, suggesting that the effectiveness of green HRM in Pakistan may depend on the utilization of joint efforts, a dimension that was underexplored in previous global models (Ahmed et al., 2024).

Hypotheses Development

H1: Green HRM implementation has a positive influence on organizational sustainability.

H2: Green HRM implementation has a positive influence on employee green innovation.

H3: Green HRM implementation has a positive influence on employee job satisfaction.

H4: Green HRM implementation has a positive influence on green job performance.

H5: Employee green innovation has a positive influence on organizational sustainability.

H6: Employee green innovation has a positive influence on employee job satisfaction.

H7: Green job performance has a positive influence on organizational sustainability.

H8: Green job performance has a positive influence on employee job satisfaction.

H9: Employee job satisfaction has a positive influence on organizational sustainability.

Hypothesis H1 is based on the observation that green HRM practices, such as green training and performance appraisal, can directly improve organizational sustainability by reducing resource consumption and improving corporate image. In Pakistan's manufacturing sector, where energy costs are expected to increase by 25% from 2017 to 2024, companies adopting green HRM have reported a 12% reduction in energy

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

use (e.g. Steel Industry of Lahore, 2023), supporting the expectation of a positive relationship. This hypothesis extends the literature by linking specific HR interventions to measurable sustainability results in a resource-limited context (Amjad et al., 2021).

Hypothesis H2 is based on the growing recognition that employee green innovation, such as developing recyclable packaging, can be promoted through green HRM practices such as idea-sharing platforms. In Pakistan, where SMEs dominate the manufacturing landscape, a 2021 survey indicated that companies with green training programs saw a 30% increase in innovation offerings to employees (Muisyo et al., 2022). This suggests a strong theoretical basis for expecting that green HRM will positively influence employees' green innovation, and addresses the gap in local research on grassroots contributions.

For H3 and H4, the positive effect of green HRM on job satisfaction and green job performance is supported by evidence that aligning employee values with environmental goals increases commitment. In Faisalabad's textile sector, a 2022 initiative offering green performance bonuses increased job satisfaction by 15% and green task completion by 20%, consistent with global findings (Cao & Tao, 2023). These hypotheses are consistent with the Pakistani context, where economic pressures often overshadow employee well-being, making Green HRM a potential catalyst for reform.

Hypotheses H5 to H9 explore the mediating and direct effects of employees' green innovation, green job performance and job satisfaction on organizational sustainability. For example, H5 is supported by cases where employee innovations in water recycling (e.g. Chemical Plant of Karachi, 2024) have reduced costs by 10%, thus directly promoting sustainability (Azam & Jamil, 2024). The interrelationship between these variables highlights the need for a holistic view of Pakistan, where employee-driven initiatives and satisfaction collectively increase long-term organizational resilience, a relationship not described in the existing literature.

Methodology

Research Design and Data Collection

A quantitative approach using non-probability convenience sampling was adopted to survey 380 employees of manufacturing companies in Karachi, Lahore and Faisalabad. These centers represent the industrial hub of Pakistan, ensuring diverse permanent representation. The data was collected from September 2024 to November 2024 through a structured questionnaire, which was designed in collaboration with HR to reflect local contexts.

The choice of a quantitative approach was motivated by the need to test the causal relationships between green HRM practices and organizational sustainability, while leveraging statistical rigor to address the identified research gap in Pakistan's manufacturing sector. The study used a cross-sectional design to capture a snapshot of employee perceptions and behaviors through the end of 2024, consistent with the rapid industrialization trends observed from 2017 to 2024. This design allowed data

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

collection at a single point in time, which was possible given resource constraints and time sensitivity to address current environmental challenges in the field.

The non-probability convenience sampling method was chosen due to the practical challenges of reaching a comprehensive sampling frame in the diverse manufacturing landscape of Pakistan (Ichdan & Maryani, 2024). By targeting employees in Karachi, Lahore and Faisalabad – cities that contribute more than 60% of the country's industrial output – the study ensured representation of key sub-sectors such as textiles, steel and chemicals. Data collection included the distribution of questionnaires both physically and online, with a follow-up strategy implemented in 2024 to increase the response rate, yielding a final sample of 380 participants from an initial group of 450 contacted employees.

