

Promoting Business Sustainability through Green Entrepreneurship: Do Green Human Capital and Innovative Activities Matter?

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Abstract: Although green entrepreneurship has been widely recognized as a driver of sustainable development, the mechanisms through which it enhances business sustainability remain insufficiently understood, particularly in developing economies where institutional and organizational capabilities continue to evolve. This study investigates how green entrepreneurship contributes to business sustainability by examining the mediating role of green human capital and the moderating role of innovative activities among entrepreneurial firms in Pakistan. A quantitative, cross-sectional research design was employed using data collected from 122 respondents through a structured online questionnaire. The proposed relationships were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4. The findings indicate that green entrepreneurship significantly enhances business sustainability, while green human capital serves as a significant mediating mechanism by transforming environmentally oriented entrepreneurial practices into sustainable organizational outcomes through employees' environmental knowledge, skills, and competencies. In contrast, innovative activities do not significantly moderate the relationship between green entrepreneurship and business sustainability, suggesting that innovation alone is insufficient to strengthen sustainability performance without complementary environmental capabilities and organizational alignment. These findings contribute to the sustainability and entrepreneurship literature by demonstrating that human capital is a more critical strategic resource than innovation in translating green entrepreneurial initiatives into sustainable business performance. The study further provides practical insights for managers and policymakers by emphasizing the importance of investing in green employee competencies, environmental training, and supportive institutional policies to strengthen firms' long-term sustainability and competitive resilience while advancing sustainable development objectives.

Keywords: Business sustainability, green entrepreneurship, green human capital, innovation activities, sustainable entrepreneurship, resource-based view, sustainable development goals.

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INTRODUCTION

In today's business landscape, sustainable development is a top priority as firms strive to meet the demands of environmental protection and social responsibility while maintaining economic growth (Rizavi, Amir, Siddique, Ali, & Umal Banin, 2026; Tekala, Baradarani, Alzubi, & Berberoğlu, 2024). Firms are moving towards more sustainable business models as a result of rapid industrialisation, climate change, resource depletion and rising stakeholder expectations (Barhoom, Alsakarneh, & Almetrami, 2025). Since the United Nations introduced the Sustainable Development Goals (SDGs) in 2015, firms have increasingly integrated environmental and social considerations into their business strategies while maintaining long-term competitiveness (United Nations General Assembly, 2015). Within this context, Green Entrepreneurship (GE) has become one of the key factors for sustainable development, through the development of environmentally-friendly products, services and business processes (AlQershi et al., 2023; Galindo-Martín, Castaño-Martínez, & Méndez-Picazo, 2020; Tekala et al., 2024). GE has been found to improve resource utilization, competitive edge, and long-term organizational performance in previous research (AlQershi et al., 2023; Barhoom et al., 2025; Galindo-Martín et al., 2020). However, empirical evidence on the mechanisms by which GE contributes to business sustainability (BS) is still limited, as environmental awareness, institutional support, and organizational capacities are still emerging (Lodhi, Asif, Abdikarimova, & Shahzad, 2026).

Green human capital (GHC) is one factor that could be responsible for this relationship and is defined as the environmental knowledge, skills, competencies and experience of employees that helps firms adopt environmentally responsible strategies and enhance their sustainability performance (AlQershi et al., 2023; Muafi, Norek, & Siswanti, 2020). The Resource Based View (RBV) (Barney, 1991) and the Natural Resource Based View (NRBV) (Hart, 1995) suggest that firms that create valuable strategic resources and environmental capabilities can sustain a competitive advantage. In this perspective, GHC is a key organizational asset, which can help firms achieve sustainable business results from green entrepreneurial projects (Lodhi et al., 2026). Furthermore, innovative activities (INA) can have an impact on the success of firms in translating entrepreneurial initiatives into better sustainability performance (Pham & Le, 2024) through cleaner technologies, environmentally responsible products and efficient production processes (Iqbal et al., 2023). Therefore, the mediation of GHC and the moderation of INA can be used to better understand the process and conditions by which GE can improve BS.

Although previous studies have provided some evidence, several important research gaps remain. First, most of the literature has focused on the direct link between GE and organisational performance (Jaskiewicz, Combs, & Rau, 2015; Tekala et al., 2024; Venâncio & Pinto, 2020) and less attention has been paid to the mediating role of GHC. Second, the moderating effect of INA on the relationship between GE and BS has been relatively under-researched (Pham & Le, 2024).

