

## Article

# Green Logistics, Green Human Capital, and Circular Economy: The Mediating Role of Sustainable Production

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**Abstract:** Many countries worldwide have adopted a sustainable development model to strike a balance between economic progress, environmental preservation, and social protection, and one of the most effective solutions for promoting sustainable development has been the circular economy (CE). Given each country's resource restrictions, businesses must implement green manufacturing practices to establish a circular economy. Therefore, this study intends to assess the role of green logistics (GL) and green human capital (GHC) in promoting a circular economy. Additionally, the mediating role of sustainable production (SP) in the interplays between the constructs was examined. Data for this research was collected from 211 garment manufacturing firms in Bangladesh, using a standardized questionnaire. The partial least square structural equation modeling (PLS-SEM) technique was employed for inferential statistical analysis. The findings revealed that GL and GHC are significant drivers of CE. Additionally, GL and GHC were observed to have a positive linkage with the SP of firms. The findings uncovered that SP positively impacts circular economy implementation. Furthermore, SP was found to significantly mediate the linkages between GL and CE, as well as between GHC and CE. Ours is one of a limited number of research projects that address the role of GL and GHC in implementing CE through SP. Hence, this study added critical insights to the extant theory and practice while reporting several theoretical and managerial implications.

**Keywords:** green logistics; green human capital; circular economy; sustainable production; green supply chain



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## 1. Introduction

In recent years, environmental worries over the impacts of human activities on the earth have escalated and, as a result, have been the focal point of mainstream media, government efforts, academic literature, and the general public [1–4]. Currently, stakeholders demand that businesses accept responsibility for adverse effects generated by their economic activity. As a result, businesses worldwide are continually searching for methods to include environmental considerations in their strategic planning [5]. Environmental management literature has established the pivotal roles of green supply chain management and green human resources in promoting the environmental sustainability of firms. From a micro-perspective, we can identify two green practices, green logistics (GL) and green human capital (GHC), both of which can be influential in implementing sustainability initiatives such as the circular economy (CE). Logistics significantly affects emissions and energy consumption [6,7], which is not disregarded by the rising emphasis on green solutions. Green Logistics (GL) fosters environmental consciousness by mandating that all logistics system users consider the environmental consequences of their operations [8]. GL's fundamental objective is to manage all operations to achieve an equilibrium between

economic, environmental, and social considerations [9]. Prior research on Green Logistics Management (GLM) has mostly focused on GLM's impact on environmental sustainability [10]. However, there is a paucity of insights on how the GLM impacts a company's overall circular economy practices (CEP). The Circular Economy (CE) idea is based on "the regenerative cycle, which facilitates the reuse of used products, parts and materials efficiently, thereby increasing profitability and reducing the environmental distraction" [11]. CE is driven by reusing and recycling principles and aims to use waste to generate renewable energy [2]. Achieving a CE is a complicated process that demands a mental shift on the part of stakeholders to build ecological goods while using greener production practices and front-to-back sustainable supply chain management [12]. The transformation from linear to circular business models requires the implementation of new business tactics [13], such as GLM [14]. Prior CE literature draws insights from a firm's natural resource-based view (NRBV) to conceptualize GLM as a green resource of an organization that can affect firms' outcomes [15,16]. The NRBV seeks to determine how green resources might yield both strategic advantages and positive environmental outcomes for enterprises [1]. Hence, we draw upon the NRBV to understand how firms' green logistics management can boost sustainable production and circular economy implementation.

In addition, human resource factors such as managers' human capital are also crucial for corporate sustainability [17,18] and circular economy adoption [19]. Recent literature suggests that organizations must develop dynamic capabilities [16,17], such as green human capital (GHC), to ensure green innovation and environmental sustainability. The presence of GHC in an organization encourages the use of environmental management strategies such as green supply chain management (GSCM), which includes green manufacturing and reverse logistics, to achieve sustainability [20,21]. Thus, enterprises' human resource objectives must be integrated with environmental objectives that aim to improve sustainability performance [22]. However, the linkage between GHC and CEP has yet to be explored. Drawing upon insights from the dynamic capabilities theory (DCT), we argue that GHC is a crucial dynamic capability that aids firms in implementing environmental initiatives such as CEP [21,23]. The DCT offers an appropriate framework to comprehend how firms' human capital enables them to develop dynamic capabilities necessary to renew and develop organizational capabilities to transform their existing business model into a CE model. Businesses that invest in GHC are more likely to develop unique environmental capabilities and skills that inspire employees' innovation and creativity [24]. This will enable them to adopt GLM, support sustainable production, comply with regulatory requirements, safeguard the health and safety of the community and the workforce, and boost CE performance [16]. However, there is mixed evidence in the literature regarding the effect of GHC on environmental performance due to the presence of different mediators. We posit that sustainable production (SP) mediates the relationship between GHC and CEP.

Despite the abundance of information on GLM and GHC practices [16,25,26], no extensive research has yet been conducted to identify the factors of GLM and GHC practices and their interrelationships that contribute to a circular economy. For instance, most of the prior studies focused on the impact of overall green supply chain management [15,27] and green human resource management [23,28] on organizations' sustainability. However, literature is scarce on the effects of GLM and GHC on CE and their mediators [16,23]. This research, to fill this knowledge gap, aims to investigate the interrelationship between GLM and GHC elements that impact the transformation of businesses into a circular economy. Recent studies reveal that GLM might be seen as a CEP-supporting organizational component [6]. Seroka-Stolka and Ociepa-Kubicka [29] asserted that the GLM is a prerequisite and critical mechanism for developing the circular economy. However, a few studies argue that the linkage between GLM and circular economy is indirect and mediated by different intervening factors [1]. This equivocal evidence drives us to examine the role of SP in the GLM and CEP interaction. We propose that the SP positively mediates the effect of GLM on CEP and the effect of GHC on CEP.

Bangladeshi readymade garments (RMG) manufacturing firms operate in a competitive and dynamic environment. RMG industry contributes to around 83% of the country's entire export volume [30]. Bangladesh's garment sector has expanded steadily over the past several decades, surpassing China as the second largest in the world. Last fiscal year, the country exported RMG valued at \$42 billion [31]. However, a decade ago, this sector used to be heavily criticized for its lack of environmental and green practices, poor working conditions, and lack of safety precautions [32]. Following the Rana Plaza tragedy, the situation has changed as many garments manufacturer have adopted green practices such as green supply chain management and green human resource management to reconfigure their existing business model and shift to a circular and sustainable one [33]. Consequently, it is necessary to understand how Bangladeshi RMG manufacturers may embrace sustainable and environmental business practices to sustain their business in the dynamic business climate. Hence, this study offers a better understanding of how the GLM and GHC of Bangladeshi RMG manufacturing firms can facilitate CEP through SP.