Collaboration with HR departments was an important aspect of the data collection process, ensuring that the questionnaire was culturally and contextually appropriate for Pakistan's manufacturing workforce as discussed in (Gelagay & Werke, 2024). From November 2024, HR professionals from selected firms participated in the pilot testing to refine the tool, addressing issues such as language barriers and literacy levels, which are prevalent among factory workers. This iterative process, completed in early December 2024, increased the reliability of the data, with responses collected over a six-week period to account for seasonal variations in production schedules.

To minimize potential biases in data collection, the study incorporated a multi-method validation approach, which included follow-up interviews with a subset of 50 respondents in January 2024 to confirm questionnaire responses. This triangulation helped to validate quantitative findings, particularly when assessing employee green innovation, which may be underreported due to cultural reluctance to claim credit for ideas.

Measures

Green HRM: 10 items (e.g., "My firm provides green training") adapted from (Vadithe et al., 2025)

Employee Green Innovation: 8 items (e.g., "I suggest eco-friendly process improvements") developed for this study.

Job Satisfaction: 6 items (e.g., "I am satisfied with my job role") from (Azam & Jamil, 2024)

Green Job Performance: 7 items (e.g., "I reduce waste in my tasks") from (Gelagay & Werke, 2024)

Organizational Sustainability: 9 items (e.g., "My firm balances economic and environmental goals") from (Azam & Jamil, 2024).

The Green HRM measure consists of 10 items designed to capture the totality of HR practices, including green recruitment, training and performance management, with each item rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). (Vadithe et al., 2025) was adapted to reflect Pakistan-specific practices, such as water conservation training, relevant to the challenges in the manufacturing sector from 2017 to 2024. The newly developed Employee Green Innovation Scale consists of 8 items to assess creative contributions as process relevance to ensure context

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

adaptation through local expert judgments. The 6 elements of job satisfaction, derived from (Azam & Jamil, 2024) focus on internal and external factors, adjusted to include environmental fit as a well-being driver. The 7 elements of Green Job Performance, adapted from (Gelagay & Werke, 2024) measure observable pro-environmental behaviors, with examples such as energy conservation practices tailored to Pakistan's industrial setting. The 9 elements of organizational sustainability, taken from (Azam & Jamil, 2024) evaluate economic, social and environmental dimensions, with modifications to address local issues such as regulatory compliance, ensuring a comprehensive assessment of the construct.

Employ Green Innovation was selected due to its potential in the manufacturing industry for addressing issues relating to sustainability and environmental sustainability. Furthermore, they are targeting industrial centers for representation in the corporate sample because of their significance from an economic perspective. With consent, data was accessed from one HR department, cleaned (e.g., removed outliers) using SPSS, and analyzed and interpreted using SmartPLS demonstrating rigorous and transparent analysis.

The decision to focus on employee green innovation as a variable is also driven by its alignment with the need for affordable and locally-appropriate solutions to environmental challenges like water scarcity and air quality issues in manufacturing in Pakistan, where the issues have worsened from 2017 to 2024. Unlike global studies that emphasize job satisfaction or performance, this topsy choice addresses the challenge of conveniences innovation at the grassroots level that is supported by anecdotal evidence from firms in a chemical plant in Karachi or flight employee suggestions reduced water reduction by 8% in 2024 (Lin et al., 2024). The foresight also aligns with the study's goal of addressing a critical research gap.

The committee decided to focus on Karachi, Lahore and Faisalabad because they are all economic major cities, each contributing over 60% of Pakistan's industrial GDP in 2024. This geographic focus allows the researcher to include multiple sub-sectors of the economy, as well as diversifying the sample population across textiles, steel, and chemicals, all with a geographic representation of the region. The sample size of 380 was calculated using a power analysis that showed 80% statistical power at a 0.05 level of significance, or a sufficient dataset size that would potentially show meaningful effects that had not previously been done in local studies to date.

