ASI Asia Social Issues
ASIA SOCIAL ISSUES 2026; 19(6): 292397
https://doi.org/10.48048/asi.2026.292397
DJMP Center for Digital Journal Management & Multidisciplinary Academic Platform
RESEARCH ARTICLE

The Impact of Green HRM on Green Work Behavior in Chinese Higher Education Industry: Examining the Mediation Role of Work Engagement and Moderation Role of Environmental Knowledge

Fei Lu

Thammasat Business School, Thammasat University, Bangkok 10200, Thailand

(Corresponding author's e-mail: lufeifly@outlook.com)

Received: 5 February 2026, Revised: 10 April 2026, Accepted: 26 May 2026, Published: 31 May 2026

Abstract

As environmental sustainability becomes an organizational priority, Green Human Resource Management (GHRM) has emerged as a critical mechanism for encouraging employees' pro-environmental behaviors. Although GHRM has been widely examined in manufacturing and service sectors, empirical evidence within higher education institutions (HEIs), particularly in the Chinese context, remains limited. Drawing on social exchange theory, job demands–resources model, broaden-and-build theory, and the knowledge–attitude–behavior framework, this research investigates the effects of GHRM practices on employees' in-role and extra-role green workplace behaviors. It further examines the mediating role of green work engagement (GWE) and the moderating role of environmental knowledge. Survey data were collected from 401 academic and administrative staff members across three universities in Shenyang, China. Structural equation modeling was employed to test the proposed relationships. The results indicated that GHRM has significant positive effects on both in-role and extra-role green behaviors. GWE significantly mediates the relationship between GHRM and extra-role green behavior but does not mediate the relationship with in-role green behavior, suggesting that emotional engagement alone is insufficient to drive prescribed sustainability-related tasks. Also, environmental knowledge significantly moderates the relationship between GHRM and extra-role green behavior, strengthening employees' voluntary participation in green initiatives, while its moderating effect on in-role behavior is not supported. These findings contribute to the GHRM literature by differentiating the mechanisms underlying different forms of green workplace behavior and extending empirical research to the higher education sector. Practically, the research highlights the importance of structured GHRM systems and environmental knowledge development in promoting sustainable behaviors among HEI employees.

Keywords: Environmental knowledge, green human resource management, green work behavior, green work engagement, Mediation effect, Moderation effect

Introduction

As environmental challenges such as climate change, resource depletion, and ecological degradation intensify and a heightened global focus on sustainability emerges, organizations across industries are reconfiguring their strategies to align with eco-friendly objectives. In this transformation, Human Resource Management (HRM) plays an essential role by integrating sustainable principles into its core functions, including recruitment, employee development, performance assessment, and engagement (Zhang et al., 2024). By embedding sustainability into HRM policies, organizations can cultivate an environmentally responsible corporate culture, reinforcing their broader ecological commitments (Adu et al., 2024). HRM is widely recognized as a key driver in fostering pro-environmental mindsets, behaviors, and awareness within the workforce, as its policies shape employees' sustainability-related attitudes and motivations (Adu et

al., 2024). When green initiatives are incorporated into HRM, they not only encourage individual employees to adopt environmentally responsible behaviors but also help shape an organization's overall sustainability culture. Consequently, HRM serves as a crucial mechanism for embedding green policies within an institution's framework, ensuring effective implementation (Freire & Pieta, 2022). Aligning HRM practices with environmental sustainability principles enables businesses to develop a workforce that actively participates in sustainability initiatives, thereby enhancing both environmental performance and competitive positioning (Zhang et al., 2024).

Employee green behavior refers to workplace actions that support environmental management practices and play a vital role in the successful implementation of sustainability initiatives (Dumont et al., 2017). Prior studies have emphasized that fostering employees' involvement in green activities is essential for improving environmental performance and gaining a competitive edge (Chen & Wu, 2022). In response, Green Human Resource Management (GHRM) has emerged as a strategic HRM framework designed to elevate employees' environmental awareness and stimulate pro-environmental behaviors. GHRM encompasses various HRM functions, such as environmentally conscious recruitment, sustainability-focused training, eco-friendly incentive structures, and green performance evaluations, all of which aim to support environmental sustainability (Ercantan & Eyupoglu, 2022). Additionally, the concept of green work engagement (GWE) refers to an employee's psychological commitment, energy, and enthusiasm in performing sustainability-related tasks. Prior research (Wang et al., 2025) has suggested that GWE plays a crucial role in explaining how GHRM initiatives translate into actual workplace green behaviors. While GHRM can instill a sense of environmental responsibility among employees, it does not inherently guarantee behavioral changes. GWE thereby serves as a motivational mechanism, transforming HRM-driven sustainability interventions into intrinsic commitment, ultimately fostering greater participation in green initiatives. Furthermore, employees' environmental knowledge, defined as the extent of consciousness, understanding, and familiarity that employees possess concerning environmental issues and practices (Paço & Lavrador, 2017), has also been acknowledged as an key determinant by early studies suggesting employees' level of environmental knowledge can amplify the degree that they embrace GHRM practices and engage in sustainable workplace behaviors through serving as a moderating factor (Saeed et al., 2019).

Higher education institutions (HEIs) serve as key facilitators of environmental sustainability, not only through academic instruction and research but also by incorporating sustainable management practices within their operational frameworks. As centers of knowledge creation and dissemination, HEIs are well-positioned to address ecological challenges and lead by example in sustainability efforts (Oliveira & Proença, 2025). Dissimilar to corporate or manufacturing organizations, HEIs possess dual responsibilities of education and social influence that enable them to shape both internal employee behaviors and students' values and broader social norms toward sustainability. To establish a green workplace culture, HEIs should adopt a proactive approach to sustainability, integrating green principles into both academic and administrative operations (Gilal et al., 2019). Faculty, researchers, and administrative personnel are pivotal in these efforts, as their daily professional activities significantly impact the success of institutional sustainability initiatives (Lashari et al., 2022). This unique institutional context makes HEIs an significant and under-examined area for exploring GHRM because sustainability practices implemented in universities can create long-run multiple impact through teaching, research, and community engagement. Despite the increasing recognition of GHRM within the manufacturing and service industries, its application in higher education remains underexplored (Fawehinmi et al., 2020). A systematic review by Oliveira and Proença (2025) highlighted this research gap, underscoring the need for further investigation of GHRM in diverse service-oriented settings. Among the limited studies on HEIs, Fawehinmi et al. (2022) suggested that GHRM practices can enhance faculty members' green behaviors indirectly by increasing their environmental knowledge. Similarly, Gilal et al. (2019) found that incorporating green behaviors into HEI management structures can yield economic and ecological benefits while fostering employee commitment to sustainability initiatives (Fawehinmi et al., 2020). In the context of China, exploring the relationship between GHRM and

employees' green behaviors in HEIs is both relevant and timely due to several factors, including the country's sustainability agenda, the rapid expansion of its education sector, and the growing role of universities in promoting environmental responsibility. China has set ambitious environmental targets, such as achieving carbon neutrality by 2060, with its 14th Five-Year Plan (2021-2025) emphasizing the necessity of green development across all industries, including education (Ba & Cao, 2023). This national strategy advocates integrating GHRM principles to encourage pro-environmental workplace behaviors. Studies demonstrating GHRM's positive impact on environmental performance in China's industrial sector suggest that similar benefits could extend to the education sector (Ba & Cao, 2023). Chinese HEIs, as institutions responsible for shaping future leaders and professionals, are well-positioned to incorporate GHRM into their governance frameworks, thereby instilling sustainability values among faculty and staff (Mou et al., 2024). This, in turn, can have a ripple effect on students and the broader community. A study conducted on private Chinese universities found that GHRM practices significantly enhance environmental performance through employee engagement in green behaviors, further reinforcing the role of HEIs in sustainability advocacy (Mou et al., 2024). Given the limited research on GHRM within Chinese HEIs, the present study aims to develop a comprehensive framework to assess how GHRM practices influence both in-role and extra-role green behaviors in higher education settings. Additionally, this research introduces GWE as a mediating variable to explain the link between GHRM practices and employees' green workplace behaviors within the Chinese cultural context.