Furthermore, studies undertaken in growing Asian nations such as China, India, and Bangladesh mainly focused on green supply chain management (GSCM) rather than the more specific issue of green logistics [34–36]. In the Chinese context, Wang et al. [37] analyzed the impact of GSCM on organizational performance, whereas Wong et al. [36] analyzed the impact of GSCM on environmental performance. In the Indian and Bangladeshi settings, most research has focused on the obstacles to GSCM in these nations [34,38,39]. Consequently, green logistics' impact in enhancing organizations' CE performance is underexplored in the context of emerging economies. In addition, there is a dearth of literature on the GHC of enterprises. The majority of the existing research has investigated the influence of green human resource management (GHRM) or green intellectual capital (GIC), which encompasses GHC, in enhancing organizational results [17,23,40]. However, there is a dearth of research focusing on the impact of GHC on organizational CEP or sustainability initiatives. Moreover, given the widespread deployment of CE in developed nations, most CEP research has been carried out in developed economy contexts [41,42]. Sustainability-wise, developing countries employ the circular economy model less frequently than do the developed nations [43]. Extant research has highlighted firms' transition towards a CE business model in developed countries such as the USA, UK, Australia, Netherlands, France, Denmark, Germany, Finland, France, Sweden, Norway, and Japan [44]. Although China, as a developing economy, has performed exceptionally in CE implementation, other developing countries are lagging due to a lack of proper strategies from governments, regulatory bodies, and policymakers to promote CEP [45]. Therefore, evaluating the connections between GLM, GHC, and CEP is essential.

The current study makes several significant additions to evaluate how GLM, GHC, SP, and CEP are connected. First, this study enhances the ubiquity of the natural resource-based view (NRBV) and dynamic capabilities theory (DCT) by demonstrating these theories' importance in investigating green logistics and green human capital in emerging economies. We integrated the two theories to have a better understanding of the role of GLM and GHC in implementing SP and CEP. We construct GHC from the perspective of the DC and GLM from the perspective of the NRBV. Second, by analyzing the crucial function of the GLM and GHC in boosting the CEP of enterprises, our work contributes to the GL, GHC, and CE literature. Third, the mediating function of SP in the links between GLM-CEP and GHC-CEP has not been proven by past research. By examining SP's function in the interaction between firms' GLM and CEP as well as GHC and CEP, this work adds to the body of knowledge already available. Finally, our study advances knowledge of the SP's role in achieving the CE and sustainability objectives, providing a foundation for future study.

The remainder of the paper is divided into the following sections: The second part reviews relevant academic research on the GLM, GHC, SP, and CEP. The third section covers research methodologies, including procedures for data collection, variables, and analysis. The results are summarized in part four and then discussed in section five. Finally,

a thorough discussion of the key theoretical and practical implications of this study's findings is followed by a discussion of its limitations and potential future directions.

## 2. Literature Review

### 2.1. *The Natural Resource-Based Theory*

Hart [46] established the natural resource-based view (NRBV) to include the exterior natural setting of an organization as a resource in addition to the internal resources represented by the resource-based view (RBV). The NRBV's perspective on enterprises extends the RBV [47]. Leveraging an organization's internal resources to boost its competitiveness is advocated by the RBV. Barney [48] argues that the RBV offers the framework for understanding businesses' methods to leverage varied, distinctive, instrumental, and limited resources to obtain a competitive advantage. The NRBV broadens the reach of the RBV by emphasizing the importance of the natural environment, which may be interpreted as "a theory of competitive advantage based on the firm's relationship with the environment" [46]. The NRBV promotes how green resources might provide firms with strategic benefits and enhanced environmental consequences. Environmentalists have argued that adopting an NRBV approach might make a firm more competitive and sustainable over time [49]. However, this demands the company's green resources and expertise [50].

The concept of NRBV is grounded in three linked environmental policies: "pollution prevention", "product stewardship", and "sustainable development" [46]. By reducing pollution and waste, the pollution prevention strategy minimizes environmental degradation and damage [46]. This strategy reduces production costs, waste, and compliance responsibilities while increasing efficiency and productivity through decreased pollutants and disposal, resulting in a significant rise in performance and profitability [46]. Product stewardship is a way that stresses the inclusion of multiple stakeholders' viewpoints in product and process design [15]. This strategy enables businesses to get a competitive advantage by gaining access to limited resources (e.g., green raw materials, locations, productive capacity, capacities) and enhancing the business' green reputation [46,51]. Finally, the sustainable development plan emphasizes minimizing the negative environmental consequences of businesses [52]. These three strategies may give a company a competitive advantage and increase its sustainability performance. Due to time and organizational capability, green supply chain strategies may be viewed as unique, diversified, and efficient assets difficult for businesses to mimic [51,52]. Green supply chain approaches, such as the GLM and SP, can give businesses a green competitive advantage. The NRBV theory underpins the impact of firms' GLM on green competitiveness and green practices such as CE [16]. The NRBV hypothesis postulates that implementing environmentally friendly practices such as reverse logistics minimizes environmental pollution and safeguards the environment from degradation by collecting discarded and defective items for remanufacturing [15]. Hence, this study employs the NRBV to assess the effect of GLM on fostering better SP and CEP.

### 2.2. *Dynamic Capabilities Theory*

The dynamic capability (DC) concept refers to a firm's ability to respond to and adapt to dynamic circumstances by successfully integrating and rearranging its resources [53]. DC contributes to a firm's development and profitability by enhancing flexibility in a complex and volatile environment [54]. Innately, DCs are beneficial for adjusting to competitive market conditions. DC theory (DCT) is a method for acquiring and developing new talents that might lead to a firm's improved performance [55]. Various forms of the DC paradigm have been described in the literature. The most prominent framework is Teece's [56], which consists of three principal components: "sensing", "seizing", and "transforming." Sensing is a firm's capability to identify, analyze, and assess technical possibilities that may be utilized to meet consumer wants and corporate strategic objectives [57]. Seizing ability is the capacity to employ relevant procedures and resources to obtain company value from identified possibilities [58]. The transforming power, sometimes referred to as reconfiguring ability, encompasses all operational procedures that swiftly rearrange asset clusters and

standard capabilities in response to market fluctuations [59]. Dynamic capabilities coupled with firms' knowledge resources generate a knowledge strategy [60] that is crucial for implementing environmental practices. It is important to identify which knowledge-based dynamic capabilities are unique, valuable, and inimitable. Agyabeng-Mensah and Tang [16] contend that firms' GHC enable them to develop dynamic environmental capabilities to implement green and sustainable organizational practices such as GLM, SP, and CEP. Green intellectual capital, particularly green human capital, must be regarded as one of the crucial managerial competencies when studying the talents that may be applied to the CE [23]. Implementing the 3Rs (reduce, reuse, and recycle) within businesses is also viewed as a DC using interdependent CE activities to reach a single objective [61]. Consequently, a company's expansion of CE-related operations must adhere to a specific capability and activity generation trajectory [62]. Hence, this study utilizes the DC perspective as its theoretical foundation to formulate GHC and GLM as dynamic organizational capabilities that may increase SP, resulting in enhanced circular economy practices.