Third, most of the existing evidence comes from the developed world and developing countries are still facing institutional, technological and environmental issues that could influence these relationships (Ansari, 2025; Singh, Kumar, & Dana, 2025). Pakistan provides an important setting for addressing these research gaps because it faces increasing environmental challenges while promoting sustainable entrepreneurship and green business practices. However, empirical evidence on the relationship between GE and BS in Pakistan remains scarce, highlighting the need for further investigation in this emerging economy. Accordingly, this study investigates the relationship between GE and BS by examining the mediating role of GHC and the moderating role of INA among firms operating in Pakistan. Specifically, the study aims to (i) examine the direct relationship between GE and BS, (ii) investigate the mediating role of GHC, and (iii) determine whether INA moderates the relationship between GE and BS.

This study contributes to the literature in several important ways. First, it contributes to the literature on sustainable entrepreneurship by not only providing an explanation of the impacts of GE on BS, but also how this relationship is achieved via GHC and when INA influences this. Second, the study enhances on the RBV and NRBV by showing that GHC can be considered as an organizational capability that can help convert GE efforts into sustainable business results. Third, the study, through its empirical findings from Pakistan, contributes to the limited literature on GE in developing economies and offers practical ideas for managers and policymakers to promote sustainable business development. Moreover, the results are relevant to the broader sustainability agenda as they help to achieve the SDGs, specifically SDG 8 and SDG 12.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Theoretical Foundation

This study is grounded in the RBV and the NRBV to explain how GE contributes to BS (Barney, 1991; Hart, 1995; Hart & Dowell, 2011). According to RBV, firms gain a sustainable competitive advantage through the assembly of resources and capabilities that are valuable, rare, inimitable, and non-substitutable (Barney, 1991; El-Garaihy, Farag, Al Shehri, Centobelli, & Cerchione, 2024). Among these strategic resources, employees' environmental knowledge, organizational capabilities, and innovative competencies are critical for creating long-term sustainable value (Chang et al., 2026).

NRBV complements RBV by stating that corporate environmental capabilities are strategic resources that positively influence both environmental and organizational performance (Hart, 1995; Hart & Dowell, 2011). In this case, firms that are environmentally conscious in their entrepreneurial activities are in advantageous situations to achieve sustainability in their business endeavors (Makhloufi, Djermani, & Meirun, 2024; Zhang, Li, & Teng, 2025).

GE provides a competitive advantage because it endows employees with skills and knowledge to pursue green entrepreneurship (Shahzad, Akhlaq, & Ghaffar, 2025). Also, innovative work acts as an additional organizational capacity that reinforces the application of GE to achieve BS. Thus, the RBV and NRBV provide a solid, complementary theoretical construct to explain the direct relationship of GE to BS, and the roles that GHC and INA hold in this context (Ansari, 2025; Barhoom et al., 2025; Lodhi et al., 2026).

Green Entrepreneurship and Business Sustainability

BS has become a central objective of corporate sustainability management, requiring firms to balance economic performance with environmental and social responsibilities while maintaining long-term competitiveness (Makhloufi et al., 2024; Tekala et al., 2024). The growth of responsible and sustainable business practices, services, and products that facilitate the economic growth of firms has generated a lot of interest in studies that focus on GE (Lotfi, Yousefi, & Jafari, 2018; Sarifudeen, Niyas, & Ramalingam, 2025). GE facilitates the creation of sustainable business value by enabling firms to deal with environmental problems through resource use efficiency and the promotion of cleaner production and innovation (Ansari, 2025; Lodhi et al., 2026; Singh et al., 2025). Many of the prior studies reported positive impacts of GE on business performance (AlQershi et al., 2023; Ansari, 2025; Shahzad et al., 2025). GE has been associated with competitive advantage and the promotion of both sustainability and social impact through job creation and economic growth (George & Schillebeeckx, 2022; Malik, Ali, Kausar, & Chaudhry, 2021; Tekala et al., 2024). In addition, Odeyemi, Usman, Mhlongo, Elufioye, and Ike (2024) found that firms pursuing GE have better corporate and environmental performance, and more prior studies reported positive impacts on sustainable business performance from environmentally oriented entrepreneurial activities (Shah & Abbas, 2025; Shahzad et al., 2025; Soomro, Ghumro, & Shah, 2020). Taking a broad view of the available studies, it can be said that firms pursuing GE have a better ability and performance in integrating environmental concerns into their corporate strategies and operations. The following hypothesis is then formulated.

H₁: GE has a positive and significant effect on BS.