The primary purposes of this research are, first, to analyze the connection between GHRM practices and employees' green workplace behaviors, considering both in-role and extra-role dimensions within HEIs; second, to explore the mediating function of GWE in the link between GHRM practices and employees' green workplace behaviors; third, to advance the expanding body of GHRM research by investigating its impact within the relatively unexplored higher education sector; and fourth, to provide practical insights for HEIs in formulating and implementing effective GHRM strategies that enhance sustainability and environmental performance. This study makes several contributions. Firstly, it is anchored in social exchange theory (SET) and develops a conceptual model to assess how GHRM influences employees' green behaviors within the cultural setting of China. Secondly, by incorporating perspectives from both the job demands-resources (JD-R) model and the broaden-and-build theory (BBT), the proposed study identifies GWE as a key mediating factor, clarifying the process through which GHRM fosters green workplace behaviors. Thirdly, grounded in the knowledge-attitude-behavior (KAB) model, this study investigates the effect of environmental knowledge, a crucial moderator variable, on the pathway from GHRM to green workplace behaviors. Importantly, these theoretical perspectives are cmobined into a coherent framework where SET explains why employees reciprocate organizational green initiatives with sustainable behaviors, JD-R model explains how GHRM functions as a job resource that improve GWE, BBT explains how positive emotions derived from engagement broaden behavioral repertoires that leading to green conduct, and KAB model justifies how environmental knowledge reinforces the translation of organizational practices into behavior. Together, these theories produce complementary explanatory mechanisms supporting both the mediation of GWE and the moderation of environmental knowledge, thus formulating a unified conceptual basis for the proposed model. Lastly, this research enriches the existing GHRM literature by investigating the under-examined role in HEIs, providing theoretical insights and practical suggestions for enhancing environmental sustainability in academic institutions.

Literature review

GHRM & Green work behavior

As an essential aspect of organizational sustainability, GHRM comprises a set of HRM practices that encourage environmental responsibility within organizations. Scholars such as Dumont et al. (2017) define GHRM as a framework that includes environmentally conscious staffing and selection, developing initiatives to improve employees' green competencies, performance evaluation adopting sustainability benchmarks, and reward mechanisms that incentivize the achievement of environmental targets. Employee green behavior refers to workplace actions

that support environmental sustainability and can be classified into mandatory in-role behaviors and voluntary extra-role behaviors. In-role green behaviors involve work-specific tasks officially integrated into employees' responsibilities and performance assessments, for instance, reducing energy use, reducing waste, and following environmental guidelines (Tirno et al., 2023). In contrast, extra-role green behaviors involve voluntary initiatives not explicitly mandated by the organization, including participating in ecological campaigns or coaching coworkers on environmental practices (Jiang et al., 2022). Within HEIs, promoting both types of green behaviors is essential for advancing organizational sustainability. Academic staff engaging in in-role green behaviors integrate environmentalism education into their teaching and research, while extra-role behaviors manifest through voluntary participation in campus-wide sustainable practices (Ercantan & Eyupoglu, 2022).

The theoretical foundation relating GHRM to employees' green behaviors is grounded on SET theory, which accentuates the value of reciprocity (Blau, 1964). This theory suggests that when organizations exhibit commitment to environmental sustainability by implementing GHRM initiatives, such as sustainability-driven development programs, performance appraisals integrating green benchmarking, and reward mechanisms for environmental contributions, employees perceive these demonstrations as organizational support. Consequently, they develop a sense of duty to respond by demonstrating both assigned and voluntary green behaviors (Nabi et al., 2023). Previous empirical research advocated that GHRM positively correlates with different aspects of green work behavior, such as employees' sustainable job outcome, empowerment, creative sustainable problem-solving, and ecologically responsible organizational citizenship behaviors across industries, including merchandising, healthcare, and automotive (Dumont et al., 2017; Wu et al., 2024). In the HEI sector, research indicates that GHRM practices, including green recruitment and professional development, are able to inspire academic staff to instill environmentalism ideologies within their teaching, thus expanding the influence of sustainable management beyond the HEIs (Gilal et al., 2019). Additionally, green performance assessments and rewarding structures were found to strengthen positive environmental behaviors, inspiring academic and administrative staff to vigorously engage in sustainability initiatives within the university setting (Bui et al., 2024). Therefore, this study postulates the following two hypotheses: H1: GHRM positively impacts employees' in-role green work behavior at HEI; H2: GHRM positively impacts employees' extra-role green work behavior at HEI.

GHRM & GWE

Work engagement is understood as the degree to which employees are rationally, emotionally, and physically involved in their professional responsibilities (Haque et al., 2024). Building upon this concept, GWE refers to the enthusiasm and effort employees devote in sustainability work, their willingness to invest in green initiatives, and their level of involvement in sustainability-related tasks (Haque et al., 2024). Previous empirical studies have acknowledged various determinants of work engagement, including job characteristics, managerial approaches, and HRM practices (Aboramadan et al., 2022). Prevailing HRM literature has extensively explored the impact of HR strategies on work engagement, for instance, Arnold et al. (2018) proposed a model highlighting managerial, task-oriented, motivational, and personal components that enhance employee engagement. Additionally, prior research (Aboramadan et al., 2022) has confirmed that organizational resources play an essential role in fostering employees' commitment and engagement at work. The relationship between GHRM and GWE can be explained through the JDR framework, where job demands elements require sustained effort, and job resources are factors that facilitate employees in accomplishing their task goals. Job resources serve as stimuli that enhance involvement, job contentment, and professional commitment. As emphasized by Susanto (2023), the availability of organizational resources, such as HRM practices, can activate motivational mechanisms that elevate work engagement. Within this context, GHRM practices, including green staffing and development and reward programs, can serve as valuable job resources that drive employees' involvement in sustainability initiatives. Thus, within the proposed integrated framework, the JD-R model explains the mechanism through which GHRM as the job resource enhances GWE as the psychological and

motivational state. By satisfying both intrinsic and extrinsic motivational requirements, GHRM not only supports employees' specialized development but also aligns with their professional aspirations, ultimately nurturing a deeper commitment to their roles and organizations (Gomes et al., 2023).

Numerous studies across various industries have demonstrated the positive influence of GHRM on employees' environmental attitudes, behaviors, and engagement. For example, research by Ibe et al. (2024) revealed that GHRM initiatives significantly boost GWE in educational settings. Also, Yadate (2025) found that employees in academic institutions who received green training and rewards exhibited higher degree of GWE, reinforcing the view that GHRM serves as a catalyst for employee engagement in sustainable work behaviors. Although research on GHRM and GWE in higher education remains limited, it is gradually expanding. For example, Veerasamy et al. (2019) found that GHRM implementation in universities significantly increased GWE by augmenting employees' environmental awareness and mindfulness. Similarly, Yang et al. (2024) emphasized that GHRM motivated university faculty to integrate sustainability into their research, thereby promoting greater involvement in environmentally conscious work- related practices. Therefore, this study posited the following two hypotheses: H3: GHRM positively impacts employees' GWE at HEI.

GWE & Green work behavior

The connection between GWE and environmentally responsible workplace behaviors in this research can be understood through the lens of Fredrickson's (2001) BBT theory. According to BBT theory, experiencing positive emotions broadens individuals' cognitive and behavioral capacities, fostering long- term personal resources including adaptability, understanding, and creativity. Within the proposed integrated model, BBT can complement JD-R by justifying how the positive affective state generated by GWE can translate into the expanded sustainable behavioral repertoires. Within the proposed integrated framework, BBT complements JD-R by explaining how the positive affective state generated by GWE translates into expanded pro- environmental behavioral repertoires. By expanding cognitive flexibility, positive emotions enhance problem- solving skills, innovation, and overall well- being (Fredrickson, 2001). Applying this framework to GWE, employees who derive positive emotions from engaging in sustainable practices, including a sense of accomplishment in supporting environmental practices or personal gratification from environmentally friendly actions, are more inclined to exhibit consistent pro- environmental behaviors. Positive emotions increase mindfulness and intrinsic motivation, thus reinforcing sustained participation in green activities and cultivating a long-term dedication to sustainability goals (Chatelain et al., 2018). By strengthening employees' motivation to engage in environmentally responsible practices, GWE also encourages knowledge sharing and collaboration among colleagues, ultimately supporting both organizational sustainability efforts and broader sustainability initiatives (Marini et al., 2023).