### 2.3. Development of Research Hypotheses

#### 2.3.1. Green Logistics and Circular Economy Practices

The Circular Economy (CE) is gaining steam, with firms increasingly incorporating its concepts into corporate sustainability strategies. CE seeks to maintain the economic worth of goods, raw resources, and energy while decreasing waste production [5]. It is a notion that stresses the production of value via the cautious utilization of resources and the minimizing of unfavorable environmental effects across the life cycle of a product, hence permitting the reuse of resources [63]. Given many suggested CE definitions, making an impartial selection is difficult. In light of their research of 114 CE definitions, the authors have chosen the viewpoint advocated by Kirchherr et al. [64]: "A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso-level (eco-industrial parks) and macro level (city, region, nation and beyond), to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" [64]. With the joint objectives of reducing waste generation and maximizing trash recycling, global authorities are rallying momentum for a circular economy [65]. Given the present pandemic, the deployment of CE has garnered greater relevance, as it is critical to boost production capacity to shorten the manufacturing supply chain [66].

We contend that the GLM can promote CEP inside an organization. The GLM integrates the initial ideas and promotes sustainable development [5]. Notably, there are two ways to comprehend the impact of logistics on the flux of wastes in an economic system within the context of an environmentally aware logistics concept: eco-logistics, reverse logistics, green logistics, and recycling logistics [67]. The GL is viewed as a firm's green supply chain management (GLSCM) that considers environmental problems and incorporates them into logistic management to improve suppliers' and customers' environmental practices [20,68]. Green logistics includes the assessment of the ecological effect of distribution techniques, the reduction of energy consumption during logistical operations, and the treatment of wastes [69]. The movement of materials and energy inside an industrial process is essential for the effectiveness of the CE system. The efficient circulation and recycling of resources among organizations is a vital aspect of both the circular economy and industrial ecology [29]. Efforts are now being undertaken to optimize industrial logistics and boost GSCM by streamlining logistical operations within firms' systems that can improve CE practices [6,70]. Thus, this study posits that:

**Hypothesis 1 (H1).** *Green logistics management positively impacts firms' circular economy practices.*

### 2.3.2. Green Logistics and Sustainable Production

Repetto [71] proposed the notion of sustainable manufacturing for the first time in 1987. The research describes actions that safeguard the efficiency of natural resource assets by employing sustainable strategies. The author suggests policy improvements that will encourage the conservation of resources, minimize environmental degradation, increase economic output, decrease budget deficits, and alleviate rural poverty. SP is an effective strategy for supply chain management [72]. It is premised on the practice of manufacturers developing harmful compounds to meet consumer demand; consequently, they are obligated to reduce or eradicate industrial pollution in the environment [73]. Implementing SP practices enables manufacturers to increase operational efficiency, preserve the community, boost environmental sustainability, and reap additional economic benefits [74]. We argue that GLM is critical for manufacturing firms' sustainable production. GL has developed to include a variety of green initiatives to lessen global ecological consequences and promote pollution prevention and SP [75]. Green operating resources and GL initiatives are vital for implementing SP, according to Bressanelli et al. [76]. Moreover, Zhang et al. [14] observed that saving energy and reducing emissions result in increased SP. Further, GL plays a crucial part in the environmental sustainability of emerging nations [77]. Jinru et al. [1] insist that GL should be incorporated into organizational procurement to produce green and sustainable products. Thus, we postulate that:

**Hypothesis 2 (H2).** *Green logistics management positively impacts firms' sustainable production.*

### 2.3.3. Green Human Capital and Circular Economy Practices

Green human capital (GHC) is one of the most critical characteristics individuals must cultivate during environmental deterioration [78]. GHC is a company resource that can facilitate the execution of GSCM procedures [21,79]. GHC involves the talents, skills, knowledge, and experiences of personnel that is utilized to execute green practices effectively. GHC refers to "the summation of employees' knowledge, skills, capabilities, experience, attitude, wisdom, creativities, and commitments, etc., about environmental management and environmental concern" [80]. We employ the DC theory to characterize GHC as a crucial DC influencing strategic organizational decisions. We argue that GHC provides firms' employees with the capacities of detecting, seizing, and changing to adopt CEP. Numerous studies [62,81–83] have utilized the DC viewpoint to determine how various DCs of business personnel contribute to CEP. Elf et al. [83] argue that dynamic capabilities enable MSMEs to operate with agility, enabling them to adopt, evaluate, and enhance CE systems while offering them more endurance in times of crisis. From the standpoint of a CE, DCs are deemed suitable for studying circular processes in enterprises [84] since this theoretical framework can incorporate proactive environmental initiatives connected to the sustainability of competitive edge in dynamic contexts [62]. Jabbour et al. [21] examined the linkage between GHC and CE business models within organization and management frameworks. The authors encouraged further study to provide light on whether GHC is associated with the CE and how and why these concerns are associated with organizational success. GHC contributes independently to the move toward a circular economy [23]. Hence, we posit that:

**Hypothesis 3 (H3).** *Green human capital positively impacts firms' circular economy practices.*

### 2.3.4. Green Human Capital and Sustainable Production

According to the research, employees' knowledge, skills, and competencies are critical for the effective adoption of sustainable practices [85] and function as a competitive advantage [17]. Intangible assets like employees' expertise, skills, talents, creativity, knowledge, experience, mindset, and attitudes are crucial for establishing sustainability [86]. These traits of employees are irreplaceable, valuable assets that are not owned by companies and are essential for the effective application of environmental management techniques [87].

Wright et al. [88] proposed that a competitive advantage could be maintained by utilizing human capital. As per Subramaniam and Youndt [89], human capital is one of the most crucial strategic assets for business success, since the knowledge and abilities of people are necessary to sustain a corporation in today's rapidly evolving environment. Currently, an organization cannot disregard environmental considerations.

Consequently, it is necessary to investigate the function of GHC and its impact on a company's sustainability practices. Large manufacturing companies worldwide have adopted green recruiting, demonstrating their preference for environmentally responsible employees. With this degree of dedication, a company will likely achieve sustainability, particularly regarding green production. Masri et al. [90] argue that GHC and other HR elements may make manufacturing organizations more sustainable. Thus, we hypothesize that:

**Hypothesis 4 (H4).** *Green human capital positively impacts firms' sustainable production.*

### 2.3.5. Sustainable Production and Circular Economy Practices

Sustainable production (SP) refers to manufacturing of goods using eco-friendly processes that limit negative ecological impacts [91]. SP considers worker safety, well-being, and social and environmental factors. SP is gaining importance in industrial science, environmental science, mechanical engineering, and energy research [92]. SP tactics vary amongst businesses based on the nature of their operations. Each firm's operation is crucial to its long-term survival [93]. Knowing the material and energy flows inside the production system gives insight into expenses, effectiveness, and environmental consequences [1].