Mediating Role of Green Human Capital

GHC has become a critical resource for firms aiming to implement environmentally oriented strategies and achieve sustainable performance (AlQershi et al., 2023; Ni et al., 2023). It consists of employees' environmental knowledge, skills and competencies, and experience that assist the incorporation of green practices and complement sustainable initiatives of the organization (Alwakid, Aparicio, & Urbano, 2020; Dutta & Sobel, 2018). According to the existing literature, firms that adopt GE focus more on environmental learning, knowledge, and skills of employees, and consequently build up their GHC (Demirel, Li, Rentocchini, & Tamvada, 2019; Martin, McNally, & Kay, 2013; Sarkodie, Adams, Owusu, Leirvik, & Ozturk, 2020). Therefore, GE promotes environmentally oriented entrepreneurial activities and further provides a framework for employees to develop the skills to pursue sustainability objectives.

Employees with environmental competence are more likely to introduce green innovations and use organizational resources in an environmentally sustainable way (Afshan, Yaqoob, Meo, & Hamid, 2023; Alketbi & Ahmad, 2024). GHC also enhances innovation, the efficiency of operations, and sustainable competitive advantage, especially in firms that adopt sustainability-focused strategies (Malik, Ali, Amir, Tariq, & Ramzan, 2024; Sarkodie et al., 2020; Soomro et al., 2020; Soomro & Shah, 2023). The most recent evidence supports that firms that prioritize GHC and develop employees' environmental competence and skills reach better sustainability outcomes (Ndagi, Omair, Suradee, & Gilani, 2025).

Since GE creates the strategic direction for environmental responsibility and GHC provides the human capabilities required to implement those strategies effectively (AlQershi et al., 2023; Memon & Bukhari, 2026) GHC is expected to function as the underlying mechanism through which GE enhances BS. Therefore, the following hypothesis is proposed.

H₂: GHC significantly mediates the relationship between GE and BS.

Moderating Role of Innovative Activities

The development of INA has turned into an important organizational competence to strengthen firms' capacity to address environmental challenges and maintain their competitiveness in the long run (Al Alawi, Al Kindi, Al Shukaili, & Ahmed, 2025).

INA can help firms increase the efficiency of their use of resources and decrease their environmental impact by developing new products, production processes and technologies (Weina & Yanling, 2022). Innovation offers flexibility and technological capacity to make sustainability initiatives a reality and into business results, as firms become more focused on sustainability (Ansari, 2025; Aslam, Kausar, & Tasneem, 2025; Lodhi et al., 2026). Previous research has indicated a close connection between GE and innovation.

The firms that are working on GE are always looking for new solutions to environmental issues, such as creating new technologies that are less polluting, developing new products that are more environmentally friendly, and establishing new business models that are more sustainable (Malik et al., 2024; Soomro et al., 2020). Similarly, firms with a high level of innovative capacity are more likely to commercialize green concepts, enhance their operational efficiency and adapt to market and regulatory shifts (Galindo-Martín et al., 2020; Martinez, Peattie, & Vazquez-Brust, 2019).

Innovation, therefore, is not only a way to improve firms' environmental performance but also a way to strengthen the competitive advantage of the firms in the long-term (Jacyna-Gołda, Gavkalova, & Salwin, 2026). Empirical evidence also shows that innovation is a means of improving the effectiveness of sustainability-oriented actions by enabling green process innovation, product innovation, and organizational learning (Pham & Le, 2024; Roscoe, Subramanian, Jabbour, & Chong, 2019; Sarkar, Ullah, & Sarkar, 2022). Firms with relatively stronger innovative capabilities are thus better equipped to use GE for enhancing BS than firms with relatively weaker innovative capabilities. That is, the sustainability advantages of GE are likely to be greater if firms have more innovation capability. Thus, the following hypothesis is proposed.

H₃: INA positively moderates the relationship between GE and BS.

Figure 1 presents the framework of the study.

