

Green Human Capital and Firms' Sustainable Performance: A Moderated Mediation Model of Green Transformational Leadership and Green Competitive Advantage

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Article History

Received 2025-06-26

Reviewed 2025-08-31

Accepted 2025-09-05

Published 2025-09-06

Keywords

Green human capital

Green competitive

advantage

Green transformational
leadership

Sustainable performance

Garment firms

ICV theory

Abstract

Purpose: This study aims to investigate the impact of green human capital (GHC) on firms' sustainable performance (SP) with a particular focus on the mediating role of green competitive advantage (GCA) and moderating effect of green transformational leadership (green TFL) in the context of garment firms in Bangladesh.

Methodology: Researchers collected data from 271 respondents using the questionnaire survey method. The partial least squares structural equation modeling approach was applied to analyze the data.

Findings: The research findings revealed a significant positive correlation between GHC and firms' SP. It also identified GHC as an essential antecedent of GCA. It was also revealed that GCA has a mediating role in the relationship between GHC and firms' SP. Finally, while green TFL moderates the direct relationship between GHC and SP, the indirect relationship between GHC and SP through GCA is not moderated by it.

Originality: This study contributes to the GHC literature in emerging markets by integrating theoretical perspectives with empirical evidence, offering nuanced insights into how GHC influences SP.

Practical Implications: This study provides valuable insights for policymakers and stakeholders, highlighting the importance of developing and utilizing GHC in business operations to enhance SP by implementing green TFL style in the organization and achieving GCA in the market.

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Introduction

In today's competitive business world, organizations encounter multifaceted complexities related to social, economic, and environmental challenges (Sulich & Soloducho-Pelc, 2024). Hence, achieving sustainable performance (SP), which integrates the economic, social, and environmental aspects of organizations' performance, has been considered a crucial issue for organizations in the current competitive business market (Danish et al., 2024). Organizations are critically concentrated on adopting the integrated management approach that will ensure firms' SP by satisfying all the environmental challenges (Opoku & Li, 2025). Firms' green practices, like developing green human resources within the organization, have substantial potential to foster firms' SP (Danish et al., 2024). Bangladesh is one of the largest garment-products producing countries in the world (Toki et al., 2023). It has secured the second-best position in terms of exports by maintaining a 7.9% growth rate worldwide (WTO, 2023). Additionally, the garment industry makes significant contributions to foreign exchange earnings and women's empowerment (Islam & Halim, 2022). This industry contributes 81.82% to the total export earnings, 36% to the total employment generation (resulting in 4.1 million jobs), and 9.25% to the total GDP of Bangladesh (Bangladesh Bank, 2023; Mamun & Hoque, 2022).

Although this industry contributes to the nation in numerous ways, it is not immune to criticism. During the production lifecycle, garment firms generate a bulk amount of waste and emit carbon dioxide, which severely influences the air and water (Hoque et al., 2023). This industry produces carbon emissions by 10%, creates wastewater by 20%, and solid waste by 4% worldwide, respectively (Habib et al., 2022; WB, 2019). As a whole, this industry has a tremendous negative impact on the environment and society (Dobos & Éltető, 2023). That is why all stakeholders are deeply concerned about the inclusion of social and environmental issues in business strategic decisions (Kabir et al., 2022). Besides, scholars recommended implementing the sustainability principles in organizations' regular business activities to accelerate firms' SP, which can mitigate environmental degradation (Almeida & Wasim, 2023).

Organizations' green practices, such as developing green human capital (GHC) in the organization, can accelerate their SP (Zuñiga-Collazos et al., 2025). Hence, the creation of GHC is deemed a critical antecedent of firms' SP (Hina et al., 2024). GHC represents the knowledge, wisdom, abilities, skills, creative activities, experience, attitude, and commitments of employees related to environmental protection, which can have a critical role in achieving firms' SP (Chen, 2008). Moreover, researchers acknowledged GHC as one of the key determinants that accelerate firms' environmental performance (Wei et al., 2023). Therefore, GHC, which fosters employees' environmental competency and commitment to environmental-related activities, contributes immensely to a firm's environmental outcomes and enhances SP (Saglam, 2023). Green competitive advantage (GCA) also plays a critical role in achieving the long-term success of firms (Baquero, 2024). GCA refers to a situation in which organizations hold unique positions regarding green practices that their competitors cannot copy or imitate (Chen, 2011). It serves as a crucial determinant of ensuring firms' ecological performance (Alhemimah et al., 2025). Furthermore, green transformational leadership (green TFL) was treated as a critical determinant of firms' SP by various researchers (Huynh et al., 2024). Green TFL is a leadership style in which a leader inspires and motivates followers to work together to achieve the organization's environmental goals (Chen & Chang, 2013b). The focal point of the current study is the potential mechanism between GCA and GHC in shaping a firm's SP. This study also focuses on the extent of impact of green TFL on the direct and indirect relationship between GHC and firms' SP, which is deemed a crucial ground for academic inquiry (Islam et al., 2024).

However, based on the literature, it was highly relevant to analyze the relationships between GHC, GCA, and firms' SP as well as the influence of green TFL in this relationship, both directly and indirectly, in the context of Bangladesh's garment industry. While numerous scholars conducted empirical studies concerning GHC,

GCA, green TFL, and SP in various organizations in various industries, and identified conflicting outcomes (Al-Halbusi et al., 2025; Din et al., 2024; Liu et al., 2025; Shahzad et al., 2025), there still exists a specific knowledge gap regarding how these green practices are related to and jointly contribute to garment firms' SP in Bangladesh. In particular, how garment firms enhance their SP by acquiring GCA and implementing green TFL practices in the organization is a vital issue of the modern competitive business world that needs to be investigated in depth (Islam et al., 2024). Therefore, the essence of the current study lies in the fact that it suggests new information that bridges the literature gap. The empirical findings of this study also help firms, especially the garment firms, overcome the challenges of ensuring SP in business activities. In this perspective, the current study aims to address the following research questions:

Q1. Is there any significant relationship between GHC and firms' SP?

Q2. To what extent does GCA mediate the relationship between GHC and firms' SP?

Q3. Does green TFL moderate the relationship between GHC and firms' SP directly, and the relationship between GHC and firms' SP via GCA indirectly?