The CE provides chances for sustainable development and growth while addressing critical problems such as resource and environmental preservation [61]. It enables implementing a 3R approach to reduce, reuse, and recycle resources as much as feasible [94]. Geissdoerfer et al. [95] note that manufacturing enterprises contribute to the vast and quick deterioration of the environment and non-renewable power sources; hence, immediate action is required, and the notion of a circular economy offers a viable answer [96]. Sustainable production may be an effective strategy to exploit CE capabilities [90]. The deterioration of resources and materials deeply concerns all countries and the world [6]. Bag et al. [91] demonstrate a favorable connection between sustainable manufacturing and CEP. Jinru et al. [1] also reveal that sustainable manufacturing is a driving factor of firms' CEP. Hence, we hypothesize that:

**Hypothesis 5 (H5).** *Sustainable production positively impacts firms' circular economy practices.*

### 2.3.6. Mediating Role of Sustainable Production

The CE model is an integrated solution that seeks to reduce the negative environmental consequences of production and consumption, particularly in terms of reducing carbon emissions and waste creation, as a reaction to contemporary threats to the natural setting [29]. The circular economy model is gaining prominence, since each unit of resources contributes to a significantly larger value than the linear model [11]. Existing literature has identified several drivers of CEP, such as GLM and GHC. However, we postulate that the effect of these green factors on firms' CEP is not a direct one. GSCM needs to incorporate different sustainability initiatives to ensure CEP in a firm. One such initiative is sustainable production. The adverse environmental consequences can be mitigated by transitioning to a CE business model by implementing sustainable production [97]. In line with Jinru et al. [1], we argue that GLM's effect on firms' CEP is mediated by sustainable production.

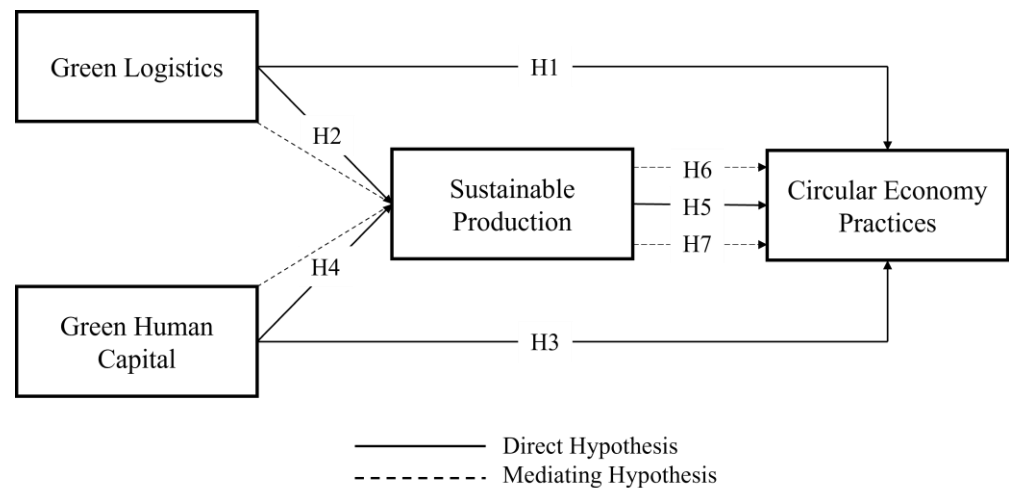
In addition, when confronted with external environmental challenges, industries utilize HR practices as a crucial tool for developing human capital to address environmental problems [18]. Furthermore, organizational participation and training can expand the human capital pool. Consequently, enterprises can appoint individuals with environmental consciousness to meet environmental requirements, thereby altering workers' capability to

accomplish environmental objectives [98]. Nonetheless, human capital alone is insufficient for the shift to a CE business model. Multiple studies have demonstrated that GHC promotes sustainable production in businesses. Zaid et al. [17] contend that GHC is a catalyst for firms' green supply chain practices, such as green or sustainable production. Another body of research shows that sustainable production is critical for enterprises implementing CEP [91]. Jinru et al. [1] report that SP is a crucial mediator via which firms' green practices like GLM and GHC affect CE implementation. Thus, we hypothesize that:

**Hypothesis 6 (H6).** *Sustainable production mediates the relationship between firms' green logistics management and circular economy practices.*

**Hypothesis 7 (H7).** *Sustainable production mediates the relationship between firms' green human capital and circular economy practices.*

Figure 1 presents the conceptual framework of this study.



**Figure 1.** Conceptual model.

### 3. Research Methods

#### 3.1. Data Collection and Sample

We surveyed Bangladeshi readymade garments (RMG) manufacturers to evaluate our hypothesis. These manufacturing companies were chosen since they operate in a competitive and dynamic environment in which competitive strategy techniques, such as GLM, GHC, SP, and CEP, are required for growth and success. In addition, we chose Bangladesh as an empirical study setting for several factors [99–104]. Bangladesh's RMG industry contributes to around 83% of the country's entire export volume. Bangladesh's garment sector has expanded steadily over the past several decades, surpassing China as the second largest in the world. In order to survive the dynamic business climate at home and abroad, it is essential to explore how Bangladeshi RMG manufacturers may embrace sustainable and environmentally friendly business practices.

A self-administered questionnaire was created to collect data on the effects of GL and GHC on the SP and CEP of Bangladeshi RMG enterprises. Two academics and five industry experts pre-tested the survey items to ensure their validity. The survey questions were modified somewhat based on the pilot survey's results. The survey data was collected from RMG manufacturing company managers with a thorough understanding of their organizations' operational practices. We sent the survey questionnaire to 320 RMG enterprises along with a cover letter describing the study's aims and stressing that participation was voluntary. In addition, participants were advised that their responses would be kept strictly confidential and used solely for research purposes [105]. Following a reminder, 211 complete and acceptable surveys were returned for a response rate of 66%. The rest of



the responses were invalid due to missing data, and firms not yet employing any green practices were also excluded. This study's data was gathered between October 2021 and February 2022.

### 3.2. Respondents' Profile

The final dataset had responses from 211 Bangladeshi RMG manufacturing firm managers. Most responders (81%) had worked in their present or most recent managerial role for at least a year. Most managers were between the ages of 25 and 50 (78%) and had post-secondary education (84%) as well. The survey addressed four firm age groups: 3 years (7%), 3–5 years (18%), 6–10 years (31%), and >10 years (44%). Aside from these attributes, 11% of businesses employ less than 500 people, 36% employ between 500 and 1000 people, and 53% employ over 1000 people (see Table 1).