Early research has similarly demonstrated that more engaged employees are inclined to build stronger connections with their organizations, resulting in positive work-related outcomes, including adherence to sustainability policies, energy conservation, and compliance with eco- friendly operational guidelines (Yong et al., 2020). Studies further advocate that employees with high levels of GWE demonstrate greater adherence to environmental responsibilities. For example, Haque et al. (2024) found that employees with deeper involvement in sustainability programs were more likely to comply with workplace environmental regulations and fulfill their green task duties effectively. Likewise, Yong et al. (2020) highlighted that GWE enhances employees' intrinsic motivation, encouraging them to integrate sustainability into their routine tasks and maintain consistent in- role green behaviors. Moreover, engagement nurtures a psychological extension that enables employees to excel beyond their designated task roles to volitional environmental activities (Amah, 2020). Early studies (Aboramadan et al., 2020; Chen et al., 2020) have confirmed that work engagement is a strong predictor of extra-role behaviors, including proposing creative sustainability strategies, motivating coworkers to embrace eco- friendly initiatives, and participating in organizational citizenship behaviors linked to environmental responsibility. For example, Amah (2020) found that highly engaged employees vigorously contributed green

ideas and willingly partaken in voluntary environmental initiatives, which is consistent with the argument of Chen et al. (2018) emphasized that employees with higher levels of GWE were more expected to promote ecological consciousness among colleagues, nurturing environment-oriented organizational culture. In higher education setting, Fawehinmi et al. (2020) suggested that HEIs' faculty employees who demonstrated strong engagement in sustainability efforts invested additional effort in integrating environmental themes into their teaching and research, thereby improving institutional ecological performance. Therefore, this study proposes the following hypothesis: H4a: GWE positively impacts employees' in-role Green Work Behavior at HEI; H4b: GWE positively impacts employees' extra-role Green Work Behavior at HEI.

The mediating role of GWE & the moderating role of environmental knowledge

As GWE is characterized as a psychological condition in which employees exhibit strong commitment, enthusiasm, and deep involvement in executing sustainable tasks, the JDR model posits that GHRM practices serve as organizational resources that can encourage employee engagement by providing meaningful work opportunities and essential support (Haque et al., 2024). Consequently, when employees attain high levels of GWE, they are more inclined to integrate sustainability into their job responsibilities and enthusiastically participate in pro- environmental initiatives (Albrecht et al., 2023). Prior research has underscored the mediating role of GWE in translating organizational environmental policies into employee behavior. For instance, Abualigah et al. (2023) found that GHRM strategies significantly enhanced employee engagement, resulting in increased displays of both mandatory and discretionary green behaviors among employees in the hospitality sector. Similarly, within the information technology industry, Ojo et al. (2022) found that GHRM enhanced employees' green engagement, thus fostering a strong commitment to adopting environmentally friendly work behaviors. In a higher education setting, the connection between GHRM and employees' green behaviors is also expected to be mediated by GWE, as faculty and staff engagement is crucial to advancing sustainability initiatives (Purnomo et al., 2024). When HEIs implement GHRM measures such as sustainability-focused training programs and performance-based incentives, employees are more expected to experience heightened motivation and commitment toward environmental goals, thereby strengthening their engagement in both mandatory and voluntary green behaviors (Aboramadan, 2022). Therefore, this study postulated the following two hypotheses: H5a: GWE mediates the relationship between GHRM and employees' in-role green behavior; H5b: GWE mediates the relationship between GHRM and employees' extra-role green behavior.

Environmental knowledge refers to the degree of consciousness, understanding, and familiarity an individual possesses concerning ecological issues and sustainable practices (Paço & Lavrador, 2017). It comprises both factual knowledge, including awareness of climate change, contamination, and resource exhaustion, and procedural knowledge, such as effective recycling techniques and strategies for minimizing resource consumption. (Ahmad et al., 2021). It has been widely recognized as a crucial factor in eco-friendly behavior in both individual and institutional contexts (Paço & Lavrador, 2017). In the context of GHRM, employees' level of environmental knowledge can affect the degree to which they engage in sustainable workplace behaviors, thereby moderating the relationship between GHRM practices and employees' green behavior. The KAB model can provide theoretical support for explaining this moderating effect by elucidating how knowledge influences employees' sustainable attitudes and, in turn, their green behaviors (Zhang et al., 2024). Within the proposed integrated model, KAB theory explains the variability in the strength of the GHRM and green behavior relationship, thus justifying the moderating role of environmental knowledge. As stated by the KAB model, knowledge is a precondition for modelling positive sustainable attitudes, which in turn inspire green behaviors (Zhang et al., 2024). Thus, GHRM practices can serve as a strategic tool to educate employees through green training programs, workshops, and policies on how to reduce waste and conserve resources, thereby enabling employees to gain knowledge and awareness of environmental issues, regulations, and best practices (Zareie & Navimipour, 2016). According to KAB, employees with high environmental knowledge are more likely to engage proactively with green HR

policies because they understand the relevance of GHRM initiatives and can integrate them into their daily work behaviors (Zhang et al., 2024). Also, when employees are knowledgeable about environmental concerns, they develop a responsible attitude toward sustainability efforts (Paço & Lavrador, 2017), meaning that they often perceive GHRM initiatives as personally meaningful, which increases their motivation to adopt and reinforces their commitment to green HR policies (Zareie & Navimipour, 2016). As a result, as environmental knowledge enhances employees' self-efficacy or their ability to perform sustainable actions effectively, they will feel more confident in engaging, committing and advocating green behaviors sustainability within organization (Otto & Pensini, 2017). Early studies also support environmental knowledge's moderation effect on employees' green behaviors, for instance. Yusop et al. (2018) concluded that environmentally knowledgeable individuals exhibited higher involvement in green behaviors, such as energy saving. Similarly, Saeed et al (2019) found that employees tend to avoid participating in sustainable workplace activities due to their lacking necessary knowledge on sustainability practices. Therefore, this research posits the following hypothesis: H6a: Environmental knowledge moderates the relationship between GHRM and employees' in-role green behavior; H6b: Environmental knowledge moderates the relationship between GHRM and employees' extra-role green behavior. Based on the above- mentioned empirical evidence in prevailing literature, the proposed research model containing all hypotheses can be observed in Figure 1.

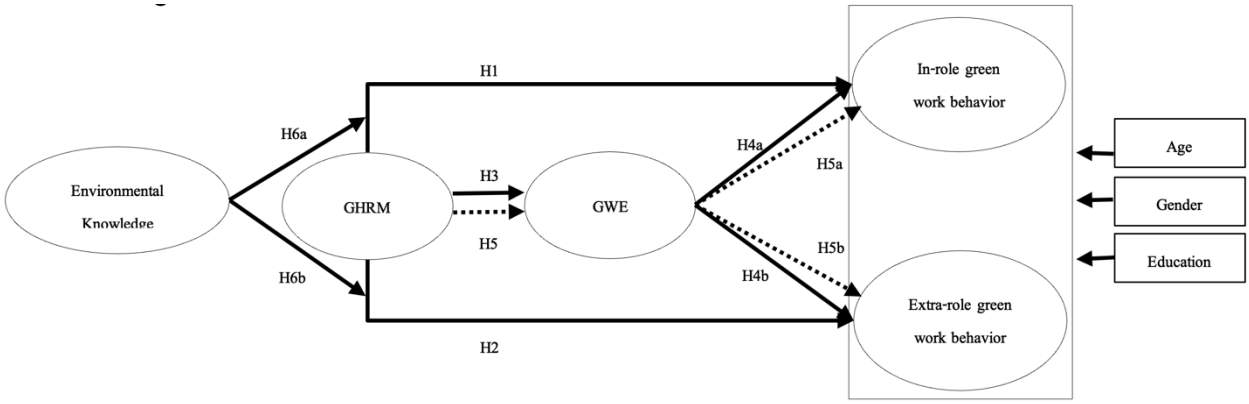


Figure 1 Proposed Green Work Behavior Framework
Source: Author's own creation
Note: Solid Line-Direct Relationship; Dash Line-Indirect relationship