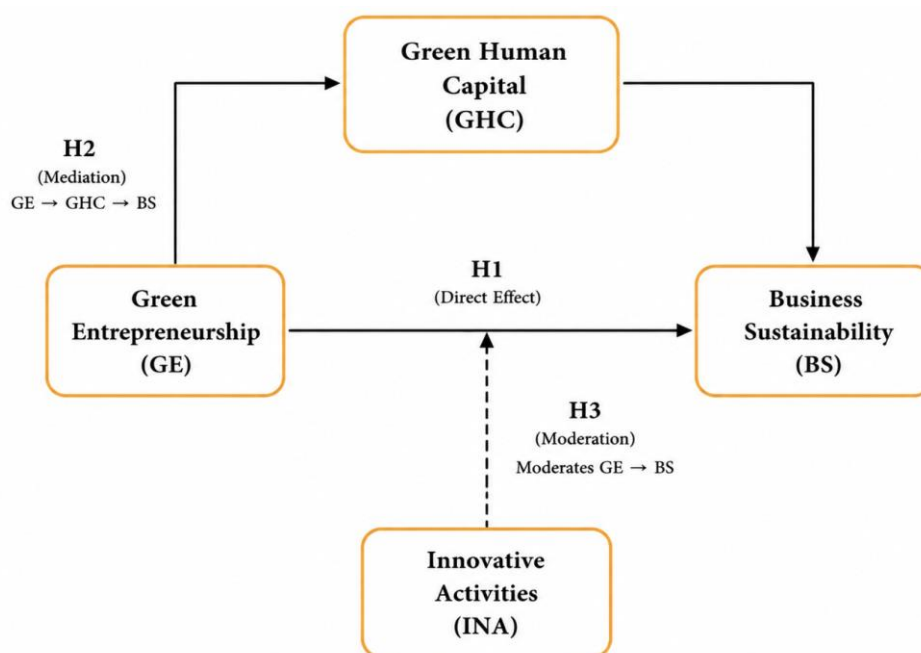


Figure 1: Framework of the study

METHODOLOGY

We adopted a quantitative cross-sectional research design for this study and considered entrepreneurial firms operating in Pakistan as the study population. It can provide a good foundation for rigorous hypothesis testing (Bougie & Sekaran, 2019) even when time and resource constraints exist, and can capture organizational dynamics at a specific point in time. The positivist research paradigm assumes that organizational phenomena are objective and measurable; thus, structured questionnaires and statistical techniques are suitable in empirical investigation, as stated by Saunders, Lewis, and Thornhill (2019). Before collecting the data, an a priori power analysis was performed using GPower ($f^2 = 0.15$, $\alpha = 0.05$, power = 0.95), indicating that a minimum of 119 responses would provide adequate statistical power. From this result, we tried to get around 150 usable questionnaires. The data were collected for about 40 days using a structured questionnaire that was sent using Google Forms.

Measurement

The instruments employed in this study were adapted from previous studies, which had been well established, to ensure content validity and consistency with previous studies. The items measured the GE with regard to environmentally responsible business practices and resource-efficient entrepreneurial activities (AlQershi et al., 2023). To measure the GHC, items that reflected the employees' environmental knowledge, skills, and competencies were adapted from (Sharabati, Naji Jawad, & Bontis, 2010). INA was evaluated based on the indicators related to sustainability-oriented innovation in products, processes and technologies (Najib, Septiani, & Nurlaela, 2020), while BS was measured by the triple-bottom-line dimension of environmental, economic and social performance (Yong et al., 2020). As in the previous PLS-SEM studies (Hair, Risher, Sarstedt, & Ringle, 2019), all constructs were measured by a 5-point Likert scale from 1 "strongly disagree" to 5 "strongly agree".

Common Method Bias and Ethical Considerations

Because the data were obtained from a self-administered cross-sectional questionnaire, we addressed the potential risk of common method bias (CMB) through both procedural and statistical remedies. When

developing the questionnaire, the respondents were assured of anonymity and confidentiality of their responses. The questionnaire was also broken down into individual sections and neutral wording was used to minimize social desirability bias and evaluation apprehension (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Podsakoff, Podsakoff, Williams, Huang, & Yang, 2024). Once the data were gathered, Harman's single-factor test and full collinearity test were performed. The first factor explained 23.78% of the total variance, well below the suggested 50%, which suggests that one latent factor did not account for the majority of the covariance among the measurement items (Podsakoff et al., 2003). Similarly, the inner VIF values were not more than 3.194, which is far less than the recommended cut-off value of 3.3 (Kock, 2015), indicating that CMB was not likely to cause a serious problem. In addition, ethical issues were followed throughout the research process. The respondents were informed about the purpose of the study, the data collection process, and the rights of the respondents as participants in the study, and informed consent was obtained. All responses were anonymized and stored securely to ensure the privacy of the participants and that the data collected is not accessible to unauthorized people. The study was conducted in accordance with the ethical principles and respondents could choose to withdraw from the study at any time without facing any penalty.