This study has several contributions to the body of knowledge. First, although the relationship between GHC and firms' SP has been investigated in previous studies, the role of GCA and green TFL in this relationship has not been explored. For this reason, this study fills the gap in the literature by differentiating itself from other research and making a significant contribution to the existing body of knowledge. Second, this research offers a new perspective on the literature regarding the role of GCA in the relationship between GHC and firms' SP. This study also contributes to the literature by explaining whether green TFL moderates the relationship between GHC and SP directly and indirectly via GCA. Therefore, it was predicted that this study would differentiate itself from the perspective of the moderation-mediation mechanism of green TFL and GCA in the relationship between GHC and firms' SP.

The novelty of this study lies in the integrated framework that investigates the impact of GHC on firms' SP, as well as the moderation-mediation mechanism through green TFL and GCA in this relationship. Moreover, the current study represents an innovative approach that helps firms create eco-friendly organizational frameworks. This study recommends how firms ensure their environmental performance by adopting and implementing green policies and guidelines in their business strategies. Finally, this study may help the government and policymakers understand the fundamental underlying concept of firms' SP from both theoretical and methodological perspectives.

The remaining sections review the literature on the link between GHC, GCA, green TFL, and SP, discuss the underpinning theory, formulate the hypotheses, and outline the conceptual framework of this study. These sections also present the current study's methodology that demonstrates the research findings obtained by employing the partial least squares structural equation modeling (PLS-SEM) technique. Further sections present the results of mediation and moderation analysis, a discussion of the results, and outline the theoretical and practical implications of this study. The integration of the study findings with the United Nations' Sustainable Development Goals (SDGs) has also been outlined. Finally, the study presents its conclusions and outlines future research directions.

Literature Review

Green Human Capital

In today's world, organizations are increasingly focusing on incorporating the green perspectives of their employees (Yusoff et al., 2019). The current study focused on one of the most critical components of green

intellectual capital: green human capital. GHC refers to the skills, competencies, and knowledge of employees within an organization that focus on environmental sustainability (Shahzad et al., 2025). In other words, it represents the talent and expertise of employees that are essential to addressing environmental challenges and implementing green practices in business operations (Thanh & Cong, 2024). GHC is a unique and critical resource that enables firms to produce their products in an environmentally friendly way (Shahbaz & Malik, 2025). Employees with green expertise strengthen firms' ability to meet environmental challenges, introduce innovative ways out, and enhance SP (Khusnah & Soewarno, 2024). Furthermore, firms equipped with expertise, competent, and knowledgeable human resources regarding green practices and their impact on the environment and society can effectively address environmental issues and create a competitive differentiation in the market (Zalfa & Novita, 2021).

Green competitive advantage

Green competitive advantage (GCA) refers to the degree to which a firm gains strategic advantages over competitors through green practices that reduce operational costs, uphold image and market share, maintain proactive regulatory compliance, and produce inimitable products (Alhemimah et al., 2025). Achieving GCA is a crucial objective for business organizations, as it ensures environmental responsibility by responding to the global demand for sustainability (Malik et al., 2023). However, it remains underexplored in the context of emerging markets, such as garment firms in Bangladesh, on how firms can systematically develop and sustain GCA, which may be a precondition for enhancing firms' SP.

Green transformational leadership

Before understanding the concept of green TFL, it is imperative to understand the concept of transformational leadership (TFL). According to Avolio et al. (1999), TFL refers to a leadership style in which a leader can visualize prospective changes and inspire, motivate, and guide their followers to achieve the organization's vision. Intellectual stimulation, individualized consideration, charisma, and inspirational motivation are the four main dimensions of TFL (Bass, 1985). Considering these four dimensions of TFL, Chen and Chang (2013b) proposed a novel concept of leadership style, referred to as green TFL. They define this leadership style as the behaviors of leaders that inspire their followers to accomplish the firm's environmental goals and motivate them to perform above par in the firm's environmental performance. Green TFL impacts many aspects of a firm positively. Huynh et al. (2024) explored the positive impact of green TFL on achieving firms' SP. In addition, a study by Suparna et al. (2021) revealed that green TFL plays a crucial role in achieving better competitive positions in the market.

Sustainable performance

The Brundtland Report has played a crucial role in advancing the global objective of environmental sustainability since 1987 (Badwy et al., 2025). The most common definition of sustainability aligns development with present needs while safeguarding the needs of future generations (WCED, 1987). In recent years, developing and developed countries have recognized the essence of ensuring SP in business operations to meet the environmental challenges (Oduro, 2024). In terms of business context, SP refers to achieving a firm's economic, social, and environmental performance (Niranjan et al., 2025). Economic performance relates to optimizing a firm's financial and economic conditions. Social performance is managing and maintaining a firm's reputation, image, and customer relationships (Liu et al., 2023). Environmental performance relates to the ability of a firm to produce its products in an environmentally friendly way that reduces the negative impacts of its business activities on the environment (Rehman, 2024).

Underpinning theory

The intellectual capital-based view (ICV) was first introduced by Reed et al. (2006). This theory focuses solely on firms' intangible assets, which are created by and stored in an organization's human capital, social capital, and organizational capital. These intangible assets enable organizations to outperform their rivals in the same industry by securing a more competitive position in the market, as well as enhancing firms' long-term performance. Based on this theory, a firm's human capital plays a crucial role in enhancing the value of its assets and performance (Yusliza et al., 2020). Bamel et al. (2022) posited that the ICV theory elucidates how specific aspects of firms' intangible assets, such as human capital, contribute to achieving superior market positions and long-term success. This theory examines the dynamics of firms' intangible assets and their interrelationships with firms' performance, enabling them to gain a better competitive edge (Ali et al., 2022). Based on the concept of the ICV theory, this study aims to explore the relationships that explain how a firm's GHC affects its SP by enabling better competitive positions, as well as the influence of green TFL in the relationship between GHC and firms' SP, and in this relationship via GCA.

Hypotheses formulation

Relationship between GHC and firms' SP

GHC is one of the critical components of green intellectual capital (Kumar et al., 2025). It is essential for ensuring firms' SP (economic, social, and environmental) (Hina et al., 2024). Numerous researchers in the literature acknowledged the importance of GHC in fostering firms' SP (Al-Issa et al., 2022; Obeidat et al., 2023). The creation of green human and their effective participation in business activities can improve the triple bottom line, e.g., economic, social, and environmental performance (Renaldo & Augustine, 2022). Literature exposed a large number of empirical studies on the relationship between GHC and SP, finding no harmonious relationship between them (Boso et al., 2022; Obeidat et al., 2023; Shehzad et al., 2023). While some researchers found a positive relationship (Adubor et al., 2022; Turi et al., 2023), others found a negative one (Bombiak, 2022). Chen and Chang (2013a), the pioneers of the concept of GHC, found a positive association between GHC and sustainability. The inconsistent findings and lack of research, especially in the garment industry, made it further necessary to conduct further studies to obtain comprehensive and authentic results on this relationship. Therefore, based on the inconsistent results of previous studies and the concept of ICV theory, researchers formulated the following hypothesis.