Methodology

The data for this research were obtained from employees at three selected universities and colleges in Shenyang, the largest metropolitan area in northeastern China. The sample included both academic faculty and administrative personnel. The three universities were chosen using purposive sampling based on several criteria and information including institutional size, diversity of academic programs, and the active involvement in sustainability-related initiatives that are in the publicly available reports, so as to ensure their relevance to the research objectives and to capture universities with varying extents of sustainability involvement, thus iproving the analytical generalizability of the research findings within the HEI sector. Shenyang was chosen as the study site due to its status as the capital of Liaoning Province and one of China's most industrialized cities. Historically recognized for its heavy manufacturing sector, Shenyang has faced significant environmental challenges, including severe air pollution, high carbon emissions, and ecological degradation (Ren et al., 2020). The city has consistently been ranked among the most polluted urban areas in China, with PM2. 5 concentrations exceeding national air quality thresholds in previous years (CEIC, 2023). Given these concerns,

the Chinese government has prioritized Shenyang for sustainability initiatives, requiring organizations, including higher education institutions, to integrate environmentally responsible practices into human resource management, daily operations, and employee behaviors (TEDLP, 2024). Additionally, Shenyang is the largest academic center in northeastern China, hosting several well-known universities that actively engage in sustainability efforts. It has over 40 HEIs, registering approximately 700,000 students and employing a substantial number of academic and administrative staff (ZZKLDZ, 2025). Due to their institutional scale, disciplinary diversity, and varying degrees of sustainability integration, universities in Shenyang offer a representative setting for examining GHRM practices and employee green behavior in higher education. To achieve the minimum sample size of 400 respondents, as recommended by Yamane (1973), a total of 700 questionnaires were *f*circulated across three universities. This target was determined to make sure the sufficient statistical power for SEM analysis and to account for the possible non-responses and to yield an adequate response rate after omitting incomplete or invalid questionnaires. A preliminary pilot study was conducted with 250 collected responses prior to the main data collection phase that is relatively larger than typical pilot tests, which is intentional to rigorously evaluate the reliability and validity of the measurement scale items across a heterogeneous sample group before shifting to the main survey and to assess any ambiguities or inconsistencies in the survey questionnaire design. And the results confirmed that the measurement scales demonstrated acceptable reliability and validity, supporting the feasibility of a larger-scale survey. To address potential non-response bias, this research applied a statistical comparison between the sample characteristics and known population parameters of the target population in Shenyang where available. Key demographic characteristics including gender, age, and educational level were evaluated and found to be broadly congruent with publicly available statistics, indicating that the sample is reasonably representative. Also, as wave analysis based on response patterns across the data collection period was infeasible due to the short data collection timespan, thus a comparison of response completeness and missing data patterns was performed. The results did not show systematic differences between fully completed and partially completed questionnaires. Thus, above results indicated that non-response bias is unlikely to substantially influence the validity of the research findings. Upon receiving approval from university administrators and obtaining formal ethics approval from the review board of researcher's institution, research assistants disseminated the online questionnaire links via email and WeChat. Participants, including faculty members and administrative staff were presented with the informed consent statement, being explained that participation was voluntary, anonymous, and they could withdraw at any time during the process without penalty, then being informed about the study's objectives before responding. The survey was designed using Microsoft Forms and included an introductory cover letter outlining the research purpose and confidentiality measures for respondents' personal data. The data collection period was approximately two weeks in March 2026, yielding 401 valid responses. The final data sample consisted of a diverse respondent group with various demographic characteristics including age, gender, and educational level, which ensure the appropriate representation of both academic and administrative staff.

The study employed validated scales from existing literature to measure key constructs. The GHRM scale was originally developed by Dumont et al. (2017) and included six items. The employee GWE scale was adopted from Schaufeli et al. (2006) consisting of six-items. Employees' green work behavior scale was proposed by Bissing-Olson et al. (2013) comprising both in-role (three items) and extra-role green behaviors (three items). The environmental knowledge scale was adopted from Wong and Yeh (2009) and comprised three items. All measurement items were adapted from prior studies with minor wording adjustments to suit the higher education context, and all survey items were rated on a seven-point Likert scale, where respondents indicated their level of agreement, ranging from 1 (strongly disagree) to 7 (strongly agree). To ensure text accuracy and cultural relevance, the questionnaire was first translated by two independent bilingual translators using the forward translation, followed by a separate back-translation process. Differences between the original and back-translated versions were carefully reviewed and revised through discussion to ensure textual accuracy. This process aimed to enhance the

reliability of translations by comparing the original and translated versions. The statistical analysis commenced with an assessment of data normality, validity, and reliability, followed by an assessment of potential common method bias (CMB). To assess the CMB concern, Harman's single-factor test was conducted, and the results need to show that no single factor will account for the majority of the variance, which suggest that CMB was not a significant concern. Subsequently, multicollinearity concerns were examined, followed by structural equation modeling (SEM), path analysis, and mediation and moderation effect testing using SPSS and AMOS software. Several control variables that could impact green work behavior were included in this study, namely age, gender, and educational level. For instance, Pham et al. (2024) suggested that younger employees displayed greater involvement in green work behaviors, whereas older employees were less actively engaged in sustainable practices within the HEI context. Also, Altassan and Ahmad (2024) argued that female employees were more active participants in workplace sustainability practices than their male colleagues. Furthermore, research by Fawehinmi et al. (2020) and Dumont et al. (2017) suggested that individuals with advanced educational qualifications can better understand intricate environmental guidelines, incorporate sustainability into their professional responsibilities, and contribute to environment-focused research and advocacy, all of which can influence their sustainable workplace behavior.

Results and Discussion

Results

The sampled participants' demographic information is summarized in Table 1. It shows that the numbers of male and female respondents were similar, and that the majority of participants were between the ages of 30 and 49 (79.3%). Moreover, the majority of the sampled participants in this study held a doctoral degree (51.6%). The statistical analysis started with a normality test, followed by reliability and validity tests, common method bias (CMB) and multicollinearity tests, structural equation modeling (SEM) and path analysis, and then mediation and moderation testing using SPSS and AMOS.

Table 1 Demographic information

Variable	Category	Frequency	Percent
Gender			
	Female	200	49.9
	Male	201	50.1
Age			
	22-29	40	10.0
	30-39	143	35.7
	40-49	175	43.6
	50 or above	43	10.7
Education Level			
	Below Bachelor	12	3.0
	Bachelor	27	6.7
	Master	148	36.9
	Doctoral	207	51.6
	Above Doctoral	7	1.7

The normality test results indicated that the skewness and kurtosis values were between -1.054 and 0.225 and between -2.000 and 1.222, respectively, both falling within the satisfactory ranges (Hair et al., 2019), indicating that the sampled study data were normally distributed. The convergent validity test was assessed by evaluating scale items with factor loadings below the satisfactory threshold (see Appendix 1) and by

calculating the composite reliability and average variance extracted (AVE). Although the AVE value for GWE (0.466) was slightly below the commonly recommended threshold of 0.50, prior studies (Maruf et al., 2021) suggests that it can be deemed acceptable when the composite reliability (CR) exceeds 0.70. And as all GWE factor loadings were either close to and above 0.60, which indicates adequate indicator reliability and supports convergent validity despite the marginal AVE value. Additionally, a re-check of the measurement items confirmed that no problematic items required omission, and the construct was retained due to its strong theoretical grounding and satisfactory CR value (0.838). Thus, the convergent validity of all measurement constructs are at acceptable levels (see Table 2). Also, the computed heterotrait-monotrait (HTMT) ratios were below the ideal threshold level of 0.85 (Henseler et al., 2015), confirming that the measurement scale's discriminant validity was established. Moreover, the scale's reliability was assessed using Cronbach's alpha coefficients, which indicated that all values exceeded the satisfactory threshold of 0.6 (Henseler et al., 2015), confirming the scale's reliability. Multicollinearity was assessed using variance inflation factor values for both indicator variables, GHRM (1.260) and GWE (1.260), which were both below the ideal threshold of 3.3 (Petter et al., 2007), indicating that the proposed study framework did not exhibit multicollinearity. The CMB test was conducted using Harman's one-factor method, and the largest factor loading was 35.8 percent, thus confirming that CMB concern was not found.

Table 2 Validity & reliability test

	CR	AVE	GWE	GHRM	In-role	Extra-Role	Reliability
GWE	0.838	0.466	0.683				0.835
GHRM	0.871	0.582	0.508	0.763			0.872
In-role	0.899	0.750	0.191	0.310	0.866		0.894
Extra-Role	0.849	0.655	0.457	0.545	0.375	0.809	0.839

Table 3 HTMT ratio

HTMT Ratio	GWE	Extra-Role	In-role	GHRM
GWE				
Extra-Role	0.429			
In-role	0.183	0.365		
GHRM	0.415	0.434	0.227	

The SEM testing results from Table 4 showed that the model fit indices values of the proposed study framework containing chi-square to degrees of freedom ratio, comparative fit index, goodness-of-fit Index, and root mean square error of approximation, were all within the acceptable threshold values, confirming that the research framework had satisfactory model fit (Kline, 2011). Table 4 also showed that only GWE did not significantly affect in-role behaviors, thus H1, 2, 3, and 4b were all supported, but H4a was rejected. Regarding the control variables included in this study, none had significant effects on work behaviors, except for gender, which significantly affected employees' extra-role work behaviors. Table 5 showed that GHRM had both significant direct and indirect effects on employees' green extra-role behaviors, indicating GWE's partial mediation effect. GHRM also showed significant direct but insignificant indirect impacts on employees' green in-role behaviors, thus indicating GWE had no mediation effect. Therefore, H5a was not supported, but H5b was supported.