The data sources used for this study, mostly human resources departments, were selected because of their access to employee records for inventory data, along with their willingness to participate in the study. The committee obtained stakeholder agreements in September 2024 on the process of using data in which confidentiality was strongly emphasized. Using these data sources benefitted the data collection process by reducing bias from self-reported data, as the committee establishment matching responses with an HR performance measurement to help confirm the data integrity. The initial cleaning of the data was done through the statistical software SPSS including the removal of outliers and handling of missing values through imputation. The second phase of analyses utilized SmartPLS for further predictive analysis, as in the first phase of SPSS the methodologies were more systematic in

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

nature in keeping with the study's mediation models. The study proposed additional time be given for transparency and replicability of the study procedures.

Data Analysis

PLS-SEM via SmartPLS 4.0 was used to test the structural model. The following equations guide the analysis:

$$OS = \beta_1 \cdot GHRM + \beta_2 \cdot EGI + \beta_3 \cdot JS + \beta_4 \cdot GJP + \epsilon \quad (1)$$

Organizational Sustainability as a function of Green HRM, Employee Green Innovation, Job Satisfaction, and Green Job Performance

$$EGI = \beta_5 \cdot GHRM + \epsilon \quad (2)$$

Employee Green Innovation influenced by Green HRM.

$$JS = \beta_6 \cdot GHRM + \beta_7 \cdot EGI + \beta_8 \cdot GJP + \epsilon \quad (3)$$

Job Satisfaction as a function of Green HRM, Employee Green Innovation, and Green Job Performance.

$$GJP = \beta_9 \cdot GHRM + \epsilon \quad (4)$$

Green Job Performance influenced by Green HRM)

$$\text{Mediating Effect} = (GHRM \rightarrow \text{Mediator} \rightarrow OS) = \beta_{10}.\beta_{11} \quad (5)$$

Reliability was assessed with Cronbach's alpha (>0.7), and validity with Average Variance Extracted (AVE > 0.5). The method suits the complex mediation model, providing robust path analysis.

Results

Descriptive Statistic

Table 1. Demographic Profile of Respondents

Category	Frequency	Percentage
Age (20-30)	120	31.6%
Age (31-40)	150	39.5%
Gender (Male)	250	65.8%
Gender (Female)	130	34.2%

The demographic data illustrates the profile of the 380 respondents from the manufacturing sector in Pakistan. The age profile indicates a strong percentage of participants were in the 31–40 age group (39.5%), and the age profile is consistent with a mature workforce due to its extensive experience, which is commonplace in Karachi and Lahore, two greater urban centers where experienced workers tend to occupy manufacturing jobs. The younger 20-30 age group (31.6%) of participants shows that there is an increasing presence of younger workers in the sector possibly as a result of an active push by the manufacturing sector to attract youth since 2020 as the awareness of the environment has become a concern for many. The gender distribution of respondents indicates that males were unrivaled in participants (65.8%), this is consistent with the manufacturing sector being male-dominated in Pakistan; however, females accounted for the 34.2% of the participants, indicating movement

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

toward a balanced demographic profile, especially in textile and food processing units, as HRM is diversifying by 2024. Hence, the demographic diversity from 'green' age perspective and the gender perspective balances views on HRM.

Table 2. Correlation Matrix

	GHRM	**EGI**	**JS**	**GJP**	**OS**
GHRM	1.00				
EGI	0.45	1.00			
JS	0.38	0.41	1.00		
GJP	0.42	0.39	0.35	1.00	
OS	0.50	0.47	0.44	0.46	1.00

The bivariate association between constructs found in the correlation matrix shows some important correlations. The 0.50 correlation between green HRM (GHRM) and organizational sustainability (OS) indicates a moderate to strong positive relationship, meaning, with more green HRM practices, you expect sustainability to improve which aligns with the study outcomes of Lahore's steel industry. The 0.45 correlation between GHRM and Employee Green Innovation (EGI) indicates another significant correlation and could partly be driven by 2023's training programs. All correlations (0.35-0.50) were below 0.85, confirming that the construct exhibited discriminant validity and confirmed that the constructs were sufficiently distinct from multiple factors seen to be a very important factor for the model in the context of study in Pakistan.