**Table 1.** Demographic analysis of the respondents.

Variables	Categories	Frequency	Percentage
Managerial Experience	At least 1 year	171	81.04%
	Less than 1 year	40	18.96%
Age	25 to 50 years	165	78.20%
	Above 50 years	46	21.80%
Highest level of education	Post-Secondary	178	84.36%
	Secondary or lower	33	15.64%
Firm Age	3 years or less	14	6.64%
	3 to 5 years	39	18.48%
	6 to 10 years	65	30.81%
	More than 10 years	93	44.08%
No. of Staff	Less than 500	23	10.90%
	500–1000	76	36.02%
	More than 1000	112	53.08%

### 3.3. Measures

All the model's hypotheses were assessed with several questionnaire items, and all items were extracted from existing research. Several items were also adjusted to meet the setting of the research. A seven-point Likert scale was employed to quantify the exogenous factors. Before the primary inquiry, the instrument was created based on the method outlined by Mishra et al. [106] and Hair et al. [24]. Five industry experts were given a complete set of the study's constructs and asked to evaluate the extent to which they believed these items accurately estimated their respective concepts on a three-point Likert scale, with 3 implying "a significant amount", 2 indicating "somewhat", and 1 indicating "not at all." The survey instrument included all items that were not ranked "one" by any expert and were graded "three" by at least two experts.

The measuring instruments for this research were drawn from the pertinent literature. Five measures were used from prior research [107,108] to assess the GLM of businesses. The metrics were used to determine if the firms engaged in green monitoring, assessment, transportation and distribution, green storage, green packaging, etc. Five items from the research of Agyabeng-Mensah and Tang [16], Chang [109], and Shoaib et al. [110] were utilized to quantify the GHC of the companies. Four items from Zeng et al. [61] and Ali et al. [111] were then used to evaluate the mediator SP. We estimated the businesses' CEP using six items from Zhu et al. [112] and Zeng et al. [61]. Table 2 lists the measurement units and their respective sources.

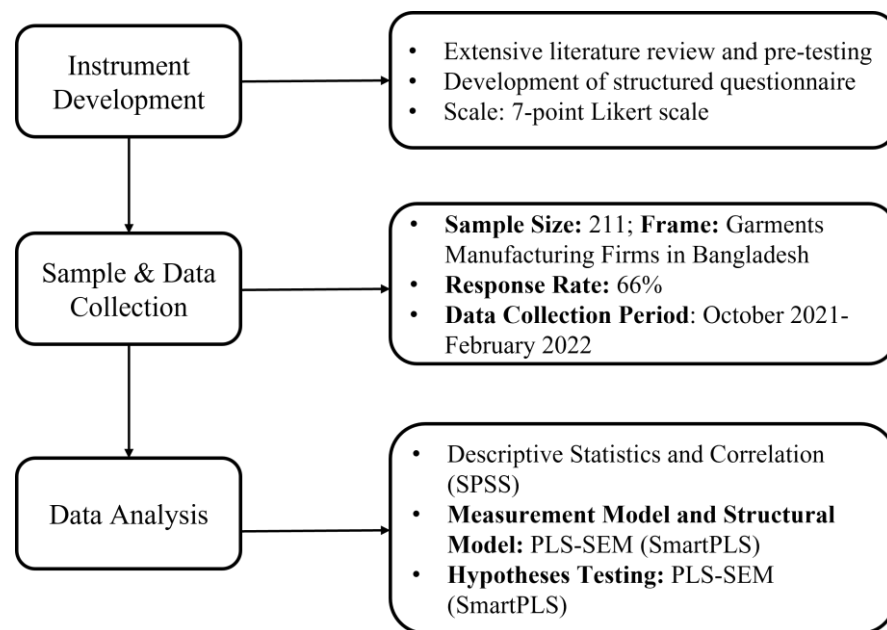
**Table 2.** Measurement items.

Variables	Codes	Items	Source
Green Logistics Management	GL1	Green education, monitoring, and evaluation	Baah et al. [108], Agyabeng-Mensah et al. [107]
	GL2	Green transportation and distribution	
	GL3	Green warehousing and green packaging	
	GL4	Waste management and recycling	
	GL5	Sustainable logistics information system	
Green Human Capital	GHC1	The contribution of environmental protection of employees in our firm is better than our major competitors	Agyabeng-Mensah and Tang [16], Chang [109], and Shoaib et al. [110]
	GHC2	Employee competence concerning environmental protection in our firm is better than that of our major competitors	
	GHC3	The product and/or service qualities of environmental protection provided by the employees of this firm are better than our major competitors	
	GHC4	The amount of cooperative teamwork concerning environmental protection in our firm is more than that of our major competitors	
	GHC5	Our managers fully support our employees in achieving their goals concerning environmental protection	
Sustainable Production	SP1	We use cleaner energy during production processes	Zeng et al. [61], Ali et al. [111]
	SP2	Environmentally friendly production technology and production processes are emphasized.	
	SP3	We ensure energy efficiency during the production process	
	SP4	The firm designs/optimize ways to recycle waste materials and spare parts	
Circular Economy Practices	CE1	The firm is devoted to reducing the unit product manual input	Zhu et al. [112], Zeng et al. [61]
	CE2	The firm is devoted to reducing the consumption of raw materials and energy	
	CE3	Product packaging materials are used repeatedly	
	CE4	The leftover material is used repeatedly to manufacture other products	
	CE5	Waste produced in the manufacturing process is recycled	
	CE6	Recycling waste and garbage are reprocessed.	

### 3.4. Data Analysis Techniques

The hypotheses in this study were tested using partial least squares structural equation modeling (PLS-SEM). Since it enables the estimation of several intricate structural relationships between variables and analyzes their mediating influence, this approach is ideally suited for this paradigm. Furthermore, PLS-SEM does not require a huge sample size to produce accurate results [113–116]. We used SmartPLS 3.3.3 to perform the PLS-SEM analysis, and our model was developed from a causal standpoint [117]. This software includes various statistical methods to understand the intricate interactions between one or more predictors and dependent variables [118]. These hypotheses were tested using a bootstrap methodology using 5000 subsamples. A measurement model and a structural model are outcomes of the SEM. While the structural model examined latent constructs, the measurement model showed connections between measurable and predictive variables. Since random errors had been assessed and eliminated, only the overall variance persisted. The structural model's parameters' validity was evaluated using various convergent and divergent validity metrics.

Additional statistical analysis was carried out to determine whether a common method bias (CMB) would have impacted the study. According to Podsakoff et al.'s [119] recommendations, Harman's single-factor testing was conducted. The results showed that an exploratory factor analysis including all variables yielded a single factor explaining 39.75 percent of the variation, below the 50% criteria. Therefore, in our investigation, no common method bias was found. Additionally, we employed the full collinearity test to investigate CMB. Kock [120] proposed the full collinearity test in PLS-SEM to determine the CMB. Variance influence factors (VIFs) are constructed and assessed for all latent constructs using this method. Our constructs' VIFs were as follows: GHC = 1.284, GLM = 1.129, SP = 1.385, and CEP = 1.561. Since all VIFs are less than 3.3, our model is devoid of common method bias [120]. Figure 2 provides a graphic representation of the complete methodology.