Data Analysis

We analyzed the collected data using SmartPLS 4. Considering the predictive nature of the proposed research model, mediation and moderation effects were included; thus, PLS-SEM was deemed the most appropriate analytical method as it allows for complex relationships without the need for any significant distributional assumptions (Hair, Hult, Ringle, & Sarstedt, 2022). First, we analyzed the measurement model and then estimated the structural model, according to the recommended analytical procedure. The assessment of the measurement model involved indicator loadings, Cronbach's alpha, the composite reliability (CR), the average variance extracted (AVE), and the heterotrait-monotrait ratio (HTMT). The structure was then evaluated based on the hypothesized relationships, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and collinearity (variance inflation factor (VIF)). The direct, indirect, and interaction effects were assessed with a bootstrapping procedure with 10,000 resamples. Finally, the overall model fit was evaluated by the standardized root mean square residual (SRMR) and normed fit index (NFI).

EMPIRICAL FINDINGS

Demographic characteristics were summarized in Table 1. Among the 122 participants, 74 (60.7%) were male, while 48 (39.3%) were female. The age distribution of the respondents showed that the majority of the respondents were in the 26-30 years age group (33.6%) and 31-35 years age group (31.1%), which means that the sample was mostly early and mid-career professionals. As regards work experience, 42.6% of the respondents reported less than five years of experience, while 24.6% of the respondents had between five and ten years of experience. As far as education was concerned, the majority of participants had a graduation degree (67.2%), while 14.8% had a postgraduate degree. In order to ensure that the respondents had the proper educational level and experience to give informed answers regarding green entrepreneurship and business sustainability.

Table 1: Profile

Characteristic	Category	n (%)
Gender	Male	74 (60.7)
	Female	48 (39.3)
Age	Less than 26 years	23 (18.9)
	26–30 years	41 (33.6)
	31–35 years	38 (31.1)
	More than 35 years	20 (16.4)
Work Experience	Less than 5 years	52 (42.6)
	5–10 years	30 (24.6)
	11–20 years	26 (21.3)

Characteristic	Category	n (%)
Education Level	Above 20 years	14 (11.5)
	School Certificate/Diploma	21 (17.2)
	Graduation Degree	82 (67.2)
	Postgraduate Degree	18 (14.8)
	Others	1 (0.8)

All measurement items are reported in the standardized outer loadings in Table 2. The majority of indicators were higher than the recommended value of 0.70 (Hair et al., 2022). The assessment of the measurement model revealed that the outer loadings of BS9 (0.468), BS10 (0.332), BS11 (0.555), GHC9 (0.568), and GHC10 (0.603) were relatively low and were excluded from the final model. Indicators with loadings lower than the recommended value can be removed in order to enhance construct reliability and convergent validity, as suggested by Hair et al. (2022). After removing these items, the retained indicators ranged from 0.795 to 0.893 for BS, 0.731 to 0.879 for GE, 0.726 to 0.878 for GHC, and 0.717 to 0.897 for INA. All the results taken together suggest good reliability of the indicators and the validity of the measurement model.

Table 2: Factor Loading

Item	BS	GE	GHC	INA
1	0.841	0.823	0.726	0.889
2	0.822	0.787	0.813	0.897
3	0.893	0.835	0.828	0.865
4	0.860	0.879	0.827	0.872
5	0.833	0.786	0.878	0.862
6	0.863	0.774	0.853	0.750
7	0.795	0.731	0.799	0.717
8	0.795	0.767	0.802	—
9	0.468†	0.790	0.568†	—
10	0.332†	—	0.603†	—
11	0.555†	—	—	—
12	0.841	—	—	—
13	0.823	—	—	—
14	0.800	—	—	—
15	0.878	—	—	—

Note: † Indicator removed during the measurement model assessment because its outer loading was below the recommended threshold.

The results of reliability, convergent and discriminant validity are presented in Table 3. All constructs showed high internal consistency (Cronbach's alpha ranging from 0.928 to 0.963, and CR ranging from 0.940 to 0.967), which is higher than the recommended value of 0.70 (Hair et al., 2022). Similarly, the AVE values were between 0.636 and 0.713, which meant that all constructs had more than 50% of the variance explained by their indicators, thus meeting the criterion for convergent validity (Fornell & Larcker, 1981; Hair et al., 2022). To evaluate the discriminant validity, the criterion of HTMT was used, and the values obtained ranged from 0.639 to 0.804, which is below the suggested criterion of 0.85 (Henseler, Ringle, & Sarstedt, 2015). In total, these results indicate that the measurement model has good reliability and validity, which can be used as a basis for testing the structural model.