H1: There is a significant relationship between GHC and firms' SP.

Relationship between GHC and GCA

GHC addresses ecological challenges effectively by accumulating knowledge, experiences, and competencies (Dang & Wang, 2022). It is the knowledge, ability, competencies, and creativity related to the environment accumulated in human within an organization. GHC is crucial for the manufacturing industry in overcoming environmental challenges and improving firms' environmental performance, which is also the basis for achieving GCA (Xin & Wang, 2023). It ensures the utilization of employees' green knowledge and competencies in green innovation and green business practices, which help firms protect the environment by meeting environmental standards. Therefore, GHC serves as the foundation for achieving a better competitive position in the market (Mustafa et al., 2023). Numerous researchers explored a positive correlation between GHC and firms' green competitiveness (Abdelfattah et al., 2024). A firm can enhance its competitive position in the market by developing green human resources in the organization (Shahbaz & Malik, 2025). Thus, based on the above discussion and supported by the concept of ICV theory, researchers posited the following hypothesis.

H2: There is a significant relationship between GHC and GCA.

Relationship between GCA and firms' SP

Significant competencies within a firm's human resources, which are not easily imitable, contribute to its competitiveness (Nu'man et al., 2020). GCA enables firms to gain sustainable benefits (Xin & Wang, 2023). A firm can achieve GCA in terms of low-cost environmental innovation or management, the capability of innovating and managing environmentally friendly products, and advancing research and development compared to its competitors (Alhemimah et al., 2025). Researchers acknowledge that incorporating green practices in business activities helps firms present themselves as environmentally sustainable in the market (Habtemaryam et al., 2025). A firm can enhance its SP by attaining a superior competitive market position with regard to a low-cost strategy, research & development, green image, and green raw materials (Mustafa et al., 2023). Numerous empirical studies in the literature revealed a positive association between GCA and firms' SP (Anwar et al., 2018). Additionally, Dang and Wang (2022) argued that firms can foster their long-term performance by enhancing their competitiveness. However, the number of studies on this relationship is minimal. Furthermore, no research has been conducted in the context of garment firms in Bangladesh. Therefore, the current researchers proposed the following hypothesis.

H3: There is a significant relationship between GCA and firms' SP.

Mediating role of GCA in the relationship between GHC and firms' SP

According to the ICV theory, a firm can enhance its superior competitive position in the market by having eco-knowledgeable employees who are concerned about the impact of the organization's activities on the environment (Bhatti & Mirza, 2023). Human capital, which is the stock of employees' knowledge, skills, and abilities, is a critical value creator as well as a valuable asset in achieving competitive advantage over competitors (Abdelfattah et al., 2024). Again, employees' knowledge, skills, and abilities committed to environmental management can play a crucial role in creating an environment for creativity and risk tolerance in green management, which can help firms attain' GCA (Agyabeng-Mensah & Tang, 2021). Employees who are competent and committed to environmental protection, and treated as core inimitable assets, are essential to gain competitive market positions (Chang & Chen, 2014). GHC is critical for designing and producing distinguished products in the market, which leads to firms' SP (Xin & Wang, 2023). Thus, the researchers of this study assumed that GHC has a significant impact on advancing firms' green competitiveness and SP. Therefore, based on the past research findings and the concept of the ICV theory, researchers postulated the following hypothesis.

H4: There is a significant mediating effect of GCA in the relationship between GHC and firms' SP.

Green transformational leadership as a moderator

Green TFL is a dynamic leadership approach that inspires an organization's employees to create an eco-conscious culture within the organization, where they will be directed towards the achievement of the organization's environmental goals (Fauziah et al., 2025). Numerous researchers opined that transformational leadership is essential for an organization to shape and influence the behavior of its employees, which plays a pivotal role in fostering firms' positive outcomes (Shweta & Panicker, 2025; Tran et al., 2025). Transformational leaders possess some unique capabilities that determine an inspiring vision and motivate the followers to act proactively to attain personal as well as organizational goals (Lofflad-Burkin et al., 2025). By integrating the environmental issues into transformational leadership, Chen and Chang (2013b) introduced the novel idea of green TFL, which is a dynamic leadership behavior that inspires and empowers followers to exceed expectations for achieving organizational goals and environmental sustainability. Empirical studies by Huynh et al. (2024) and Shiferaw et al. (2025) identified green TFL as one of the critical antecedents of ensuring firms' SP. The ICV theory provides a theoretical foundation to understand the interactive effects of GHC and green TFL

behavior on firms' SP. Thus, the researchers of the current study argued that the interactive effects of GHC and green TFL may strengthen the association of GHC and firms' SP. Therefore, researchers posited the following hypothesis:

H5: Green TFL moderates the relationship between GHC and firms' SP, such that the relationship will be strengthened when green TFL is high.

Moderated mediation

Green TFL encourages and motivates employees to achieve the vision of corporate improved performance by creating and innovating new products (Xin & Wang, 2023). Green TFL, proposed by Chen and Chang (2013), is a leadership behavior that inspires, motivates, and drives employees toward achieving the firm's environmental goals. According to Xin and Wang (2023), a high level of green TFL pays special attention to the ecological demands of stakeholders and complies with the environmental principles, which helps firms create a good corporate image. Sharma et al. (2025) and Abourokbah et al. (2024) also explained how green TFL plays a critical role in developing and cultivating employee green creativity in organizations. In addition, firms' green image, green creativity, green innovations, and inimitable products are essential for creating and sustaining their superior green competitive positions in the market (Achmad & Wiratmadja, 2025; Huang & Liu, 2025; Zameer et al., 2020). Thus, green TFL is considered a crucial antecedent of firms' GCA. The literature revealed a positive association between green TFL and GCA. Suparna et al. (2021) conducted an empirical study on 300 respondents working in SMEs in Indonesia and explored a positive link between green TFL and firms' GCA through the creation of green innovation values. Demir et al. (2025) also revealed the same association between green TFL and GCA by conducting another empirical study among 412 respondents working in SMEs in Istanbul. Likewise, other researchers examined the association mentioned above through their research and revealed a positive link between green TFL and firms' green capability, which ultimately contributes significantly to the achievement of organizations' SP (Bhatti & Mirza, 2023; Ozgul & Zehir, 2023). Based on previous studies, the current study's researchers suggested an integrated moderated-mediation relationship where green TFL may increase the indirect relationship between GHC and firms' SP through GCA. This integrated relationship is supported by the ICV theory that describes the mechanism by which firms' GHC can achieve its SP via achieving GCA. Thus, researchers proposed that a high level of green TFL will strengthen the indirect relationship between GHC and firms' SP through GCA. Accordingly, the following hypothesis was proposed:

H6: Green TFL moderates the indirect relationship between GHC and firms' SP through GCA, such that the indirect relationship will be stronger when green TFL is high.