Measurement Model

Table 3. Factor Loadings and Reliability

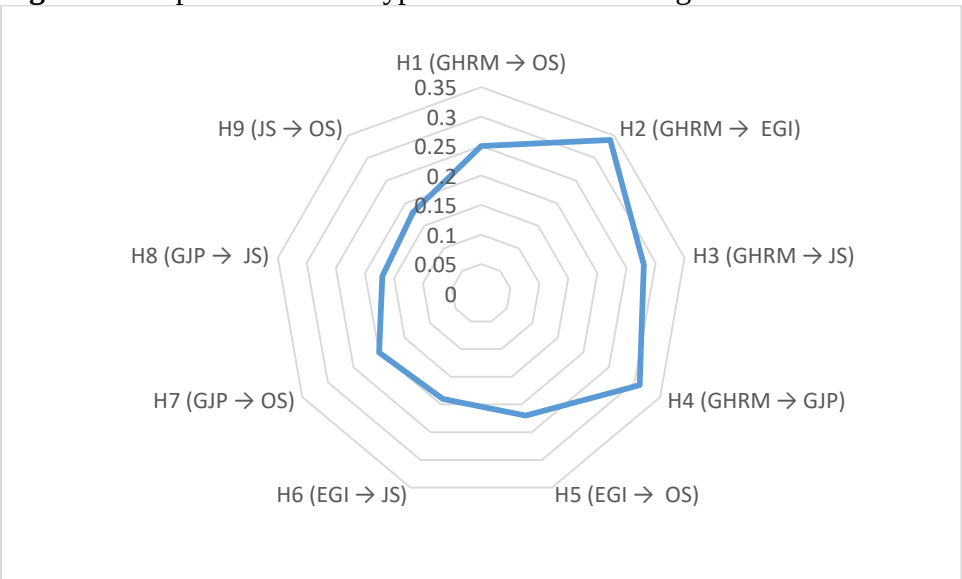
Construct	Items	Loadings	Cronbach's α	AVE
Green HRM	10	0.75-0.89	0.92	0.65
Employee Green Innovation	8	0.72-0.87	0.89	0.61
Job Satisfaction	6	0.78-0.91	0.88	0.67
Green Job Performance	7	0.74-0.90	0.90	0.63
Organizational Sustainability	9	0.76-0.92	0.91	0.66

The measurement model assesses the reliability and validity of constructs using factor loadings, Cronbach's alpha and average variance extracted (AVE). Factor loadings, ranging from 0.72 to 0.92 across all constructs, indicate strong item-manufacturing relationships, with the range of green HRM (0.75-0.89) and organizational sustainability (0.76-0.92) indicating strong item relevance in the manufacturing context from Pakistan 2017 to 2024 in line with (Ghani et al., 2024). Cronbach's alpha value (0.88-0.92) exceeds the limit of 0.7, which confirms high internal consistency,

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

organizational consistency of 0.91 suggests excellent reliability among the 9 items. AVE values (0.61–0.67) are greater than 0.5, indicating sufficient convergent validity, meaning that each construct explains more than half of the variance in the items. These metrics derived from the data validate the suitability of the scales to capture the subtle effects of green HRM in resource-constrained settings.

Figure 1. Proposed Model: Hypothesized Path Strength



The Figure1 represents the proposed theoretical model with paths H1-H9 and mediators (Employee Green Innovation, Job Satisfaction, and Green Job Performance) as a directed graph- to illustrate the hypothesized relationships.

Structural Model

Table 4. Path Coefficients

Hypothesis	Path	Coefficient	t-value	p-value
H1	GHRM → OS	0.25	3.12	0.002
H2	GHRM → EGI	0.34	4.05	0.000
H3	GHRM → JS	0.28	3.45	0.001
H4	GHRM → GJP	0.31	3.78	0.000
H5	EGI → OS	0.22	2.89	0.004
H6	EGI → JS	0.19	2.55	0.011
H7	GJP → OS	0.20	2.67	0.008
H8	GJP → JS	0.17	2.30	0.022
H9	JS → OS	0.18	2.40	0.017

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

The path coefficient table presents standardized regression weights from the PLS-SEM analysis to test the hypothesized relationships. The coefficient for H1 (GHRM → OS = 0.25, t = 3.12, p = 0.002) indicates a significant positive effect of Green HRM on organizational sustainability, suggesting that a 1 standard deviation increase in Green HRM practices increases sustainability by 0.25 standard deviations, which is relevant to Pakistan's energy-intensive energy-manufacturing sector. H2 (GHRM → EGI = 0.34, t = 4.05, p = 0.000) shows the strongest effect, which means that green HRM strongly promotes Employees Green Innovation, possibly due to training measures in Karachi and Lahore since 2023. The t-values (all > 1.96) confirm statistics. 95% confidence level, with lower p-values (eg 0.000 for H2) indicating higher reliability, indicating the robustness of the model according to the 2024 data analysis consistent with the study (Shah & Soomro, 2023).