Table 3: Reliability and Validity

Variable	Cronbach's α	CR	AVE	BS	GE	GHC	INA
BS	0.963	0.967	0.713	—			
GE	0.928	0.940	0.636	0.650	—		
GHC	0.934	0.945	0.684	0.735	0.639	—	
INA	0.929	0.943	0.703	0.643	0.804	0.642	—

The results of the structural model evaluation are presented in Table 4. The SRMR value of 0.064 suggests an acceptable fit of the model, and the NFI value of 0.726 reinforces the overall appropriateness of the proposed model (Hair et al., 2022). The model also explained reasonably well with $R^2 = 0.566$ (Adjusted $R^2 = 0.555$), which means that the model explained 56.6% of the variance in BS. The explanatory power at this level indicates that the framework proposed covers a significant percentage of the factors that relate to BS. The $Q^2_{predict}$ value was positive (0.522), indicating good out-of-sample predictive capacity for the endogenous construct. Inner VIF values were also explored and the values ranged from 1.712 to 2.530, all of which were below the recommended value of 3.3 (Kock, 2015). The results suggest that the structural relationships were not negatively impacted by the presence of multicollinearity and that collinearity was not an issue.

Table 4: Structural Model Assessment

Criterion	Measure	Construct	Value
Model Fit	SRMR	-	0.064
Model Fit	NFI	-	0.726
Explanatory Power	R^2	BS	0.566
Explanatory Power	Adjusted R^2	BS	0.555
Predictive Relevance	$Q^2_{predict}$	BS	0.522

The results of the structural model and hypothesis testing are presented in Table 5. As predicted in H1, GE had a positive and statistically significant effect on BS ($\beta = 0.193$, $t = 1.912$, $p = 0.028$). This finding indicates that firms placing greater emphasis on green entrepreneurial practices are more likely to achieve higher levels of business sustainability. Support was also found for H2. The indirect effect of GE on BS through GHC was positive and statistically significant ($\beta = 0.284$, $t = 3.477$, $p < 0.001$). Moreover, the 95% bias-corrected confidence interval (0.133–0.400) did not include zero, providing additional evidence that GHC serves as an important mechanism through which green entrepreneurship enhances business sustainability.

Table 5: Hypotheses Testing

Hypothesis	Relationship	β	SE	t	p	95% Bias-Corrected CI	Decision
H1	GE $\rightarrow$ BS	0.193	0.101	1.912	0.028	[0.038, 0.370]	Supported
H2	GE $\rightarrow$ GHC $\rightarrow$ BS	0.284	0.082	3.477	<0.001	[0.133, 0.400]	Supported
H3	INA $\times$ GE $\rightarrow$ BS	-0.042	0.059	0.716	0.237	[-0.151, 0.044]	Not Supported

In contrast, H3 was not supported. Although the interaction effect between INA and GE was negative ($\beta = -0.042$), it was not statistically significant ($t = 0.716$, $p = 0.237$). Similarly, the corresponding confidence interval (-0.151 to 0.044) crossed zero, indicating that INA did not significantly influence the relationship between GE and BS in the present sample.

Lastly, the f^2 values provide further evidence regarding the contribution of each predictor to the model. GHC exhibited a moderate effect on BS ($f^2 = 0.296$), whereas GE ($f^2 = 0.041$) and the interaction term ($f^2 = 0.028$) showed comparatively smaller effects.

These findings further highlight the important role of GHC in explaining business sustainability and are consistent with the significant mediation effect reported for H2. The estimated structural relationships and their corresponding path coefficients are illustrated in Figure 2.