Conceptual framework

Based on the literature and the concept of ICV theory, this study proposed the conceptual framework shown in Figure 1.

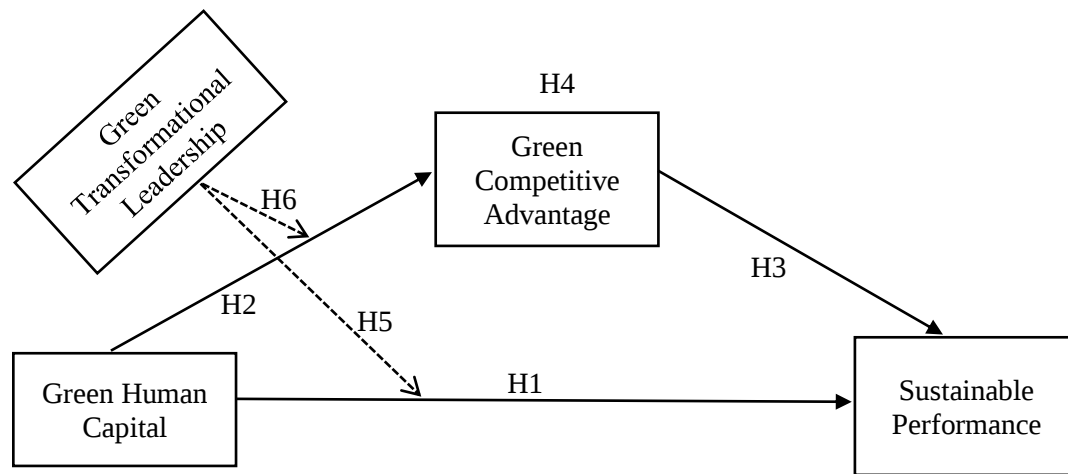


Figure 1: Conceptual framework

Source: Developed by authors

Methodology

Context and sample

The context of this research was Bangladesh's garment industry, which holds comparative significance in contributing to the national economy, generating employment, and promoting women's empowerment. The geographical scope of this study is limited to Dhaka city only. The total sample size was 271 employees, including plant managers, HR and compliance managers, and production managers.

Data collection approach

Following a simple random sampling technique, researchers collected data by employing a 34-item self-administered questionnaire. Using the Google Forms tool, researchers created a survey link and sent it to 500 respondents, stating the purpose of the survey and the confidentiality of their responses. Respondents were reminded of the survey's purpose at the midpoint and end of each month during the data collection phase. After a thorough follow-up, only 87 valid responses were obtained, as most respondents reported being too busy with their office work and were reluctant to share the information due to concerns about job security. After receiving insufficient responses, researchers conducted a face-to-face survey among 300 respondents and obtained another 184 usable responses. Thus, researchers ultimately received 271 responses, which represents a 33.8% response rate. Data were collected from December 2024 to March 2025. However, before conducting the final survey, a pilot test was conducted among 30 respondents who had sufficient understanding of green practices and their effects on firms' SP, to test the validity and reliability of the questionnaire. Following feedback from respondents in the pilot assessment phase, the necessary modifications to the questionnaire were made and sent to them for the final survey.

Measures development

The constructs of this study were measured through an extensive literature review to ensure the reliability and validity of the study variables. Respondents were requested to rate their level of agreement or disagreement with the observed items on a 5-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (5).

The questionnaire's pattern was closed-ended, allowing respondents to select the best option from the alternatives.

Construct and items

The construct, GHC, was measured using eight items related to employees' knowledge, competence, and expertise regarding environmental practices essential for producing green products and innovations that mitigate ecological pollution and address global sustainability challenges. All items were adapted from Chen (2008) and Zaragoza-Sáez et al. (2023). GCA was assessed using ten items adapted from Chen and Chang (2013a). These items are related to firms' low-cost strategy, green image, research and development, product inimitability, fast mover advantage, profitability, and growth rate. These items focus on how firms can achieve a superior competitive position in the competitive business market by implementing the strategic decisions discussed above. Green TFL was assessed using a six-item scale adapted from Chen and Chang (2013b). These items are related to leaders' capability to anticipate probable future changes and motivate and inspire followers to work together to achieve the organization's environmental goals. Finally, SP was measured using a scale adapted from Paulraj (2011) and Zhu and Sarkis (2004), with ten items related to a firm's ability to mitigate hazardous materials, reduce pollution, recycle natural resources, meet environmental standards in business operations, meet stakeholders' expectations, ensure employees' health and safety at the workplace, and reduce environmental risk for the general people, gain long-term profit, and reduce waste treatment charges and ecological accidents.

Data analysis and results

Demographic profile

The current study utilized two software programs, SPSS and SmartPLS, to analyze the data. The SPSS software helps analyze descriptive statistics, including respondents' profiles, means, medians, and standard deviations. Table 1 summarizes the demographic statistics of the respondents in the current study. Regarding gender distribution, 96.7% (262 respondents) of the respondents were male, and 3.3% (9 respondents) were female. These apparent gender discrepancies are primarily due to the fact that males occupy the majority of managerial-level positions in garment firms in Bangladesh.

Table 1: Demographic profile of respondents

Item	Type	Frequency	Percentage (%)
Gender	Male	262	96.7
	Female	9	3.30
Education level	SSC	3	1.10
	HSC	2	0.70
	Bachelor Degree	68	25.1
	Master Degree	193	71.2
	PhD	5	1.80
Marital status	Single	27	10.0
	Married	244	90.0
Position of respondents	Plant Manager	159	58.7
	HR & Compliance Manager	93	34.3
	Production Manager	19	7.0

Source: Developed by authors

In terms of educational background, the majority of respondents (193) hold a master's degree, while a few have a bachelor's degree, a PhD, or a secondary level education. Among 271 respondents, 244 were married and 27

were unmarried. Table 1 also shows that most respondents were plant managers (58.7%), followed by HR & Compliance Managers (34.3%) and Production Managers (7%). Additionally, based on service duration, employees had a minimum of 5 years and a maximum of 35 years of service experience, while their ages ranged from 21 to 67 years.