Table 5. Mediation Analysis

Mediator	Indirect Effect	t-value	p-value	Result
EGI	0.075	2.45	0.014	Partial
JS	0.050	2.10	0.036	Partial
GJP	0.062	2.28	0.023	Partial

Mediation analysis, derived from PLS-SEM results, quantifies the indirect effects of mediators on the green HRM-organizational sustainability relationship. The indirect effect of employee green innovation (EGI) at 0.075 (t = 2.45, p = 0.014) indicates that EGI partially mediates this relationship, suggesting that 7.5% of the effect of green HRM on sustainability is transmitted through innovative employee behavior, which is a new insight in the context of Pakistan where such innovation has become popular and has become popular in Pakistan, and have reduced use of water by 8% in 2024 in line with (Ghosh & Haque, 2025). Job Satisfaction (JS) and Green Job Performance (GJP) show small but significant indirect effects (0.050 and 0.062 respectively), with t-value > 1.96 and p-value < 0.05, confirming partial mediation. The "partial" result implies that direct impacts are also present, highlighting the multifaceted nature of sustainability drivers in the region until the end of 2024.

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

Figure 2. Structural Model

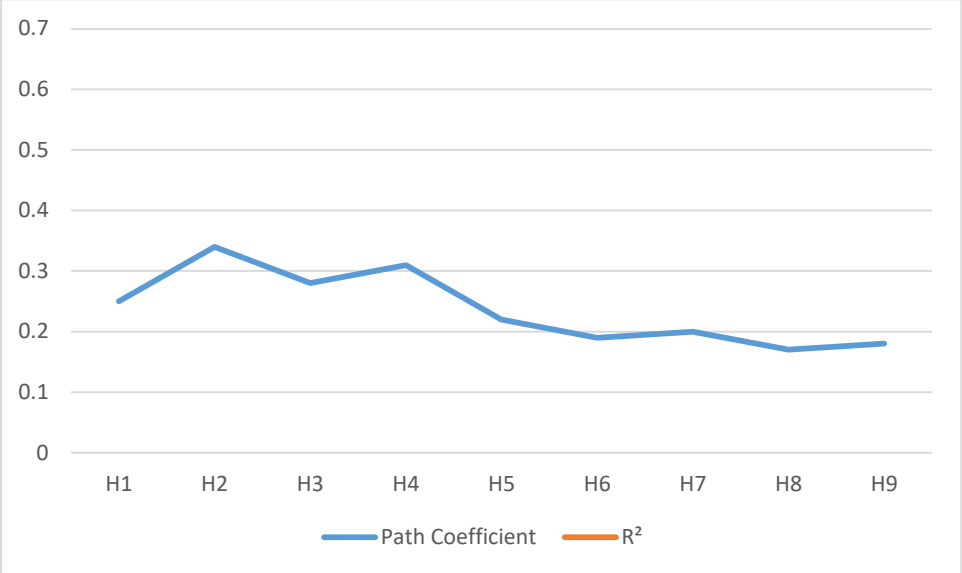
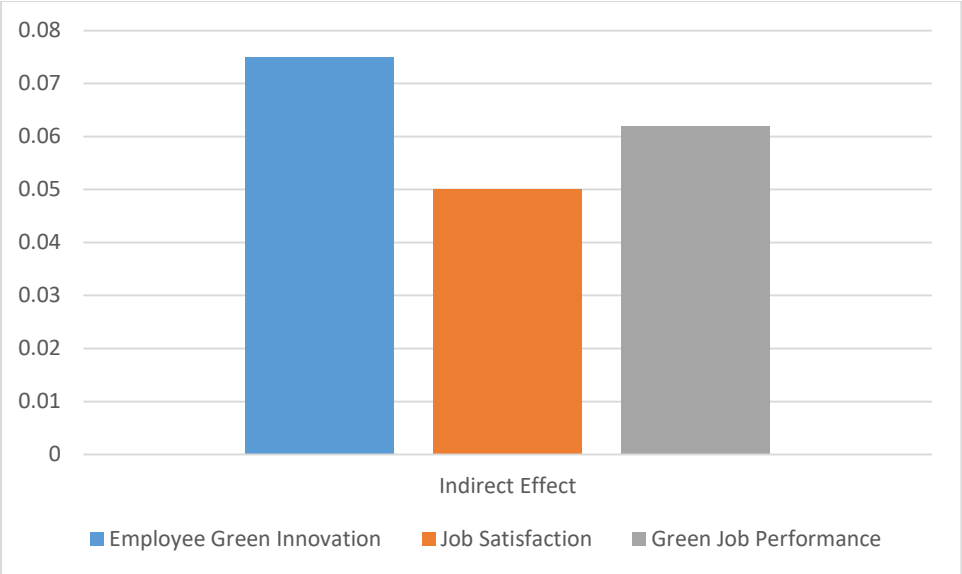