In Table 6, the output results from hierarchical regression analysis showed that after obtaining the centralized values for all variables and interaction term by performing mean-centering that aims to reduce multicollinearity before creating the interaction term

GHRM* EK, the environmental knowledge showed relatively weak and nearly insignificant moderating effect on employees' in-role work green work behavior (less than 1% R square increase)., but show considerably significant moderation impact on extra-role green work behavior (2.3% R square increase). Thus, H6a was not supported while H6b was supported,

Specifically, for in-role behavior, Model 2 showed that the interaction term (GHRM_EK_CC) had a rather small coefficient (B = 0.296) and contribution to the variance explanation, which suggested that environmental knowledge does not substantially strengthen or weaken the relationship between GHRM and in-role green behavior. In contrary, for extra-role behavior, Model 4 showed that the interaction term (GHRM_EK_CC) had comparatively stronger positive coefficient (B = 0.356), indicating that higher levels of environmental knowledge significantly enhance the positive impact of GHRM on employees' extra-role green behavior.

Table 4 Regression weight

			Estimate	S.E.	C.R.	P
GWE	<---	GHRM	0.368	0.044	8.349	***
In-Role	<---	GWE	0.112	0.079	1.423	0.155
Extra-role	<---	GWE	0.323	0.069	4.698	***
In-Role	<---	GHRM	0.187	0.060	3.143	0.002
Extra-role	<---	GHRM	0.285	0.052	5.482	***
Extra-role	<---	EDUCATION_LEVEL	-0.057	0.078	-0.738	0.460
Extra-role	<---	GENDER	-0.341	0.104	-3.273	0.001
Extra-role	<---	AGE	0.113	0.074	1.531	0.126
In-Role	<---	EDUCATION_LEVEL	0.051	0.092	-0.559	0.576
In-Role	<---	GENDER	-0.174	0.123	-1.417	0.156
In-Role	<---	AGE	-0.038	0.087	-0.441	0.659

*Note: Model fit indices: $\chi 2 = 295.788$ ($P < 0.00$), $df = 154$, $\chi 2/df = 1.921$, CFI = .964, GFI = .933, NFI = .928, TLI =. 955, RMSEA = .048, *** = .001 significance level*

Table 5 Mediating effect of GWE

Relationship	Estimate	Bootstrapping		2 Tailed Significance
		Bias-Corrected 95% CI		
Direct Effects		**LB**	**UB**	
GHRM - GWE	0.368	0.266	0.473	0.001
GHRM - Extra-role	0.285	0.183	0.415	0.001
GHRM - In-Role	0.187	0.075	0.309	0.004
GWE - Extra-role	0.323	0.183	0.461	0.001
GWE - In-Role	0.112	-0.047	0.280	0.172
Indirect Effects				
GHRM - Extra-role	0.119	. 0067	0.186	0.001
GHRM - In-Role	0.041	-0.016	0.109	0.149

Table 6 Hierarchical regression analysis

Model	Variable	Coefficients B	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics		
							R Square Change	F Change	Sig. F Change
1			0.279[a]	0.078	0.075	1.45	0.078	33.6	0.000
2	(Constant)	-4.21E-5	0.294[b]	0.087	0.082	1.44	0.009	3.97	0.047
	GHRM_CC	0.095							
	GHRM_EK_CC	0.296							
3			0.475[c]	0.225	0.223	1.06	0.225	116.1	0.000
4	(Constant)	-3.52E-5	0.499[d]	0.249	0.245	1.05	0.023	12.4	0.000
	GHRM_CC	0.263							
	GHRM_EK_CC	0.356							

Model 1 & 2: Dependent Variable: In-role Work Behavior
a & c. Predictors: (Constant), GHRM_CC
Model 3 & 4: Dependent Variable: Extra-role Work Behavior
b & d. Predictors: (Constant), GHRM_CC, GHRM_CC_EK_CC

Note: EK – Environmental knowledge; CC – Centralized value

Discussion

This research provides significant insights into the role of GHRM in fostering green work behaviors in the context of Chinese HEIs. The study findings indicate that the significant effects of GHRM on both in-role and extra-role green behaviors suggest that structured green human resource initiatives implemented to encourage sustainability can efficiently inspire pro-environmental behaviors among employees, which aligns with prior studies (Dumont et al., 2017; Haque et al., 2024) claiming that GHRM functions as a critical organizational resource that augments employees' commitment to sustainability. The positive direct impact of GHRM on extra-role green behaviors indicates that employees perceive strong organizational environmental commitments as an inspiring determinant that leads them to willingly participate in activities such as advocating green practices among coworkers. This finding also corroborates previous research (Saeed et al., 2019; Aboramadan, 2022), which found that employees in organizations with well-established sustainability guidelines are more inclined to engage in volitional green actions beyond their designated job duties. Moreover, GWE was found to have a significant impact on employees' green extra-role work behaviors, which is consistent with the findings from the study conducted by Lu (2025), but GWE did not show a significant impact on in-role work behaviors, which contradicts the findings from earlier studies (Albrecht et al., 2023; Abualigah et al., 2023), suggesting that GWE plays a key role in translating environmental policies into employee behaviors. This research extends the literature by proposing that GWE as a motivational state characterized by vigor, dedication, and absorption, is more strongly related to discretionary extra-role behaviors than the prescribed in-role behaviors, as suggested by the JD-R framework. Under this framework, engagement typically results in proactive and volitional actions rather than compliance-based behaviors that are formally required within institutions. As extra-role green behaviors are generally discretionary and aligned with intrinsic motivation, causing them more sensitive to the engagement levels while in-role green behaviors are regulated by formal job descriptions, performance evaluation systems, and institutional policies, thus reducing the relative impact of psychological states such as engagement. This distinction is also supported by early research (Demerouti et al., 2015) suggests that work engagement is more predictive of extra-role behavior than in-role behavior. One possible explanation for this incongruity is that engaging with green initiatives may not necessarily translate into noticeable eco-friendly behaviors at work, especially when external factors such as organizational policies and performance appraisals exert a relatively stronger impact. Moreover, under HEI context, employees' green behavior engagement levels may be affected by several competing occupational and academic responsibilities such as teaching, research, student mentorship, and administrative responsibilities,

which may increase employees' workload stresses and competing priorities that lessen their capacity and motivation to vigorously participate in green initiatives, even though they feel emotionally connected to environmental goals.

Furthermore, the findings of this research found that green knowledge does not significantly moderate the relationship between GHRM and in-role green behaviors, but significantly moderates the correlation between GHRM and extra-role green behaviors under the Chinese HEI context, which offers significant theoretical and practical understandings regarding the effect of green knowledge in driving employees' green behaviors. From the theoretical perspective, environmental knowledge can be considered as a personal resource within the JD-R framework, augmenting employees' capacity to convert organizational support into proactive behaviors. The absence of a moderation effect from green knowledge on the relationship between GHRM and in-role green behaviors revealed that prescribed sustainable management initiatives and guidelines implemented through GHRM were adequate to motivate employees to embrace HEIs' instructed green behaviors, irrespective of their degree of sustainability knowledge. That is, regulated GHRM policies, including green teaching programs, performance assessments, and reward mechanisms, may successfully institutionalize environmental workplace behaviors as mandatory accountabilities rather than as behaviors contingent on employees' existing environmental knowledge, which is consistent with the conclusion advocated by Nabi et al. (2023). In contrary, extra-role green behaviors need cognitive awareness, personal values, and volitional initiative that are more inclined to be activated among employees having higher levels of environmental knowledge. Thus, environmental knowledge augments the impact of GHRM on extra-role behaviors by allowing employees to better recognize opportunities for proactive green behaviors. This result was also in line with Saeed et al. (2021), who argued that green behaviors can be directly affected by organizations' GHRM policies, as employees may accept green initiatives as an integral part of prescribed job duties, owing to the performance appraisal system and organizational standards. On the other hand, the research finds that green knowledge significantly moderates the relationship between GHRM and extra-role green behaviors, indicating that employees with higher levels of environmental knowledge are more inclined to engage in volitional, proactive green behaviors that go beyond their assigned job duties when supported by GHRM practices. This is because employees with a higher level of green knowledge often hold a stronger intrinsic sense of sustainable accountability that, when facilitated with supportive HRM initiatives, can motivate them to vigorously demonstrate pro-environmental behaviors, which is in accord with what Zhang et al. (2024) advocated in their empirical study claiming that knowledge influences employees' environmental attitudes, thus shapes their green behaviors. This finding is also in line with the findings from early research conducted by Dumont et al. (2017) suggesting that green psychological factors such as knowledge and environmental awareness can considerably augment employees' volitional engagement in green behaviors, which aligns with the argument of Karmoker et al., (2021) claiming that green knowledge significantly moderate the relationship between GHRM and employees' green in-role behaviors in Bangladesh.