Common method bias

In the PLS-SEM approach, evaluating the common method bias (CMB) is essential to look for the multicollinearity problems, which can influence the research findings (Fauziah et al., 2025). In this study, researchers employed several statistical and procedural techniques to reduce the effect of the common method bias (CMB) (Podsakoff et al., 2003). For example, researchers structured the questionnaire's items clearly and in straightforward language, stating the aims of the study and confirming the confidentiality of the respondents' responses. The "full collinearity assessment" and "Harman's single factor test" were also conducted to assess the CMB. The collinearity (VIF) values were below the threshold value of 5 (Hair et al., 2019), confirming that the measurement instrument of this study was free from CMB. Furthermore, the results of "Harman's single-factor test" indicated that the first factor explained 44% of the total variance, which is below the threshold value of 50% (Hair et al., 2019). These results provide clear evidence of the non-existence of the CMB, further ensuring the validity of the study.

Table 2: Results of the measurement model

Construct	Items	Factor loadings	Cronbach's alpha	Composite reliability	AVE
<i>Green Human Capital</i>	<i>GHC1</i>	0.805	0.885	0.909	0.555
	<i>GHC2</i>	0.804			
	<i>GHC3</i>	0.709			
	<i>GHC4</i>	0.713			
	<i>GHC5</i>	0.738			
	<i>GHC6</i>	0.756			
	<i>GHC7</i>	0.715			
	<i>GHC8</i>	0.709			
<i>Green Competitive Advantage</i>	<i>GCA1</i>	0.786	0.910	0.927	0.612
	<i>GCA2</i>	0.795			
	<i>GCA3</i>	0.813			
	<i>GCA4</i>	0.811			
	<i>GCA5</i>	0.788			
	<i>GCA6</i>	0.732			
	<i>GCA7</i>	0.773			
	<i>GCA9</i>	0.757			
<i>Green Transformational Leadership</i>	<i>GTL1</i>	0.875	0.796	0.880	0.711
	<i>GTL3</i>	0.840			
	<i>GTL5</i>	0.813			
<i>Sustainable Performance</i>	<i>SP1</i>	0.810	0.918	0.933	0.635
	<i>SP2</i>	0.800			
	<i>SP3</i>	0.785			
	<i>SP4</i>	0.803			
	<i>SP5</i>	0.793			
	<i>SP6</i>	0.822			
	<i>SP7</i>	0.780			
	<i>SP8</i>	0.781			

Source: Developed by authors

PLS-SEM analysis

Using SmartPLS software, researchers analyzed the proposed model of the current study, applying the PLS-SEM approach, which involves a two-step analysis process: assessment of the measurement model and assessment of the structural model.

Step 1 - Assessment of the Measurement Model

It is imperative to test the reliability and validity of the measurement scale to justify the ability of measurement techniques to provide consistent and stable findings (Taherdoost, 2016). Researchers in this study employed various statistical techniques, including composite reliability, Cronbach's alpha, convergent validity, and discriminant validity, to assess the reliability and validity of the measurement model, as recommended by Hair et al. (2022). Evaluating the factor loadings is the first step of the measurement model. Each item's values of 0.708 or above indicate that the construct has an acceptable level of reliability (Hair et al., 2022). Statistical analysis of this study revealed that five items contained values less than 0.708. Therefore, after excluding these five items, the remaining 29 items were considered for the final data analysis.

In the next step of the measurement model, it is essential to evaluate Cronbach's alpha and composite reliability, with a threshold value of 0.70 (Hair et al., 2022). Table 2 presents the Cronbach's alpha values of the constructs, which ranged from 0.796 to 0.918, and composite reliability values from 0.880 to 0.933 in the current study, meeting the recommended values. Furthermore, the average variance extracted (AVE) values ranged from 0.555 to 0.711. It was revealed that AVE values exceeded the recommended threshold of 0.50 as proposed by Hair et al. (2022). Thus, this study met the requirements for convergent validity.

Moreover, the discriminant validity of constructs can be measured by utilizing the “Fornell-Larcker criterion,” “heterotrait-monotrait ratio” (HTMT), and “cross-loading criterion” (Hair et al., 2022). The square root of AVE values represents the value of Fornell-Larcker criterion, and the values should be higher than the correlation coefficient between the variables. The bold italicized diagonal values in Table 3 indicate a high discriminant validity of the constructs in this study.

Table 3: Fornell-Larcker criteria

Construct	GCA	GHC	GTL	SP
GCA	0.782			
GHC	0.619	0.745		
GTL	0.684	0.517	0.843	
SP	0.778	0.701	0.705	0.797

Source: Developed by authors

Again, a study model is valid if the HTMT values do not exceed 0.90 (Henseler et al., 2015). Table 4 presents the HTMT values from the current study, which demonstrate values below the recommended threshold. Hence, the discriminant validity criteria were confirmed in this study.

Table 4: Heterotrait-monotrait ratio (HTMT)

Construct	GCA	GHC	GTL	SP
GCA				
GHC	0.682			
GTL	0.780	0.602		
SP	0.846	0.768	0.813	

Source: Developed by authors

Finally, it is essential to assess the cross-loadings of all unobservable constructs to ensure the discriminant validity, where the values of one construct should be higher than those of its other respective constructs. Table 5 demonstrates that the cross-loading values of a construct were higher than those of its other constructs. Thus, this study satisfied the discriminant validity criteria.

However, before excluding the items containing values of factor loadings less than 0.708, the AVE value of green TFL was 0.464, which is less than the threshold value. In addition, in the HTMT calculation, two values exceeded the recommended value (0.90). Thus, if the items containing factor loadings less than 0.708 were not excluded before final data analysis, then the content validity of the constructs might be questionable.