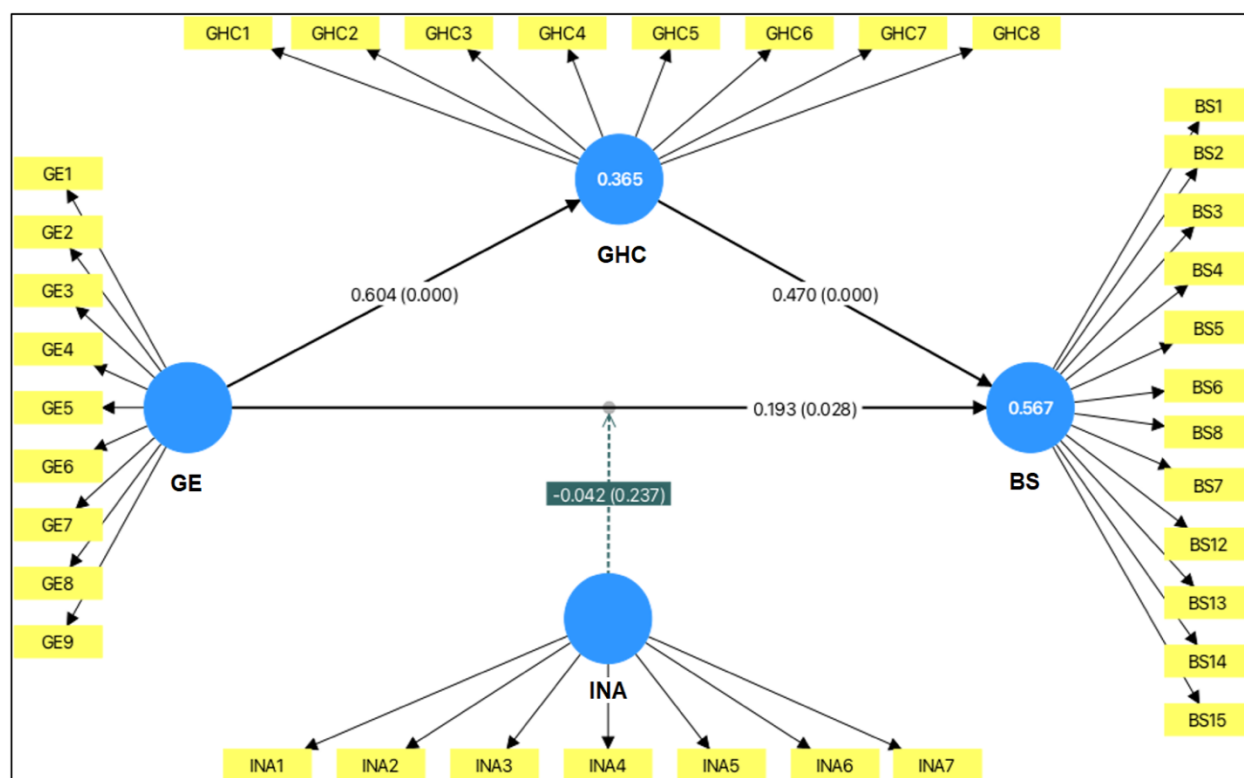


Figure 2: Structural Model

DISCUSSION AND RESEARCH IMPLICATIONS

Empirical findings prove that there is a strong positive relationship between GE and BS, which supports H1. It indicates that GE makes a significant improvement in BS, which is usually determined by profitability, market position, contributions to society, and minimization of environmental impact (Chang et al., 2026; Lodhi et al., 2026). Entrepreneurs are very instrumental in determining sustainability outcomes, particularly where their values are consistent with environmental protection. Nevertheless, external environmental pressures also affect sustainability, which highlights the fact that various types of entrepreneurship, such as opportunity-driven, growth-oriented and innovation-focused, respond differently to sustainability principles (Barhoom et al., 2025; Neumann, 2021; Rizavi et al., 2026). Examples of GE practices, including emissions reduction, the use of renewable resources, and waste management, demonstrate the fact that GE leads to long-term sustainability, which is correlated with the results of eco-innovation, which improves the environmental and financial performance (Cao, Nie, Sun, Sun, & Taghizadeh-Hesary, 2021; Lotfi et al., 2018).

The results of H2 confirm that mediation results are consistent with earlier research (Barhoom et al., 2025; Kapfudzaruwa, Nagao, & Mutisya, 2018). GHC, which is environmental knowledge, skills, and competencies of employees, has become more important as businesses adjust to the environmental requirements of the Fourth Industrial Revolution (Iqbal et al., 2023; Rizavi et al., 2026). GE improves this type of human capital by promoting an environmentally responsible attitude and innovation (Soomro et al., 2020). In line with Dutta and Sobel (2018) the results indicate that GHC plays a very important role in enhancing sustainability outcomes because it allows firms to minimize costs, resource use, and carbon emissions. This helps to support the idea that GHC investment creates competitive advantages and enhances innovation (AlQershi et al., 2023; Demirel et al., 2019; Hmaidan, ur Rehman, Akram, & Zuagaili, 2025; Ndagi et al., 2025).

The H3 examined whether INA moderates the relationship between GE and BS. Even though innovation has been considered a critical factor in the fight against environmental issues and enhancing competitiveness, the moderating influence was not substantial in the study. It has been demonstrated in the past that innovation

increases the viability of firms in different settings (Aslam et al., 2025; Lodhi et al., 2026). Sustainability is also enhanced by eco-labeling and green marketing (Skordoulis et al., 2022). Nevertheless, the INA in Pakistani manufacturing firms did not play a significant role in changing the effects of GE on sustainability, which rejected H3. One possible explanation is that innovation initiatives in many manufacturing firms remain incremental and are not sufficiently integrated with environmental strategies to amplify the sustainability benefits of GE. Moreover, the effectiveness of innovative activities may depend on complementary institutional support, such as favorable government policies, financial incentives, and technological infrastructure, which remain relatively limited in emerging economies like Pakistan. Although innovation continues to improve resource efficiency and organizational performance (Cheng, Yang, & Sheu, 2014), its moderating role may not emerge unless firms possess the institutional and organizational capabilities needed to translate innovation into enhanced sustainability outcomes (Al-Abdallah & Al-Salim, 2021; Galindo-Martín et al., 2020).