The findings also indicate that age and education level do not significantly influence on green behaviors, which suggests that demographic characteristics may not be determining factors of employees' green behaviors within the context of Chinese HEIs, where organizational and contextual factors appear to play a more dominant role. From a theoretical perspective, this finding can be interpreted by the JD-R model where GHRM practices, institutional norms, and formalized policies may act as strong situational factors that guide employees' behaviors across demographic groups. Thus, individual differences such as age and education become less impactful in shaping both green behaviors. Additionally, the absence of significant demographic effects may also indicate that environmental expectations and sustainability practices within HEIs have been broadly shared and consistently communicated, thus reducing the behavior gaps across various employee groups meaning that employees are likely to respond more uniformly to institutional policies regardless of their individual characteristics.

Conclusion

The findings of this study contribute significantly to the prevailing literature by validating the nuanced relationships between GHRM and employees' in-role and extra-role green behaviors, highlighting the mediation impact of GWE and the moderation effect of green knowledge, which hold substantial theoretical and practical implications. Importantly, research findings reveal that GWE does not significantly impact in-role green behavior within the Chinese HEIs context, where formal job responsibilities, institutional regulations, and performance assessment systems generally exert stronger control over employees' work behaviors. This suggests that employees are more inclined to perform in-role green behaviors due to compliance with institutional expectations rather than intrinsic engagement. From a theoretical perspective, this research provides evidence that GHRM has significant direct effects on both in-role and extra-role green behaviors, underscoring the importance of structured GHRM practices in effectively inspiring employees' green workplace behaviors. These findings are congruent with early researches (Dumont et al., 2017) that accentuate the direct role of GHRM in shaping employee behavior. This study also advances the understanding of GHRM's effectiveness in stimulating green behaviors by challenging the assumed mediating role of GWE as a key psychological driver of workplace sustainability behaviors. Particularly, while GWE was found to partially mediate the relationship between GHRM and extra-role green behavior, it did not mediate the relationship with in-role green behavior, which highlights the boundary conditions under which engagement translates into behavioral results. It indicates that employees' engagement with environmental initiatives does not automatically translate into observable green work behaviors when institutional guidelines and performance assessments exert stronger influence. These findings can be further interpreted from various theoretical perspectives. From the viewpoint of SET Theory, the direct effect of GHRM on both types of green behavior indicate that employees reciprocate organizational support through compliance and discretionary behaviors, although the absence of mediation in in-role behavior shows only partial support for SET. Drawing on the JD-R model, GHRM can be considered as organizational resource that enables GWE, yet the limited conversion of GWE into in-role behavior means that job demands and formal role expectations may overpower motivational factors, showing only partial support for JD-R. Similarly, the findings provide partial support for BB Theory, as positive GWE improves extra-role behaviors but does not extend to pre-defined in-role behaviors. In contrary, KAB theory was found strongly support the explanation of extra-role green behaviors, particularly through the moderation role of environmental knowledge. The varying moderation role of green knowledge further contributes to theoretical discourse by distinguishing its effects on in-role and extra-role green behaviors. The insignificant moderation effect of environmental knowledge on the relationship between GHRM and in-role green behavior indicates that such behaviors are largely formalized and regulated within institutional systems, thus less dependent on individual cognitive factors. On the contrary, the significant moderating effect of green knowledge on extra-role green behaviors underscores that GHRM has a more substantial effect on the volitional green behaviors of employees with high environmental knowledge and awareness, thereby validating the application of KAB theory in explaining green knowledge's effect on sustainable behaviors.

From a practical perspective, findings from this research have important implications for HEIs' management seeking to encourage sustainable behaviors and outcomes through HRM practices. These implications are consistent with the empirical distinction between in-role and extra-role green behaviors. Firstly, the importance of structured GHRM initiatives for employees' green behaviors implies that HEIs need to embed environmental policies into HRM frameworks and employees' formal roles and tasks, particularly to enhance in-role green behavior that is primarily driven by formal institutional mechanisms rather than work engagement or knowledge factors. Secondly, provided that GWE only displayed a partial mediation impact on extra-role green behavior and no mediating effect on in-role behavior, it implies that HEIs should not prioritize emotional connection in motivating green work behaviors, instead it should be combined with a structured GHRM initiative to promote green behaviors. Thirdly, the confirmed moderating effect of green knowledge on extra-role instead of in-role green behaviors, emphasizes the necessity to integrate

environmental education into GHRM practices, particularly to inspire employees' proactive and volitional green actions that are in line with institutional green objectives, while understanding that such knowledge has a limited role in shaping mandatory in-role behaviors.

Recommendation

Based on research findings from this study, several recommendations are proposed for Chinese HEIs to improve the efficiency of GHRM practices in boosting green behaviors among employees. Firstly, considering the significant effect of GHRM on in-role green behaviors, Chinese HEIs administrators should prioritize the employment of regulated GHRM practices to institutionalize sustainability as an essential aspect of work culture. This can be achieved through clear guidelines, training workshops, and reward mechanisms that emphasize pro-environmental behaviors among employees. Ensuring that environmental philosophies are implemented in employment, performance appraisal, and occupational development can further reinforce employees' commitment to sustainable goals. Secondly, given the direct impact of GHRM on extra-role green behaviors, Chinese HEIs should emphasize the importance of fostering a work environment in which employees perceive strong institutional support for sustainability. This can be achieved by actively promoting and communicating sustainability commitments, making it a noticeable and fundamental part of institutional identity. Fostering a collaborative green culture on knowledge-sharing platforms and encouraging employees to participate in voluntary green practices through acknowledgement programs, participation in decision-making, and leadership endorsement can further motivate green behaviors. Thirdly, as study findings revealed that GWE does not significantly influence employees' in-role green behavior, but does have a significant positive effect on employees' extra-role green behavior, HEIs should adopt a more differentiated approach when promoting workplace sustainability. Specifically, while engagement initiatives can be effective in encouraging voluntary, extra-role green behaviors, they may not be sufficient to influence behaviors that are formally required as part of employees' job responsibilities. Furthermore, the findings show that GWE partially mediates the relationship between GHRM practices and employees' extra-role green behavior, but does not mediate the relationship with in-role green behavior. This suggests that HEIs should continue strengthening GHRM practices as a direct mechanism to enhance in-role green performance, while simultaneously utilizing engagement strategies to encourage volitional, extra-role environmental actions. In addition, institutions should consider integrating structural and policy-based mechanisms including clearly outlined green job responsibilities, performance evaluation criteria, and organizational support systems, so as to ensure that sustainability is integrated within routine tasks. Addressing potential barriers including workload pressures and conflicting job demands, may also further motivate employees to vigorously participate in both required and discretional green initiatives. Fourthly, as this study highlights, green knowledge exerted a moderating effect on extra-role green behaviors; Chinese HEIs should leverage this impact and instill environmentalism education into the organization's development programs. Providing frequent teaching sessions, seminars, and certifications on environmentalism can equip employees with the essential knowledge and mindfulness to engage in volitional green actions. By nurturing an environment where green knowledge is continually enriched, Chinese HEIs can ensure that their employees are intrinsically motivated to go beyond their assigned duties in advocating for green behaviors. In addition, given that green knowledge did not moderate the relationship between GHRM and in-role green behaviors, Chinese HEIs should consider institutionalizing baseline green guidelines as an integral part of workplace practices. By establishing clear environmental policies, setting transparent green performance metrics into employee evaluation, and relating green practices to job promotion and an acknowledgement system, Chinese HEIs can help ensure that green behaviors are recognized as central job accountabilities rather than voluntary actions. Embedding environmental expectations within HR practices can help HEIs design a structured strategy to augment green behaviors, regardless of employees' pre-existing environmental knowledge.

Limitations and Future research

Apart from the valuable insights this research provided and its contributions to the existing green behavior literature, a few limitations need to be acknowledged. First, the results from this study are based on self- reported data obtained through self-administered survey questionnaires, which are likely biased by socially desirable responses, in which respondents may exaggerate their green attitudes and behaviors. Second, this research is a cross- sectional study that limits its ability to validate causal relationships between employees' green behaviors and the included predictor variables. Third, the sample data utilized in this study were collected from a single city in China, which may limit the generalization of the test results both domestically and globally. Fourth, while this research confirmed the GWE's mediation effect and employees' green knowledge's moderation effect, other antecedent factors, including leadership styles, organization' s green dynamic ability, and cultural factors, may also impact the effectiveness of GHRM in cultivating green behaviors.