Table 5: Cross-loadings

Item	GCA	GHC	GTL	SP
GCA1	0.786	0.497	0.372	0.560
GCA2	0.795	0.462	0.714	0.634
GCA3	0.813	0.457	0.379	0.533
GCA4	0.811	0.501	0.654	0.634
GCA5	0.788	0.494	0.396	0.626
GCA6	0.732	0.475	0.703	0.617
GCA7	0.773	0.470	0.467	0.569
GCA9	0.757	0.513	0.481	0.663
GHC1	0.473	0.805	0.245	0.555
GHC2	0.447	0.804	0.528	0.600
GHC3	0.351	0.709	0.170	0.393
GHC4	0.395	0.713	0.376	0.412
GHC5	0.479	0.738	0.246	0.499
GHC6	0.476	0.756	0.546	0.588
GHC7	0.526	0.715	0.321	0.539
GHC8	0.504	0.709	0.577	0.529
GTL1	0.652	0.433	0.875	0.563
GTL3	0.587	0.395	0.840	0.564
GTL5	0.487	0.480	0.813	0.659
SP1	0.668	0.576	0.407	0.810
SP2	0.603	0.559	0.770	0.800
SP3	0.641	0.580	0.398	0.785
SP4	0.585	0.535	0.692	0.803
SP5	0.665	0.585	0.432	0.793
SP6	0.670	0.535	0.699	0.822
SP7	0.610	0.615	0.376	0.780
SP8	0.520	0.490	0.651	0.781

Source: Developed by authors

Step 2 - Assessment of the Structural Model

The structural model begins by assessing the variance inflation factor (VIF), where a VIF value below 5 is considered a threshold value (Hair et al., 2022). Table 6 shows that all VIF values met the threshold level, meeting the collinearity issues of the current study's proposed model. Afterward, the hypothesized relationships were measured, and Table 6 shows that all formulated relationships were significant and positive in direction. Therefore, all the direct hypotheses, *H1* (relationship between GHC and firms' SP), *H2* (relationship between GHC and GCA), and *H3* (relationship between GCA and firms' SP) were accepted with the values of $\beta = 0.289$, $t = 5.698$, and $p = 0.000$ ($p < 0.05$) for *H1*, $\beta = 0.353$, $t = 6.293$, and $p = 0.000$ ($p < 0.05$) for *H2*, and $\beta = 0.388$, $t = 6.166$, and $p = 0.000$ ($p < 0.05$) for *H3*.

Table 6: Hypotheses testing

<i>H</i>	<i>Path</i>	<i>Original sample</i>	<i>T statistics</i>	<i>VIF</i>	<i>R²</i>	<i>f²</i>	<i>Q²</i>	<i>P values</i>	<i>Decision</i>
H1	GHC -> SP	0.289	5.698	1.701	0.737	0.187	0.651	0.000	Accepted
H2	GHC -> GCA	0.353	6.293	1.416	0.562	0.201	0.559	0.000	Accepted
H3	GCA -> SP	0.388	6.166	2.307		0.246		0.000	Accepted

Notes: H = Hypothesis, GHC = Green Human Capital, GCA = Green Competitive Advantage, and SP = Sustainable Performance

Source: Developed by authors

Calculating the R^2 values, or the model's explanatory power, is another important objective of assessing the structural model. R^2 values illustrate the proportion of variance in the endogenous construct accounted for by the exogenous construct. According to Chin (1998), R^2 values of 0.67, 0.33, and 0.19 represent the model's substantial, moderate, and weak explanatory power, respectively. Table 6 indicates that the current study's model has substantial explanatory power, as it explains 73.7% of the variance in firms' SP ($R^2 = 0.737$). Additionally, the effect size (f^2) needs to be assessed to determine the strength of an exogenous construct on an endogenous construct. According to Cohen (1988), f^2 values of 0.35, 0.15, and 0.02 denote large, medium, and small effect sizes, respectively. Table 6 presents that GHC demonstrated a medium effect size on SP and GCA. Besides, the present model demonstrated a medium predictive relevance, as Stone-Geisser's Q^2 values exceeded 0.15 (Hair et al., 2022). Hence, the model's predictive relevance was also established.

Mediation analysis

Researchers in the current study employed the bootstrapping approach suggested by Preacher and Hayes (2008), using a subsample of 5,000 and a 95% confidence interval level, to conduct the mediation analysis. The results of the mediation analysis are presented in Table 7. The results indicate that GCA mediated the relationship between GHC and firms' SP with a $\beta = 0.137$, $t = 4.090$, and $p = 0.000$ ($p < 0.05$). Thus, $H4$ was accepted.

Table 7: Mediation analysis

<i>H</i>	<i>Path</i>	<i>Original sample</i>	<i>Sample mean</i>	<i>SD</i>	<i>T statistics</i>	<i>P values</i>	<i>Decision</i>
H4	GHC -> GCA -> SP	0.137	0.139	0.033	4.090	0.000	Accepted

Notes: H = Hypothesis, GHC = Green Human Capital, GCA = Green Competitive Advantage, and SP = Sustainable Performance, SD = Standard Deviation

Source: Developed by authors

Moderated mediating effect testing

Researchers of this study examined the interaction effect at high (+1 SD) and low (-1 SD) levels of green TFL. In Table 8, the results indicate that green TFL moderates the positive relationship between GHC and firms' SP (GTL x GHC -> SP), with a β value of 0.084, a t value of 2.327, and a p value of 0.020 ($p < 0.05$). Hence, $H5$ was accepted, which demonstrates that the high level of green TFL significantly moderates the positive relationship between GHC and firms' SP. The results recommend that green TFL strengthens the positive relationship between GHC and firms' SP. Additionally, researchers used simple slope analysis (Figure 2) to assess the moderating effect of green TFL. The increasing green slope means that the high green TFL style enhances firms' SP over time compared to a low level of green TFL.

Additionally, $H6$ proposed that green TFL moderates the indirect effect of GHC on firms' SP via GCA. To assess the conditional indirect effect of GHC on firms' SP through GCA across different levels of green TFL, researchers of this study conducted a parametric bootstrap PROCESS macro analysis. Table 9 shows the results

of a 5,000-replication bootstrap sample with a 95% confidence interval (CI). Results demonstrate that the indirect effect of GHC on firms' SP through GCA is not substantially stronger under high green TFL ($\beta = 0.093$, 95% CI = [0.049, 0.175]) than under low green TFL ($\beta = 0.160$, 95% CI = [0.043, 0.270]). These findings do not align with *H6*, indicating that green TFL has an insignificant role in moderating this indirect relationship. Therefore, *H6* was not accepted.