**Figure 2.** Flowchart of Research Methodology.

## 4. Results

### 4.1. Measurement Model

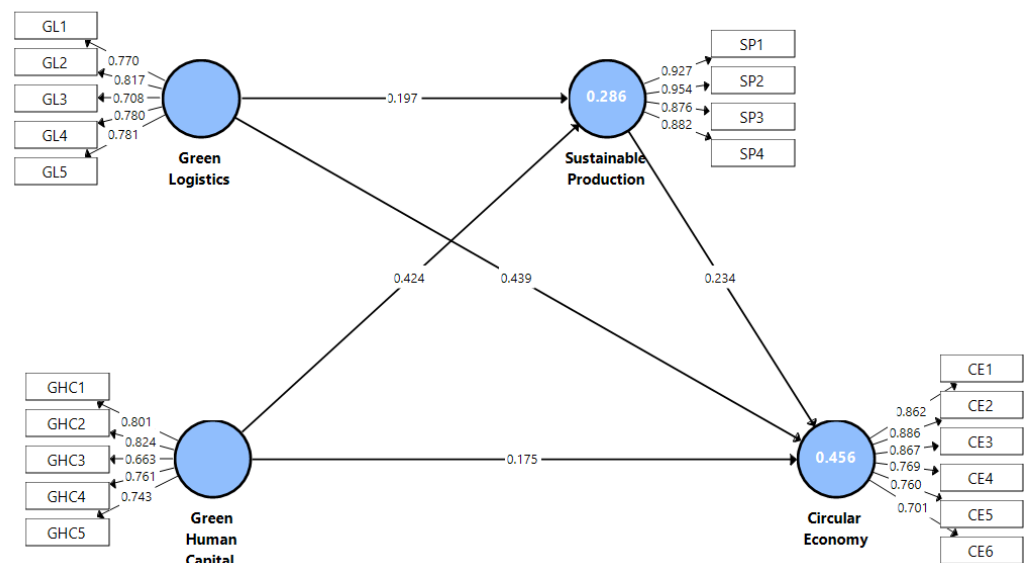
The measurement model incorporates two types of evaluations to assess the variables employed in this study: reliability (item and internal consistency) and validity (convergent and discriminant). Both Cronbach's alpha (CA) and composite reliability (CR) were utilized to assess the constructs' reliability. All CRs were over the acceptable threshold of 0.70 [121,122]. The CA values for each component likewise were above the 0.70 requirements, corroborating the reliability assumption established by Hair et al. [117]. Fornell and Larcker [123] indicate that the AVE values should be more than 0.5 to establish convergent validity (CV). This study additionally validated the CV, as each model item has a substantial and statistically significant standard loading on its target construct. Additionally, the AVE values of the model constructs, which range from 0.578 to 0.829, support the CV of the variables (Table 3). Figure 3 illustrates the measurement model of this study.

Additionally, it is crucial to assess a measuring model's constructs' discriminant validity (DV). We estimated the DV for all variables using the heterotrait–monotrait correlation ratio (HTMT) criterion. The DV is the degree to which one construct is distinct from others. The square root of each latent variable's average extracted variance (AVE) was computed regarding the first criterion.

**Table 3.** Summary results of the measurement model.

Constructs	Items	Factor Loadings	CA	CR	AVE
Green Logistics	GL1	0.770	0.832	0.88	0.596
	GL2	0.817			
	GL3	0.708			
	GL4	0.780			
	GL5	0.781			
Green Human Capital	GHC1	0.801	0.816	0.872	0.578
	GHC2	0.824			
	GHC3	0.663			
	GHC4	0.761			
	GHC5	0.743			
Sustainable Production	SP1	0.927	0.931	0.951	0.829
	SP2	0.954			
	SP3	0.876			
	SP4	0.882			
Circular Economy Practices	CE1	0.862	0.896	0.919	0.657
	CE2	0.886			
	CE3	0.867			
	CE4	0.769			
	CE5	0.760			
	CE6	0.701			

Note: CA = Cronbach’s Alpha, CR = Composite Reliability, AVE= Average Variance Extracted. Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) = 0.902; Bartlett’s test of sphericity =  $p < 0.000$ .



**Figure 3.** Measurement model.

Since the HTMT ratios of the components shown in Table 4 are less than the 0.85 criteria suggested by Henseler et al. [124], our analysis revealed that the model had significant discriminant validity. The maximum HTMT score attained was 0.664, supporting the DV of the constructs. Overall, the components of our model demonstrated strong reliability and validity.

**Table 4.** HTMT criterion.

	GHC	GL	SP
Green Logistics	0.474		
Sustainable Production	0.579	0.402	
Circular Economy Practices	0.533	0.664	0.510

### 4.2. Structural Model

Before assessing the structural model, the data were analyzed for potential multicollinearity concerns. The correlation assessment revealed a maximum correlation coefficient of 0.595 between the latent components, implying the absence of multicollinearity. In addition, the variance inflation factor (VIF) was calculated for each variable to verify its reliability. GL, GHC, and SP were found to have VIF values of 1.243, 1.441, and 1.400, respectively. The values were far below the maximum criterion of 5.00, demonstrating the lack of multicollinearity in our model [125]. After confirming that the model was not multicollinear, it was appropriate for PLS-SEM analysis.

In this research, we utilized the SmartPLS 3.3.3 program to evaluate the structural model and test the proposed hypotheses (see Figure 4). The significance of the latent construct relationships was determined using 5000 subsamples and the bootstrapping method [126]. Since PLS does not give the overall goodness of fit measures,  $R^2$  and  $Q^2$  tend to be the most important methods for establishing the predictive capability of the structural model [121]. All  $R^2$  values in Table 5 are more than 0.1 (CEP  $R^2 = 0.299$ , SP  $R^2 = 0.439$ ). Consequently, the power of the model to predict the associations is developed [127].

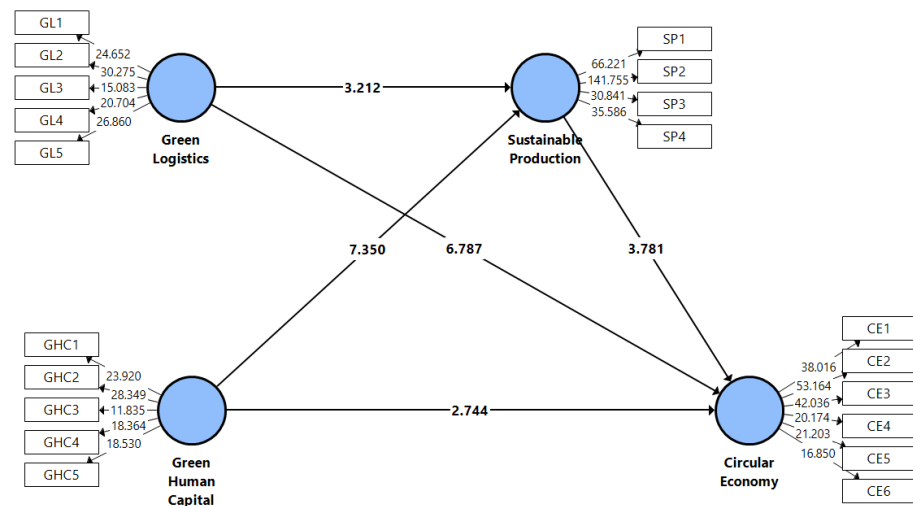


Figure 4. Structural model.