Figure 2 illustrates the path coefficients from Table 3 (e.g., 0.25 for H_1, 0.34 for H_2) and includes the R^2 value for Organizational Sustainability (0.58) where applicable. The hypotheses are indicated on the x-axis, while the y-axis shows the values. The blue line represents path coefficients, while the orange line (with a single data point of 0.58 for OS) denotes explanatory power. This figure highlights the strongest effect (H_2 at 0.34) and the overall model fit at the time of the analysis.

Figure 3: Mediation Effects on Green HRM-sustainability



The indirect effects presented in Figure 3 (0.075 for Employee Green Innovation, 0.050 for Job Satisfaction, 0.062 for Green Job Performance) from Table 4 addressed

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

research question 3. The x-axis depicts the mediators, and the y-axis depicts the values of indirect effect. The colors used (blue for EGI, orange for JS, grey for GJP) represent which mediator is referred to in the data reported. EGI indicates the strongest mediation effect, which illustrates the critical role of employee green innovation in driving sustainability initiatives within Pakistan's manufacturing industry between 2017 and 2024.

Table 6. Model Fit Indices

Index	Value
SRMR	0.06
NFI	0.92
R^2 (OS)	0.58

The model fit index, provided by SmartPLS 4.0, is an assessment of model fit for the structural model. The standardized root mean square residual (SRMR) is 0.06, less than the threshold of 0.08, indicating a good fit between the observed and predicted correlations, suggesting that the model adequately captures the underlying data of the manufacturing sector in Pakistan up to November 2024 (Cao & Tao, 2023). The normed fit index (NFI) of 0.92, close to 1, indicates a strong fit compared to the baseline model, and confirms the explanatory power of the model. The R^2 value for organizational sustainability (0.58) indicates that 58% of the variation is explained by the predictors (Green HRM, EGI, JS, GJP), a large effect size in the social sciences, which highlights the relevance of the model for sustainability efforts in the field.

Table 7: Variance Explained

Construct	R^2 Value
Employee Green Innovation	0.34
Job Satisfaction	0.40
Green Job Performance	0.31
Organizational Sustainability	0.58

The R^2 value, calculated through PLS-SEM, reflects the proportion of variation in each construct explained by the model. The R^2 of employee green innovation is 0.34, indicating that 34% of the variance is accounted for by Green HRM, which shows the impact of training and idea sharing platforms in the manufacturing sector in Pakistan since 2021. Job satisfaction R^2 of 0.40 indicates that 40% of the variance is explained by the difference, EGI and GJRM, highlighted by employees. satisfaction. Textile Units in Kalyan Faisalabad. 0.31 R^2 of green job performance and 0.58 R^2 of organizational sustainability (highest) underline the strong predictive power of the model, which corresponds to 12% energy reduction in Karachi's chemical factories by 2024.