Table 8: Moderation analysis

H	Path	Original sample	Sample mean	Standard deviation	T statistics	P values	Decision
H5	GTL $\times$ GHC $\rightarrow$ SP	-0.084	-0.099	0.036	2.327	0.020	Accepted

Notes: H = Hypothesis, GTL = Green Transformational Leadership, GHC = Green Human Capital, and SP = Sustainable Performance

Source: Developed by authors

Table 9: Conditional indirect effect of GHC on firms' SP under green TFL $\pm 1SD$

H	Path	Moderator	Level	Boot indirect effect	Boot SE	95% bias corrected CI	Decision
H6	GTL $\times$ GHC $\rightarrow$ GCA $\rightarrow$ SP	Green TFL	Low -1SD	0.160	0.139	[0.043, 0.270]	Not accepted
			Medium	0.126	0.109	[0.061, 0.215]	
			High +1SD	0.093	0.080	[0.049, 0.175]	

Source: Developed by authors

Notes: SE = standard error, original size = 271, bootstrapping size = 5000

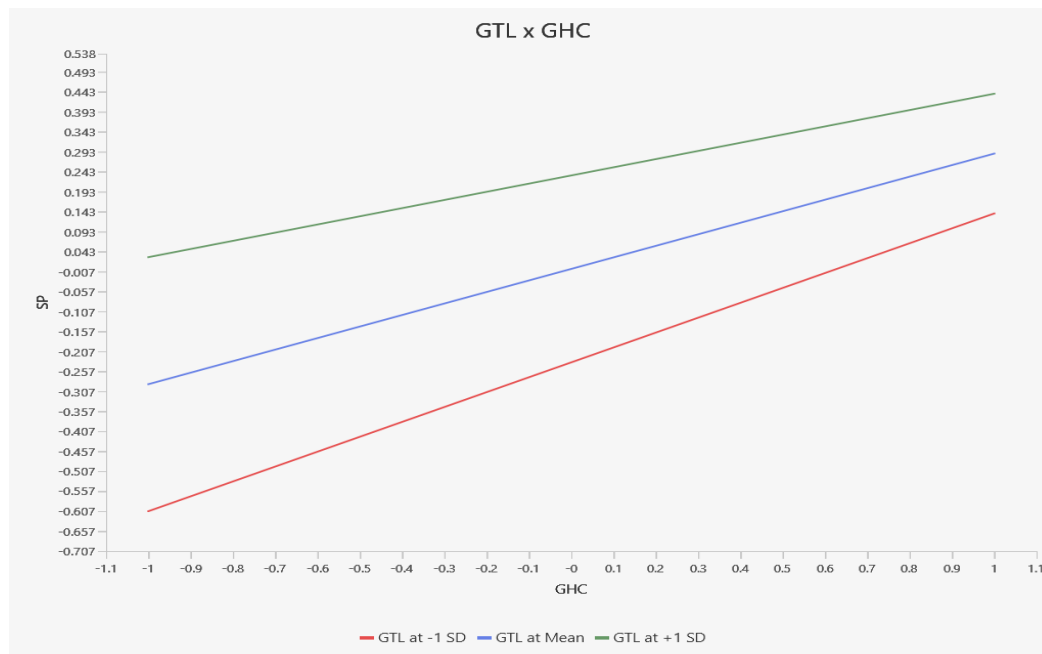


Figure 2: Moderation analysis of green TFL on GHC influencing firms' SP.

Discussion

The study was conducted to satisfy three objectives: to examine the relationship between GHC and firms' SP, to assess whether GCA mediates the relationship between GHC and firms' SP, and to assess whether green

TFL moderates the relationship between GHC and firms' SP directly, and the relationship between GHC and firms' SP via GCA indirectly. The statistical findings supported all hypothesized relationships except one (*H6*). The findings of this study supported the notion that GHC has a positive impact on firms' SP. Therefore, *H1* was confirmed for this study. This result is consistent with previous research (Renaldo & Augustine, 2022), which indicated that GHC is considered a critical antecedent for ensuring a firm's SP. The study also identified a positive association between firms' GHC and GCA, examining how firms' initiatives to develop knowledgeable human resources regarding environmental business practices help them achieve a superior competitive position in the market. Hence, statistical results confirmed the *H2* of the current study. An empirical study by Xin and Wang (2023) among 400 employees working in the Spanish hotel industry explored that when a firm invests in developing its human resources to combat environmental challenges in the present world, it can improve the firm's competitive position. Firms attain these superior competitive positions through inimitable products, a low-cost advantage, a good image, and favorable stakeholder perception, which ultimately accelerates the firm's long-term performance.

Besides, the current study's findings revealed a positive correlation between GCA and firms' SP. Therefore, *H3* was also accepted in this study. This finding was also consistent with a previous study (Saputra et al., 2023), which confirmed that firms with green business practices can gain a market advantage, achieving better green competitiveness compared to their competitors, which is crucial for advancing their environmental performance. Furthermore, the mediation effect of GCA in the relationship between GHC and firms' SP was supported by statistical results. Hence, *H4* was also confirmed. In terms of moderation analysis, the statistical results indicate a significant moderation effect of green TFL on the relationship between GHC and SP, suggesting that high green TFL strengthens the proposed direct relationship in this study. Therefore, *H5* was also accepted. Finally, moderation-mediation analysis revealed an insignificant impact of green TFL on the indirect relationship between GHC and SP through GCA. Hence, *H6* was not supported, which describes that green TFL does not strengthen the indirect relationship in this study. Therefore, *H6* was not accepted.

Implications

Theoretical implications

The current study has several theoretical implications. First, based on ICV theory, the research findings revealed a positive association between GHC and firms' long-term performance, considering both environmental and social considerations alongside financial considerations. Second, the current study further strengthened the assumptions of the ICV theory by explaining that GHC can create firms' superior competitive position in the market in terms of green image, inimitable products, advanced research and development strategies, and low-cost products, which help advance their SP. Based on the concept of ICV, this study suggested that firms' attitudes towards developing environmentally friendly employees in organizations are concerned with implementing environmental principles in business operations and improving firms' environmental performance. The findings of this study also extend the ICV by highlighting GHC as a critical intellectual resource that not only influences firms' SP directly but also interacts with GCA to enhance firms' environmental performance. Additionally, the study findings refined the understanding of ICV by demonstrating how GCA mediates the relationship between GHC and SP. It recognizes that firms' ability to achieve a superior position in the market serves a complementary but distinct strategic function in enhancing firms' SP. Moreover, the findings demonstrate the nature of leadership behavior on performance, stating that green TFL significantly moderates the relationship between GHC and SP, thereby advancing the ICV theory in business and management fields. It describes the impact of GHC as not uniform, but somewhat varying based on the leadership style practiced within the organization. Fourth, the current study employed a single theory and contributed to the literature of green organizational behavior by explaining the mediating role of GCA in the

relationship between GHC and firms' SP, as well as the moderating effect of green TFL on this relationship, both directly and indirectly through GCA. Thus, the results of this study demonstrated how GHC helps create GCA in the market by utilizing firms' resources in an environmentally friendly manner, and enhances firms' environmental performance. Research findings also revealed how a high level of green TFL strengthens the relationship between GHC and firms' SP.