Table 5.  $R^2$  and  $Q^2$  of the Model.

Constructs	$R^2$	$Q^2$
Sustainable Production	0.286	0.241
Circular Economy Practices	0.456	0.311

In addition, the  $Q^2$  value demonstrates the predictive significance of the endogenous components, with a value greater than 0 showing their predictive significance. The outcomes also suggested that the predictive relevance of this study’s components is significant (SP  $Q^2 = 0.241$ , CEP  $Q^2 = 0.311$ ) (see Table 5). Furthermore, the model fit was tested using the PLS-SEM SRMR. It was noticed that the SRMR value was 0.078, which is below the maximum threshold of 0.08, suggesting a good model fit [128].

Following the evaluation of the model’s multicollinearity and predictive power, we evaluated the direct and indirect interactions between the GL, GHC, SP, and CEP. Table 6 depicts each hypothesis’s path coefficients, standard errors, and t-values.

**Table 6.** Results of hypothesis testing.

Hypotheses	Coefficients	t-Statistics	2.5% CI	97.5% CI	Remarks
Direct Effects					
H1: GL → CEP	0.444 (0.065) ***	6.787	0.299	0.555	Supported
H2: GL → SP	0.200 (0.061) ***	3.212	0.079	0.315	Supported
H3: GHC → CEP	0.175 (0.064) ***	2.744	0.048	0.298	Supported
H4: GHC → SP	0.427 (0.058) ***	6.787	0.299	0.527	Supported
H5: SP → CEP	0.230 (0.062) ***	3.781	0.114	0.358	Supported
Mediating Effects					
H6: GL → SP → CEP	0.046 (0.018) **	2.524	0.018	0.092	Supported
H7: GHC → SP → CEP	0.099 (0.031) ***	3.16	0.045	0.17	Supported

\*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

The direct and indirect impacts of the model constructs are presented in Table 6. The results indicate that each of the seven hypothesized associations in our model is statistically significant. Table 6 indicates that the GL positively impacts RMG firms' circular economy practices ( $\beta_1 = 0.444$ ,  $t = 6.787$ ,  $p = 0.000$ ), confirming hypothesis H1. The coefficients indicate that a 1% change in GL will result in a 0.444% increase in the CEP. Moreover, GL positively influences organizations' sustainable production since a 1% change in GL leads to 0.200% rise in SP ( $\beta_2 = 0.200$ ,  $t = 3.212$ ,  $p = 0.001$ ). Thereby, H2 is also supported.

Next, we observed that firms' GHC substantially affects the CEP ( $\beta_3 = 0.175$ ,  $t = 2.744$ ,  $p = 0.005$ ). The output suggests that a 1% increase in GHC would increase RMG firms' CEP by 0.175%. Hence, H3 is confirmed. Further, GHC positively drives organizations' sustainable production ( $\beta_4 = 0.427$ ,  $t = 6.787$ ,  $p = 0.000$ ), supporting hypothesis H4. The findings reveal that a 1% change in GHC results in a 0.427% rise in sustainable production. The coefficient indicates a strong impact of green human capital on RMG firms' sustainable production.

In addition, the results suggest that SP has a positive linkage with firms' circular economy practices ( $\beta_5 = 0.230$ ,  $t = 3.781$ ,  $p = 0.000$ ), corroborating hypothesis H5. A 1% improvement in SP leads to a 0.230% improvement in firms' CEP. We performed a mediation analysis to identify the indirect effect of GL and GHC on CEP through SP. The mediation analysis suggests that SP significantly mediates the linkage between GL and CEP, supporting H6. Next, we found that SP mediates the association between GHC and CEP, validating hypothesis H7. Figure 4 represents the structure model of our study.

PLSpredict was also used in this study to validate the model's out-of-sample predictive ability [129]. The majority of root mean squared error (RMSE) values of the linear model (LM) are lower than PLS-SEM values for the primary target constructs of SP and CEP, as indicated by the findings. Six of the ten indicators have PLS\_RMSE values that are larger than LM\_RMSE, suggesting that the model's predictive power is low to moderate [130]. The PLSpredict output is presented in Table 7.

**Table 7.** PLSpredict assessment of manifest variables.

Items	PLS_RMSE	LM_RMSE	PLS_RMSE—LM_RMSE
CE1	1.137	1.136	−0.02
CE2	1.048	1.071	0.00
CE3	1.192	1.226	0.01
CE4	1.414	1.403	0.03
CE5	1.447	1.441	−0.03
CE6	1.702	1.673	0.01
SP1	1.211	1.219	−0.02
SP2	1.200	1.199	−0.01
SP3	1.244	1.264	0.00
SP4	1.240	1.239	0.00

## 5. Discussion and Conclusions

To achieve national SDGs, companies must enhance their sustainability practices and performance. Numerous businesses are embracing green and sustainable methods to promote circular economy practices [7,61]. For example, several businesses worldwide have included green supply chain management methods in their operations to secure CE business models [34]. One of the critical ingredients of a green supply chain is green logistics management, which may serve as a critical accelerator for the circular economy [131]. In addition, human aspects are essential for implementing green and sustainability programs such as CEP. Thus, we investigated the function of GHC in enhancing the CEP of RMG enterprises. Consequently, the purpose of this study was to investigate the role of GLM and GHC in driving organizational CEP through sustainable production. Drawing upon the NRBV theory and DCT, we conceptualized and tested a model incorporating four constructs: Green logistics management, green human capital, sustainable production, and circular economy practices. Our PLS-SEM findings revealed several direct and mediating relationships among the constructs. These findings add crucial insights to the relevant literature in the emerging economy context.

First, this study observed that green logistics strongly affect firms' circular economy practices. This finding parallels prior studies that show the function of GLM in enhancing the 3R principle of the CE [6,29,132]. GLM components such as green transportation, distribution, packaging, and warehousing significantly drive the reduction of material consumption, reuse, and recycling of materials and waste. GL operations are connected to the environmentally-efficient management of the flow of goods and information to produce additional value for consumers and meet their demands [5]. The implementation of green packaging, green transportation, green warehousing, and green processing flows are GL's activities in putting the circular economy of businesses into practice [29]. This finding corroborates the proposition of the NRBV theory [46]. The NRBV paradigm suggests that implementing sustainable alternatives, such as green logistics, lowers environmental contamination and saves the environment from deterioration by collecting obsolete and damaged products for remanufacturing [15]. Second, we found that GLM also substantially predicts firms' sustainable production. We argue that the inbound logistics system is critical in the manufacturing process, and green practices in logistics management can drive sustainable manufacturing. Our finding aligns with prior research that connects GLM with sustainable production [1,14,76]. Jinru et al. [1] stress that GL should be implemented into organizational procurement to produce sustainable and green products.