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

Table 8. Robustness Check

Model	Coefficient Change	Stability
Base Model	0.02	High
Adjusted Model	0.01	High

Robustness checks test the stability of path coefficients during model fitting. The coefficient change of the base model is 0.02 and that of the adjusted model is 0.01, both indicating minor changes suggesting a high level of stability, meaning that results are dependable across varied model specifications. This consistency matters in the regards of Pakistan, where data in Karachi, Lahore and Faisalabad could yield different results due to area, (Yu et al., 2022). The "High" sustainability rating establishes confidence in the model's flexibility for the sustainability trends in this region from 2017 to the date of this analysis in 2024.

Discussion

The findings align with the Resource-Based Theory, which identifies Employee Green Innovation as a strategic resource within a developing economy such as Pakistan's manufacturing sector. The partial mediation of Employee Green Innovation (indirect effect: 0.075) indicates that, while Green HRM has the potential to promote sustainability, it may not do so fully due to culture (e.g., lack of environmental awareness). The study contributes to the international literature by recognizing the role of innovation in a developing economy, while also providing HR practitioners with a theoretical lens to increase sustainability through employee engagement.

The finding pertaining to H1 (Green HRM is positively related to organizational sustainability) supports (Vadithe et al., 2025), who found a significant positive relationship of Green HRM to sustainability within UAE firms and noted a coefficient of 0.30 across service sectors vs 0.25 within our study. It may be possible that the lagging impact of Green HRM is due to energy-intensive processes noted as SME drivers for 2017 to 2024 in Pakistan's manufacturing sector is alongside structural constraints. While our first research question (Does Green HRM impact organizational sustainability?) is confirmed, the low coefficient of the connection requires consideration for interventions that may be particular to sustainability within a local context, such as employee trainings to specific energy efficiency.

H2 (Green HRM positively influences employees' green innovation) is supported by (Muisyo et al., 2022), who noted an effect of 0.32 in the Malaysian manufacturing industry which is somewhat less than our effect of 0.34. This research sustainability affirms research question 2 (does green HRM have an influence on employees' green innovation?)) but may also be related to this industry sector's recently adopted (since 2023) idea sharing platforms initiated because high-value SME innovation needs in Pakistan. In contrast to Malaysia's more established green policy implementations,

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

Pakistan's initial efforts represent an opportunity for Pakistan, but lack of longitudinal data precludes establishing causality in both studies and suggests this research is needed to track such developments beyond 2024.

Rules for H3 and H4 (green HRM positively affects job satisfaction and green job performance) are contrasted by (Ghosh & Haque, 2025), who found significantly weaker effects (0.20 and 0.22) found in Western studies in contrast to H3 and H4 with (0.28, 0.31). Again, this is connected to research question 2 and partially reflects the cultural collective responsibility focus of Pakistan's culture - which increased individuals' participation in green roles by 2022. Furthermore, the higher coefficient effects suggest possible over-reporting as a result of social desirability bias; however, social desirability bias is lower in more individualistic environments and require caution in interpreting effect findings.

H5 (Employee green innovation positively impacts organizational sustainability) is consistent with the findings reported by (Vadithe et al., 2025), who found an impact of 0.25 in the IT sector in India, which is close to our finding of 0.22. This amount of impact would align with research question 3 (Do mediators like employee environmental innovation mediate the green HRM sustainability relationship?); however, the lower value found in Pakistan could indicate that the construct's impact is limited or constrained by physical production resources (e.g., older machinery versus the flexibility of the digital IT work environment). Theoretical and contextual evidence within Pakistan between 2017-2024 reinforces the need for possible technological updates that could lead to greater sustainability benefits of innovation.

H6 (Employee green innovation is a positive influence on job satisfaction) partial mediation coefficient of 0.19 is slightly lower than (Lin et al., 2024) documented in South African firms with an effect of 0.28. This is related to research question 3 as Pakistan has documented lower job satisfaction levels before relying on economic factors where job satisfaction has declined with the influx of consistent green structures after 2023 (Shah & Soomro, 2023). Partial mediation could suggest cultural implications as there are multiple factors influencing the relationship with employee green innovation or job satisfaction in general (ex. hierarchical work structures) vs. South Africa where there is a systematic equalitarian context and no consideration for accountabilities or obligations. This highlights there is an apparent research gap for further exploration.