Therefore, to overcome the aforesaid limitations, future research could consider combining qualitative methods such as observation, experiments, interviews, or case studies to collect more objective assessments and gain a deeper understanding of green behavior across various contexts. Also, future research could be designed to include more diverse demographic, geographic, and regional sample groups to generalize the research findings to other institutional or cultural contexts. Moreover, future research could employ longitudinal methods to measure variations in employees' green behaviors over extended periods. Furthermore, future studies could investigate additional determinants to develop a more dynamic and robust framework that captures the mechanisms underlying GHRM's influence on green behaviors.

Declaration of generative AI in scientific writing

- Generative AI tools may be used only to improve the readability and language of a manuscript.
- Such tools must be applied with human oversight and control. Authors remain fully responsible for the content.
- AI tools must not be listed as authors or co-authors.
- If AI- assisted technologies were used, a declaration must be included in the manuscript, in a dedicated section before the references.

CRediT author statement

Fei Lu: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Visualization, Project Administration, Supervision.

Reference:

Ababneh, O. M. A. (2021). How do green HRM practices affect employees' green behaviors? The role of employee engagement and personality attributes. *Journal of Environmental Planning and Management*, *64*(7), 1204-1226.

Aboramadan, M. (2022). The effect of green HRM on employee green behaviors in higher education: the mediating mechanism of green work engagement. *International Journal of Organizational Analysis*, *30*(1), 7-23.

Abualigah, A., Koburtay, T., Bourini, I., Badar, K., & Gerged, A. M. (2023). Towards sustainable development in the hospitality sector: Does green human resource management stimulate green creativity? A moderated mediation model. *Business Strategy and the Environment*, *32*(6), 3217-3232.

Adu Sarfo, P., Zhang, J., Nyantakyi, G., Lassey, F. A., Bruce, E., & Amankwah, O. (2024). Influence of Green Human Resource Management on firm's environmental performance: Green Employee Empowerment as a mediating factor. *Plos one*, *19*(4), e0293957.

Ahmad, S., Islam, T., Sadiq, M., & Kaleem, A. (2021). Promoting green behavior through ethical leadership: a model of green human resource management and environmental knowledge. *Leadership & Organization Development Journal*, *42*(4), 531-547.

Albrecht, S. L., Donnelly, T., Frenkiel, M., Rajic, S. K., Kavadas, V., & Leiter, M. P. (2023). Pro-environmental employee engagement: the influence of pro-environmental psychological capital, pro-environmental job resources, and perceived corporate environmental responsibility. *Frontiers in Sustainability*, *4*(1), 1117892.

Altassan, M. A., & Ahmad, A. (2024). Green threads of change: Unravelling the gendered and experienced moderators in the sustainable symphony of green HR practices and environmental responsibility. *International Journal of Innovative Research and Scientific Studies*, *7*(2), 852-862.

Amah, O. E. (2020). Innovative Work Behaviors. *Indian Journal of Industrial Relations*, *56*(2), 356-373.

Ba, Y., & Cao, L. (2023). Assessing the impact of green human resource management practices on environmental performance in China: role of higher education. *Environmental Science and Pollution Research*, *30*(41), 94386-94400.

Bakker, A. B., & Albrecht, S. (2018). Work engagement: Current trends. *Career Development International*, *23*(1), 4-11.

Baykal, E., & Bayraktar, O. (2022). Green human resources management: A novel tool to boost work engagement. *Frontiers in Psychology*, *13(1)*, 951963.

Bissing-Olson, M. J., Iyer, A., Fielding, K. S., & Zacher, H. (2013). Relationships between daily affect and pro-environmental behavior at work: The moderating role of pro-environmental attitude. *Journal of Organizational Behavior*, *34*(2), 156-175.

Blau, P. M. (1964). Justice in social exchange. *Sociological inquiry*, *34*(2). 193-206.

Bui, H. T. M., Bui, T., & Pham, B. T. (2024). The role of higher education in achieving sustainable development goals: An evaluation of motivation and capacity of Vietnamese institutions. *The International Journal of Management Education*, *22*(3), 101088.

CEIC. (2023). *Air quality: PM2.5 concentration: Monthly average: Shenyang.* Retrieved from: https://www.ceicdata.com/en/china/air-quality-pm25-concentration-city/air-quality-pm25-concentration-monthly-average-shanghai.

Chatelain, G., Hille, S. L., Sander, D., Patel, M., Hahnel, U. J. J., & Brosch, T. (2018). Feel good, stay green: Positive affect promotes pro-environmental behaviors and mitigates compensatory “mental bookkeeping” effects. *Journal of environmental psychology*, *56*(1), 3-11.

Chen, L., Luo, F., Zhu, X., Huang, X., & Liu, Y. (2020). Inclusive leadership promotes challenge-oriented organizational citizenship behavior through the mediation of work engagement and moderation of organizational innovative atmosphere. *Frontiers in psychology*, *11(1)*, 560594.

Chen, T., & Wu, Z. (2022). How to facilitate employees’ green behavior? The joint role of green human resource management practice and green transformational leadership. *Frontiers in psychology*, *13*(1), 906869.

Demerouti, E., Bakker, A. B., & Gevers, J. M. (2015). Job crafting and extra-role behavior: The role of work engagement and flourishing. *Journal of Vocational Behavior*, *91*, 87-96.

Dumont, J., Shen, J., & Deng, X. (2017). Effects of green HRM practices on employee workplace green behavior: The role of psychological green climate and employee green values. *Human resource management*, *56*(4), 613-627.

Ercantan, O., & Eyupoglu, S. (2022). How do green human resource management practices encourage employees to engage in green behavior? Perceptions of university students as prospective employees. *Sustainability*, *14*(3), 1718

Fawehinmi, O., Yusliza, M. Y., Ogbeibu, S., Tanveer, M. I., & Chiappetta Jabbour, C. J. (2022). Academic employees’ green behaviour as praxis for bolstering environmental sustainable development: A linear moderated mediation evaluation. *Business Strategy and the Environment*, *31*(7), 3470-3490.

Fawehinmi, O., Yusliza, M. Y., Wan Kasim, W. Z., Mohamad, Z., & Sofian Abdul Halim, M. A. (2020). Exploring the interplay of green human resource management, employee green behavior, and personal moral norms. *Sage Open*, *10*(4), 2158244020982292.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American psychologist*, *56*(3), 218-226.

Freire, C., & Pieta, P. (2022). The impact of green human resource management on organizational

citizenship behaviors: The mediating role of organizational identification and job satisfaction. *Sustainability*, *14*(13), 7557.

Gatersleben, B., Steg, L., & Vlek, C. (2002). Measurement and determinants of environmentally significant consumer behavior. *Environment and behavior*, *34*(3), 335-362.

Gilal, F. G., Ashraf, Z., Gilal, N. G., Gilal, R. G., & Channa, N. A. (2019). Promoting environmental performance through green human resource management practices in higher education institutions: A moderated mediation model. *Corporate Social Responsibility and Environmental Management*, *26*(6), 1579-1590.

Gomes, J. F., Sabino, A., & Antunes, V. (2023). The effect of green human resources management practices on employees' affective commitment and work engagement: The moderating role of employees' biospheric value. *Sustainability*, *15*(3), 2190.

Haque, M. A., Islam, M. A., & Soh, S. (2024). Green HRM practices and green work engagement: The roles of green knowledge sharing and green group cohesion. *Global Business and Organizational Excellence*, *44*(1), 1-16.

Ibe, C. B., & Moroh, O. D. (2024). Green human resources practices and green work engagement of manufacturing firms in South-East Nigeria. *Innovations*, *77*(6), 2052-2074.

Islam, T., Khan, M. M., Ahmed, I., & Mahmood, K. (2021). Promoting in-role and extra-role green behavior through ethical leadership: mediating role of green HRM and moderating role of individual green values. *International Journal of Manpower*, *42*(6), 1102-1123.

Jiang, Y., Jackson, S. E., Shim, H., Budhwar, P., Renwick, D. W., Jabbour, C. J. C., & Kim, A. (2022). Culture as context: A five-country study of discretionary green workplace behavior. *Organization & Environment*, *35*(4), 499-522.

Karmoker, K., Kona, F. A., Oyshi, A. H., & Yasmin, K. S. (2021). Effects of green human resource management on employee green behavior: Moderating role of employee environmental knowledge. *International Journal of Sustainable Development & World Policy*, *10*(2), 64-80.

Kania, D. (2024). Green human resource management and green behavior: Mediating work engagement. *International Journal of Applied Finance and Business Studies*, *12*(1), 19-27.