Besides, the study developed the ICV theory by suggesting that a connection can be formed between an organization's GHC and GCA, which ultimately helps firms ensure their economic, social, and environmental performance. Finally, while previous researchers used ICV theory in various industries, such as the SME manufacturing industry (Hina et al., 2024), the hotel industry (Badwy et al., 2025), etc., and revealed a positive correlation between GHC and firms' SP, this study further strengthened this relationship in the context of the garment industry. Hence, the current study's empirical findings solidified the above-mentioned relationship across different industry contexts. Moreover, previous researchers conducted empirical studies on how firms' green practices, like developing GHC in the organization, can enhance their SP while maintaining all environmental principles (Al-Shammari et al., 2022; Zihan & Makhbul, 2024). Studies by Zhang et al. (2024) and Wolor et al. (2025) revealed that GHC is a critical determinant for achieving a firm's superior market position. They recommended creating, developing, and maintaining environmental knowledge within human resources that will play a crucial role in attaining good market positions. In addition, Baquero (2024) explored a positive association between GCA and firms' SP. An empirical study by Ali et al. (2023) among 289 respondents working in the Pakistan construction industry examined the relationship between GCA and mega-project sustainable performance. However, studies on the relationship between GHC and firms' SP via GCA and Green TFL are scarce in the literature. Therefore, it was expected that this study would contribute to the literature by stating how GHC influences firms' SP through the mediating role of GCA and the moderating effect of green TFL.

Practical implications

The results of the study confirmed and expanded the notion that environmentally friendly employees have a critical influence on increasing firms' competitiveness. The model presented in this study offers a novel perspective that clarifies the importance of employees having a proper understanding of the impact of organizations' green practices on firms' environmental performance in meeting the challenges of sustainability in the current business world. Therefore, managers and businesspeople may adopt business strategies that develop human resources within organizations, contributing to the firm's SP. Additionally, based on the findings on the correlation between GHC and GCA, it may be suggested that organizations should implement necessary programs to develop employees who can be a source of competitiveness. As study findings confirmed that GCA is a source of firms' SP, organizations should set and implement the business strategies that accelerate firms' green competitiveness by creating a good image, reducing costs, engaging in research and development, and producing inimitable products, which can ultimately foster firms' SP. Besides, achieving GCA is essential to strengthening the relationship between GHC and firms' SP. Finally, firms' initiatives to introduce green TFL practices within the organization can significantly influence the SP. As a result, firms can benefit by gaining a superior green competitive position in the market. Therefore, policymakers and business leaders can set their business policies and strategic decisions in business operations by considering green strategies. This study will also help the government and other environmental agencies set their environmental standards and principles to minimize environmental degradation.

Contribution to the United Nations' Sustainable Development Goals (SDGs)

This study contributes to achieving some of the Sustainable Development Goals (SDGs) agenda recommended by the United Nations. It was expected that out of 17 SDGs, three goals — namely, SDG 3, SDG 8, and SDG

12 — could be attained by implementing the green policies and activities suggested in this study. SDG 3 (Good Health and Well-Being) emphasizes the importance of ensuring healthy lives and promoting well-being by fostering a green environment within organizations. Firms' green human resources can act as a critical partner in establishing a good work environment within an organization, where the well-being of all employees can be ensured. SDG 8, “Decent Work and Economic Growth,” focuses on promoting sustained, inclusive, and sustainable economic growth, maintaining full and productive employment, and ensuring decent work for all. This study examined the relationship between GHC and firms' SP, which is closely aligned with SDG 8, where firms' GHC plays a critical role in maintaining sustainable economic growth and decent work for all employees. This study also aligns with SDG 12, “Responsible Consumption and Production,” which aims to ensure sustainable consumption and production patterns.

Conclusion

The study identified the positive impact of GHC on GCA and firms' SP, which was not examined by previous research. The study also confirmed the positive association between GHC and GCA, in line with the earlier studies (Agyabeng-Mensah & Tang, 2021), indicating that firms' GHC is essential for achieving a better market position. Hence, firms that develop green human resources can enhance organizations' financial, environmental, and social conditions, while also meeting the demands of all stakeholders in society. The current study, finally, revealed that a high level of green TFL practices in organizations can strengthen the direct relationship between GHC and firms' SP, but not the indirect relationship through GCA. However, although the research findings were based on a large sample size (271 respondents), the response proportions for males and females (males: 96.7% and females: 3.3%) clearly indicate a gender imbalance in managerial positions. This can create some potential bias implications during decision-making. Therefore, data collected from balanced respondents may yield different results with varying implications in practice.

Limitations and future research direction

Limitations are the opportunities for future researchers to investigate new findings. The results obtained were specific to garment organizations only, which may limit the generalizability of the research findings. In this research, the relationship between GHC, GCA, green TFL, and firms' SP was examined by analyzing data collected from employees working in garment firms in Bangladesh. However, other studies may be conducted in other industries and businesses with the same variables. Furthermore, this study was conducted on selected variables, including GHC, GCA, green TFL, and SP. Other variables, such as corporate social responsibility, green culture, and stakeholders' expectations, may also be critical antecedents for ensuring firms' SP. From a geographical perspective, this study was conducted solely in Dhaka city. Future research on the entire country, both nationally and internationally, may yield varying results. Although the sample size of the current study is sufficient (271 respondents) for conducting quantitative research and yielding more generalizable findings, the proportion of males to females (males: 96.7% and females: 3.3%) was not balanced enough. Therefore, further research may be conducted by maintaining a satisfactory male-female ratio, which may reveal more comprehensive and accurate research results.

Additionally, this study focused solely on one dimension of green intellectual capital: green human capital. Other researchers may consider the other two important dimensions, such as green relational capital and green organizational capital, in future studies. In terms of time horizon, this study employed a cross-sectional research design, where data were collected within a short time frame. A longitudinal study may yield different results. In addition, this study used a quantitative approach. A qualitative method to examine the relationships between the variables of this study might help explain these relationships more effectively. Finally, this study examined the mediating role of GCA and the moderating role of green TFL in the relationship between GHC and firms'

SP. However, other variables may contribute to a better understanding of the moderation as well as the mediation role in the understudy relationship.

Declaration

Funding:

The authors received no funding support for this study.

Acknowledgments:

The authors are grateful to the journal's anonymous referee for their valuable suggestions, which significantly improved the quality of the article. We would also like to express our sincerest gratitude to all the respondents who participated in the data collection of this study.

Conflicts of Interest:

The authors declared no potential conflicts of interest concerning the authorship and production of the article.

Data Availability Statement:

The data that support the findings of this study are available from the corresponding author, [M.J.I], upon reasonable request.

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