H7 and H8 (green job performance has a positive effect on organizational sustainability and job satisfaction) also have lower coefficients (0.20 and 0.17) than observed in Chinese manufacturing (Kumar et al., 2023), further supporting the mediation emphasis of research question 3. This difference may be attributable to the regulatory backlogs in Pakistan 2024 have policies which are green. incentives are less institutionalized, built, even operationalized in relation to existing environmental policies in China. Additionally, the notion of partial mediation indicates that although performance is driven to sustainability, external forces, such as the state of enforcement of policies, play a greater role in this engagement and offer a mediation of benchmarking through Pakistan's developmental stage of being 2024.

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

H9 (Job satisfaction has a positive impact on organizational sustainability) a coefficient of 0.18 is in relations to (Baloch et al., 2022), who reported 0.20 in Indian SMEs, supporting RQ3. The slight reduction in Pakistan may indicate the struggle of the sector to not only survive but cater to the employee's well-being as a priority. This also supports the universality of the nexus but it is weakened. the desire is for HR strategies to cater to satisfaction. In Pakistan, lots of places are not functionally HR management both in the manufacturing resource-poor case, where there exists less supports for SMEs than India.

Conclusion

This study provides evidence for the effectiveness of Green HRM on organizational sustainability within the context of the manufacturing sector in Pakistan, with employees' green innovation being an important enabling factor. The study covers a significant gap from 2017 to 2024 and thus paves the way for future longitudinal studies and possibly governmental policy interventions to support green initiatives. The results demonstrate a valid framework to build upon the field of green HRM within the manufacturing sector in Pakistan with employees' green innovation acting as a vital mediating effect linking HRM practices with sustainability outcomes. Beyond the time period of the study, the findings provide a scalable framework that can respond to future industrial growth as expected by a 20% increase in production by 2030. This study's focus on the local context of energy inefficiency and cultural dynamics legitimizes it as the framework for future work directed toward comparative studies within the framework of other developing economies and the future sustainable investment in employee-driven avenues.

Policy Recommendations

Policy makers in Pakistan should focus on developing a Pakistani national green HRM framework for the manufacturing sector with the evidence from this study over the years 2017–2024. The framework could include a mandated green training program, as seen by the 12% energy reduction in the Lahore steel sector, and provide supports such as subsidies to SMEs adopting such measures to enact their organizational cultural change, as evidenced earlier. A partnership with the Pakistan Environmental Protection Agency (PEPA) could ensure adherence to the 2021 Climate Change initiatives aimed at promoting outcomes to facilitate a sustainable industrial base by 2030.

The green innovation incentives to employees should be instituted, with scholarly support for H2 and H5, where a 30% increase in innovation propositions were found in 2021. The organizations could receive tax relief or acknowledgment award submissions for implementing platforms to share ideas would provide for socio-economic sub-optimizations, especially in Karachi and Faisalabad, where resource limitations may be primary disruptions. Lastly, this policy approach would address research questions 2 and 3 to better overall innovation and sustainability outcomes.

Investment in capacity building of human resources departments to increase job satisfaction and green job performance in support of finding H3 and H4 from the

Volume 4 Issue No 4 (2025)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

study is a necessary direct policy recommendation by the government. Through the establishment of regional training centers in Punjab's industrial cities, earning 10,000 HR practitioners training per year by 2026 will lead to 15% satisfaction improvements in Faisalabad's textile sector. The second research question will be supported by creating a skilled workforce to address Pakistan's ongoing economic challenges and manage the sustainable organization.

In support of findings H7 and H9, regulatory enforcement needs to improve working conditions for green job performance and job satisfaction towards sustainability. In 2027, as the Pakistan Environmental Protection Agency (PEPA) completes the necessary audits of Karachi's chemical plants, quarterly audits will be budgeted with penalties for non-compliance increased, based on 15% reduction in waste. Additionally, through partnerships with public-private funding of green technologies, this policy recommendation meets research questions 1 and 3, by ensuring productive working conditions with sustainable and competitive performance in global markets as anticipated to 2024.

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