Next, the findings reveal that GHC strongly influences firms' CEP. This result is supported by prior studies that established the positive link between GHC and CEP [21,23]. The findings suggest that if the managers and employees of an organization possess green dynamic capabilities such as motivation and awareness for environmental preservation, they are most likely to engage in circular economy activities. Marrucci et al. [23] conclude that human factors are as crucial as supply chain-related factors for implementing CEP in firms. The application of the 3Rs (reduction, reuse, and recycling) within organizations is regarded as a dynamic capability comprising interdependent CE initiatives aimed at achieving a shared purpose. Drawing upon the DCT, CE literature reported that firms' GHC facilitates developing dynamic green capabilities necessary for implementing CEP within the organization. Further, we observe that GHC is fundamental for introducing and managing sustainable production in a firm. Our findings corroborate previous research that explores the linkage between GHC and green manufacturing. For instance, Masri et al. [90] contend that GHC and other HR factors can influence sustainable production in manufacturing organizations. Thus, to incorporate sustainability practices such as SP, firms need to develop specific dynamic capabilities by improving the GHC of the employees.

The final hypothesis of direct relationship reveals that SP directly affects organizations' CEP. Several studies support this finding and report that SP can be an effective strategy for exploiting CE opportunities [1,79,90]. Bag et al. [91] establish a positive relationship between sustainable manufacturing and CEP. Additionally, Jinru et al. [1] demonstrate that

sustainable manufacturing is a driving element of enterprises' CEP. Through the optimal use of resources (e.g., energy, raw materials, and labor), sustainable manufacturing may produce valued products with a significant positive influence on the environment [132].

Finally, the mediation analysis suggests that sustainable production mediates the linkages between GLM and CEP. Since we also found a direct association between GLM and CEP, sustainable production partially mediates the association between GLM and firms' CEP. Moreover, the findings reveal that sustainable production also partially mediates the linkage between GHC and CEP. Prior literature has established sustainable production as an outcome of GHC [90] and a predictor of organizational CEP [1]. Hence, it can be concluded that corporate green practices such as GLM and managers' GHC lead to green manufacturing and subsequent circular economy practices. Given the paucity of research on the indirect effects of GLM and GHC on corporate CE practices and performance, our findings would add to the GSCM and GHRM literature.

## 6. Theoretical Implications

This research has made several theoretical contributions to the current GL, GHC, and CE literature. First, our research enhances the sparse literature on the linkage between green practices and CEP in developing countries by supplementing the conceptual framework of the NRBV and DCT. Regarding the NRBV and DCT, this research has significant implications for adopting sustainable manufacturing and attaining excellent CE performance in a hypercompetitive environment. Second, our study provides statistical evidence to support the assertion that GLM deployment is crucial for enhancing SP and CEP [6]. According to our results, the GLM positively influences the SP and CEP, which is congruent with the NRBV theory. This outcome is consistent with findings from research conducted in other countries. Our finding demonstrates that the NRBV paradigm is not geographically restricted and may be implemented anywhere to achieve CEP and SP goals. In addition, utilizing the DCT, we demonstrate that GHC, a significant DC of enterprises, is essential for carrying out circular economy activities. Consequently, this study broadens the scope of firms' NRBV and DC.

Thirdly, our research contributes to the existing knowledge base by establishing a direct relationship between sustainable production and CEP. This outcome suggests that a better degree of sustainable production significantly affects the CE performance of Bangladeshi RMG manufacturing enterprises. This is an essential contribution to the existing research in the context of developing economies, given that the bulk of studies finding a direct relationship between SP and CEP have been conducted in developed nations [1]. The NRBV framework contributes to expanding the discussion on the role of green endeavors, mainly green or sustainable manufacturing, in the CE performance of enterprises.

Fourthly, our paper adds to the literature by examining the mediating effect of SP on the interaction between GLM and CEP, GHC, and CEP. GSCM, GHRM, and CE literature have mostly focused on the SP as an outcome of the GLM and GHC and a driver of companies' CEP [1,91] while disregarding its mediating function. However, we are interested in the mediating influence of SP between the constructs. Evidence shows that the SP positively mediates the relationship between the GLM and CEP and the relationship between the GHC and CEP. This suggests that green manufacturing processes strengthen the deployment of green transportation and distribution, green logistics information systems, green training, and green recruiting to boost resource reduction, reuse, and recycling significantly. Since no previous research has addressed the crucial mediating role of the SP in the combined effects of GLM and GHC on businesses' CEP, our findings are a crucial addition to the literature.

Our study enriches the extant literature by expanding the understanding of the significance of green human factors, such as GHC, and green supply chain factors, such as GLM and SP, in attaining circular economy objectives in the context of an emerging economy. Our research provides empirical evidence for the direct influence of GLM, GHC, and SP in promoting circular economy practices in the Bangladeshi garments industry.



## 7. Practical Implications

Our study's findings have wide-ranging implications for managers, legislators, and policymakers. This research suggests that to increase competitiveness and achieve CEP, a company incorporates numerous green supply chain management initiatives and green human resource practices into its on-the-ground operations while adhering to sustainable manufacturing. The CE is a low-cost method utilized by several businesses to turn linear economic models into circular ones for protracted corporate sustainability. CE business practices may help settle resource shortfall issues while increasing the firm's value. Additionally, the CEP will aid a firm's key competencies in attaining organizational sustainability. Stakeholders are now urged to consider green practices while building a sustainability implementation plan and evaluating the outcomes generated by their CEP. Since RMG sectors are significant contributors to the region's emerging economies, the findings will substantially impact the South Asian region. This research will encourage garment manufacturers to integrate GL into their supply chain management and develop dynamic capabilities such as GHC to succeed in the circular economy. By reducing, reusing, and recycling materials in the supply chain, apparel firm managers and employees, must also cultivate GHC to change their organizations into a circular model. Governments can leverage various strategies to expedite the implementation of GSCM and CE standards in the apparel sector.

## 8. Limitations and Future Research Directions

The results of this study have made a substantial contribution; however, they may have some limits that could serve as guidelines for future research. The fact that this study draws data from Bangladesh's garment sector may limit the findings' application to all circumstances. In order to confirm the accuracy and validity of the conclusions, future studies may take into account gathering data from various sectors and regions. Additionally, although study samples accurately reflect the target population, the sample size may impact the study results. Therefore, additional approaches likely to boost respondent engagement may be used in future investigations. Future studies may also examine the effects of GLM and GHC using larger sample sizes and longitudinal data. Furthermore, we used variance-based structural equation modeling (PLS-SEM) for data analysis and model validation. Covariance-based structural equation modeling (CB-SEM) may be used to validate the findings in different scenarios. Moreover, future researchers may apply various robustness checks to ensure the validity of their findings. We demonstrate that elements relating to the supply chain and human resources are both essential for implementing CEP. There is, however, a dearth of empirical research that integrates these two elements to forecast CEP. We urge that there be more studies on how supply chain and human resource factors interact to affect corporate sustainability and the adoption of CE.

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