Kim, T. T., Kim, W. G., Majeed, S., & Haldorai, K. (2023). Does green human resource management lead to a green competitive advantage? A sequential mediation model with three mediators. *International Journal of Hospitality Management*, *111(1)*, 103486.

Lashari, I. A., Li, Q., Maitlo, Q., Bughio, F. A., Jhatial, A. A., & Rashidi Syed, O. (2022). Environmental sustainability through green HRM: Measuring the perception of university managers. *Frontiers in Psychology*, *13*(1), 1007710.

Marini, M., Handoyo, S., & Sukadiono, S. (2023). Green work engagement: A literature review. *RSF Conference Series: Business, Management and Social Sciences*, *3*(3), 179-185.

Maruf, T. I., Manaf, N. H. B. A., Haque, A. K. M. A., & Maulan, S. B. (2021). Factors affecting attitudes towards using ride-sharing apps. *International Journal of Business, Economics and Law*, *25*(2), 60-70.

Miah, M., Szabó-Szentgróti, G., & Walter, V. (2024). A systematic literature review on green human resource management (GHRM): an organizational sustainability perspective. *Cogent Business & Management*, *11*(1), 2371983.

Mou, X. M., Kelana, B. W. B. Y., Jie, C., & Mahmod, A. (2024). Linking GHRM to Environmental Performance through Green Behaviour in Private Chinese Universities. *International Journal of Management Business and Social Sciences*, *14*(12), 4419-4439.

Nabi, T., Joshi, A., Malik, S. H., Siddiqui, M. A., & Yetgin, M. A. (2023). Nexus between green human resource management and environmental practices: An empirical study using structural equation modelling. *Journal of Environmental Accounting and Management*, *9*(1), 1-27.

Ojo, A. O., Tan, C. N. L., & Alias, M. (2022). Linking green HRM practices to environmental performance through pro-environment behaviour in the information technology sector. *Social Responsibility Journal*, *18*(1), 1-18.

Oliveira, M. C., & Proença, J. (2025). Sustainable Campus Operations in Higher Education Institutions: A Systematic Literature Review. *Sustainability*, *17*(2), 607.

Otto, S., & Pensini, P. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global environmental change*, *47*(1), 88-94.

Paço, A., & Lavrador, T. (2017). Environmental knowledge and attitudes and behaviours towards energy consumption. *Journal of environmental management*, *197*, 384-392.

Pham, S. L., Hoang, V. H., Ngo, Q. D., & Pham, H. H. (2024). Unveiling the drivers of green purchase intention in Vietnam: The moderating role of environmental consciousness and perceived consumer effectiveness. *Journal of Ecohumanism*, *3*(7), 1163-1178.

Purnomo, A. K., Asri, Y. N., & Marditama, T. (2024). Implementation of green human resource management towards green employee behavior mediated by top management commitment in higher education. *International Journal of Economics Development Research*, *5*(3), 1474-1485.

Putri, V. W., Sudarma, K., Hasibuan, P. E., Waliuddin, A. N., & Humaira, H. (2023). Green work engagement mechanism in higher education. *AIP Conference Proceedings*, *2765*(1, 020031.

Qingquan, Ren., Shuyin, Li, Chunling, Xiao., Zhang, J., Hong, Lin., & Shuai, Wang. (2020). The impact of air pollution on hospitalization for cardiovascular and cerebrovascular disease in Shenyang, China. *Iranian journal of public health*, *49*(8), 1476.

Saad, Z. A., Fauzi, M. A., Zulkepeli, L., Moshood, T. D., & Hussain, S. (2024). Green human resources in higher education institutions: a systematic literature review. *Journal of Applied Research in Higher Education*, *17*(5), 1572-1593.

Saeed, B. B., Afsar, B., Hafeez, S., Khan, I., Tahir, M., & Afridi, M. A. (2019). Promoting employee's proenvironmental behavior through green human resource management practices. *Corporate Social Responsibility and Environmental Management*, *26*(2), 424-438.

Schaufeli, W.B., Bakker, A.B. and Salanova, M. (2006), "The measurement of work engagement with a short questionnaire: a cross-national study", *Educational and Psychological Measurement*, *66*(4), 701-716.

Shi, H., Shangguan, L., Dong, L., Li, M., & Zhang, Y. (2024). Voluntary vs. Compulsory: examining the consequences of two forms of employee green behaviors. *Current Psychology*, *43*(26), 22297-22306.

Susanto, A. (2023). The role of Green Human Resources Management (GHRM) on job satisfaction and Green Work Engagement (GWE): An empirical study on manufacturing industries. *Journal of Economics, Finance and Management Studies*, *6*(03). 1123-1131.

Tang, G., Ren, S., Wang, M., Li, Y., & Zhang, S. (2023). Employee green behaviour: A review and recommendations for future research. *International Journal of Management Reviews*, *25*(2), 297-317.

The Education Department of Liaoning Province. (2024). *Liaoning Provincial Department of Education's 2024 ecological and environmental protection education work plan.* Retrieved from https://jyt.ln.gov.cn/jyt/gk/zxtz/20240126174353 57254/index.shtml.

Tirno, R. R., Islam, N., & Happy, K. (2023). Green HRM and ecofriendly behavior of employees: Relevance of proecological climate and environmental knowledge. *Heliyon*, *9*(4), e14632.

Veerasamy, U., Joseph, M. S., & Parayitam, S. (2024). Green human resource management and employee green behaviour: Participation and involvement, and training and development as moderators. *South Asian Journal of Human Resources Management*, *11*(2), 277-309.

Wang, Y., Ummar, R., Qureshi, T. M., Ul Haq, J., & Bonn, M. A. (2025). Employee sustainability: How green practices drive employee well-being and citizenship behavior. *Sustainability*, *17*(3), 936.

Wong, J. Y., & Yeh, C. (2009). Tourist hesitation in destination decision making. *Annals of Tourism Research*, *36*(1), 6-23.

Wu, C., Xu, W., Lu, H., & Zheng, J. (2024). Crossing Spatial Boundaries: A Study on the Impact of Green Human Resource Management on Employees' Household Pro-Environmental Behaviors. *Sustainability*, *16*(21), 9330.

Yadate, D. A. (2025). The effect of green human resource management on employee green behavior. *Corporate Social Responsibility and Environmental Management*, *32*(1), 404-418.

Yamane, T. (1973). Statistics: An introductory analysis (3rd eds.). New York, NY: Harper & Row.

Yang, C., Chen, C. S., & Wei, L. W. (2024). The influence of green human resource management on environmental performance: Exploring the differential effects of green work engagement and moral reflection. *Environment and Social Psychology*, *9*(10), 1-22.

Yong, J. Y., Yusliza, M. Y., & Fawehinmi, O. O. (2020). Green human resource management: A systematic literature review from 2007 to 2019. *Benchmarking: An International Journal*, *27*(7), 2005-2027.

Yusop, H. M., Adam, A. A., Rahim, A. R. A., Munusami, C., & Hussin, S. A. (2023). Green human resource management and employee pro-environmental behavior: environmental knowledge best mediate or moderate the relationship. *Malaysian Journal of Consumer and Family Economics*, *31*(1), 757-787.

Zareie, B., & Navimipour, N. J. (2016). The impact of electronic environmental knowledge on the environmental behaviors of people. *Computers in Human Behavior*, *59*(1), 1-8.

Zhang, G., Wang, L., & Meng, H. (2024). Environmental knowledge level and consumer behavior regarding green fashion: A moderated mediation model. *Asia Pacific Journal of Marketing and Logistics*, *36*(4), 977-992.

Zhang, S., Chen, M., & Tang, G. (2024). How green human resource management can promote green competitive advantage: The role of green innovation. *Business Strategy and the Environment*, *33*(5), 4613-4625.

ZZKLDZ. (2025). *What is the trend in the number of college graduates from 2025 to 2040?* Retrieved from https://www.zzkldz.com/3724.html

Appendix 1 Factor Loadings of Measurement Items

	Factor loading			
	GHRM	**GWE**	**Extra-role**	**In-role**
GHRM_1	0.716			
GHRM_2	0.749			
GHRM_4	0.774			
GHRM_5	0.803			
GHRM_6	0.822			
GWE_1		0.721		
GWE_2		0.737		
GWE_3		0.810		
GWE_4		0.711		
GWE_5		0.713		
GWE_6		0.590		
Extra-role Green Behaviors _1			0.777	
Extra-role Green Behaviors _2			0.817	
Extra-role Green Behaviors _3			0.831	
In-role Green Behaviors _1				0.846
In-role Green Behaviors _2				0.901
In-role Green Behaviors _3				0.914