Implications

Theoretical Implications

This study makes several important contributions to the literature on GE and BS. First, it builds on the RBV (Barney, 1991) and the NRBV (Hart, 1995) by showing that GHC is a useful organizational tool that GE can use to augment BS. Given the key role of GHC, the environmental knowledge, skills and competencies of employees are considered strategic assets that can help firms achieve sustainable business results from green entrepreneurial projects. Second, the findings offer a set of empirical data from a developing economy, thereby complementing the expanding sustainability research stream in emerging markets where institutional and environmental conditions are different from developed markets. Third, the non-significant moderating effect of INA suggests that there is no strong moderating effect of INA on the relationship between GE and BS without the support of complementary organizational capabilities and green human resources (Ahmed et al., 2023; Rizavi et al., 2026). The discovery will help to better apply RBV and NRBV, as it will show that not only must innovation be used to create sustainable competitive advantage, but also strategic environmental resources must be developed and used to achieve it. Last but not least, the measurement framework developed in this study is validated and can serve as a basis for future research that will focus on sustainability-oriented entrepreneurship in other sectors, countries and institutional contexts.

Practical Implication

Results offer practical guidance for managers seeking to enhance BS through GE. The positive correlation between GE and BS indicates that environmental issues should not only be viewed as a compliance issue but should also be incorporated into business strategy. Firms need to focus on employee development by providing targeted training, ongoing learning, and knowledge-sharing to cultivate environmental knowledge and skills, establishing a strong connection between GE and BS. Environmental targets can also be incorporated into recruitment, performance measurement and reward systems to promote sustainable working. INA did not find any significant moderation effect on the relationship between GE and BS, but innovation initiatives should be based on the capabilities of the organization and environmental strategies, not on their own. These practices can have a positive impact on the long-term competitiveness of firms and contribute to the achievement of the United Nations Sustainable Development Goals, such as SDG 8 (Decent Work and Economic Growth) through sustainable business growth and developing employees' green skills, as well as SDG 12 (Responsible Consumption and Production) by promoting resource-efficient operations, environmentally responsible business practices, and sustainable production processes.

Implications for Policymakers

The findings also provide valuable implications for policymakers and regulatory authorities. Governments should establish supportive policy frameworks that encourage firms to adopt green entrepreneurial practices through financial incentives, tax benefits, and technical assistance for sustainability-oriented initiatives. Policymakers should also promote environmental education and workforce development by supporting industry–university collaborations and professional training programs that strengthen green skills and

competencies. In addition, environmental regulations should encourage firms to integrate sustainability into long-term business strategies while facilitating investments in environmentally responsible technologies and practices. Such policy initiatives can accelerate the transition toward a green economy, improve firms' environmental and economic performance, and contribute to the achievement of SDG 8 and SDG 1, thereby supporting sustainable industrial development and climate resilience.

CONCLUSION, LIMITATIONS AND POTENTIAL AREAS OF FUTURE STUDIES

The current study aimed to explore the role of GE in the development of BS in Pakistani manufacturing firms with the mediation of GHC and moderation of INA. The findings support the fact that the more robust the green entrepreneurial practices, the higher the sustainability outcomes of the firms. Most significantly, GHC became the focus of how GE improves BS, underscoring the role of employees' environmental knowledge, skills, and competencies in driving organizational performance. INA was predicted to enhance this relationship, but it was not statistically significant, meaning that the relationship between innovation and sustainability outcomes is unlikely to be positive unless combined with the right organizational capabilities. The findings underscore the importance of GHC in enhancing the effectiveness of green entrepreneurial efforts toward achieving business sustainability. Despite these contributions, the present study is subject to several limitations that provide opportunities for future research. The findings may not be generalizable to other institutional and industrial contexts as only entrepreneurial manufacturing firms in Pakistan were analyzed. Furthermore, the limited number of respondents and the fact that the study is based on CFOs only could have resulted in a lack of representation of other stakeholders in the organization. Further studies are needed in these relationships based on larger and more representative samples in various countries and industries. In addition, future research could focus on other mechanisms, such as green innovation capability, organizational green culture, and environmental regulatory support, to gain a more comprehensive understanding of the mechanisms that enhance the linkage between GE and BS.

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TRANSPARENCY: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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