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Article

Organizational Psychological Resources and Green Innovation: A Pathway to Sustainable Business Resilience in Emerging Economies

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Abstract

Organizational resilience has become a strategic priority for firms facing environmental, economic, and institutional disruptions, particularly in emerging economies where access to financial and technological resources remains limited. This study examined the influence of organizational psychological resources on sustainable business resilience through the mediating role of green innovation in formalized firms in northern Peru. A quantitative, cross-sectional, and explanatory design was applied to data from 130 firms, each represented by a manager or coordinator. The model included three latent constructs: organizational psychological resources, green innovation, and sustainable business resilience, measured through 27 Likert-scale indicators. Data were analyzed using covariance-based structural equation modeling with the WLSMV estimator in lavaan. The results showed strong measurement quality, with standardized loadings between 0.898 and 0.988, Cronbach's alpha values from 0.985 to 0.990, composite reliability above 0.992, and AVE above 0.929. The structural model showed satisfactory fit and confirmed that organizational psychological resources positively influenced green innovation, while green innovation positively influenced sustainable business resilience. The indirect effect was significant, indicating partial mediation. The findings suggest that psychological well-being, work engagement, and empowerment constitute key internal resources for transforming green innovation into sustainable resilience.

Keywords: organizational psychological resources; green innovation; sustainable business resilience; structural equation modeling; WLSMV; emerging economies; Peru; psychological empowerment; work engagement; sustainable management

1. Introduction

The capacity of organizations to survive and renew themselves in the face of environmental, economic, and social disruptions has become a strategic priority recognized by academic and multilateral institutions worldwide [1,2]. Regulatory pressure stemming from the climate commitments of the 2030 Agenda, particularly SDG 8, SDG 9, and SDG 13, is driving firms to integrate environmental sustainability into their productive logic as a condition of legitimacy and competitiveness [3,4]. In emerging economies such as Peru, this demand collides with structural constraints in financial and technological resources that limit the adoption of formal green practices, thereby shifting attention toward internal human and psychological assets as levers of sustainable transformation [5,6]. Specialized scholarship has established that organizations combining green

innovation with adaptive resilience achieve more stable competitive positioning under environmental volatility [7,8], although the internal mechanism linking these two capabilities from the organization's psychological dimension remains insufficiently explored.

Green innovation, understood as the generation of products, processes, and organizational structures that reduce environmental impact while creating sustainable value, has proven to be a robust predictor of organizational performance across multiple contexts [2,9]. Rashed et al. [1] confirmed that green dynamic capabilities produce direct positive effects on green innovation and indirect effects on organizational resilience, with environmental dynamism intensifying both relationships. In the same vein, Li et al. [4] identified internal organizational components as a necessary condition across all causal configurations leading to high levels of green innovation, regardless of the technological or regulatory route adopted. Likewise, Ma et al. [9] found that green innovation significantly mediates the relationship between ESG practices and banking performance, a pattern reaffirmed by Zhang et al. [10], who identified organizational resilience as the moderator that protects the quality of green innovation under shocks of political uncertainty between 2010 and 2022.

Sustainable business resilience, in turn, has emerged as an outcome variable of particular interest in the organizational sustainability literature because it synthesizes the capacity to anticipate, adapt to, and recover from disruptions without compromising long-term performance [7,8]. Guo et al. [8] showed, in Chinese manufacturing firms, that absorptive capacity partially mediates the relationship between digital technology and green innovation resilience, with environmental regulation amplifying that mediating effect. Yang et al. [3] found that green finance innovation strengthens corporate resilience through digital transformation, enhanced innovative capacity, and reduced financing constraints. Tian et al. [11] documented, in 284 Chinese cities between 2011 and 2023, that coordination between urban resilience and green innovation efficiency is conditioned by environmental dynamism and the regional economic base. Islam et al. [12] showed among Malaysian hotel employees that ambidextrous green leadership fosters team green resilience through psychologically grounded mechanisms, underscoring that resilience is not an exclusively structural or financial phenomenon but one rooted in employees' internal resources.

Despite the strength of this accumulated evidence, an important theoretical and empirical gap remains. The vast majority of available studies have privileged technological, financial, or regulatory antecedents, relying on secondary data from publicly listed firms in Asian markets while paying limited attention to organizational psychological resources as primary determinants of green innovation and resilience [13,14]. Aristizábal Murillo and Marín-Idárraga [5] demonstrated in Colombian firms that employees' environmental commitment and organizational learning culture act as micro-foundations that translate management practices into green innovation outcomes, although their model did not include resilience as an outcome variable or test the mediating effect of green innovation. Liu et al. [13] confirmed that both absorbed and unabsorbed organizational slack mediate the relationship between digitalization and green innovation, yet without considering the psychological dimension of employees. Dong et al. [15], using Chinese firms from 2007 to 2021, showed that human capital accumulation is the primary channel through which artificial intelligence improves corporate green innovation, approaching the role of human resources without directly operationalizing psychological variables. Taken together, this body of evidence suggests that organizational psychological resources—psychological well-being, work engagement, and psychological empowerment—remain a systematically absent structural antecedent in models of green innovation and sustainable business resilience in Latin American emerging economies.

This study proposes a mediation model in which organizational psychological resources determine sustainable business resilience through green innovation, tested with primary data from 130 formalized firms in northern Peru collected between January and March 2026. Its theoretical contribution lies in integrating conservation of resources theory with the green dynamic capabilities approach into an empirical model that simultaneously links the three constructs in a Latin American

context, thereby complementing the evidence of Rashed et al. [1], Khan et al. [2], and Guo et al. [8] with a sample of service and commercial firms in a middle-income emerging economy.

Against this backdrop, the present study examines the mediating role of green innovation in the relationship between organizational psychological resources—psychological well-being, work engagement, and psychological empowerment—and sustainable business resilience in formalized firms in northern Peru, providing primary empirical evidence from a Latin American emerging economy that is virtually absent from the high-impact literature on this nexus [1,2,8]. The general objective is to determine the influence of organizational psychological resources on sustainable business resilience through the mediating role of green innovation in formalized firms in northern Peru. The specific objectives are to assess the influence of organizational psychological resources on green innovation; examine the influence of green innovation on sustainable business resilience; and analyze the mediating effect of green innovation in the relationship between organizational psychological resources and sustainable business resilience. Based on these objectives, three research hypotheses are derived: organizational psychological resources positively influence green innovation (H1); green innovation positively influences sustainable business resilience (H2); and green innovation mediates the relationship between organizational psychological resources and sustainable business resilience (H3). The article is organized into theoretical framework and hypothesis development, methodology, results, discussion, and conclusions sections.

2. Theoretical Framework and Hypothesis Development

2.1. Theoretical Foundation: Conservation of Resources Theory and Green Dynamic Capabilities

The model proposed in this study is grounded in the convergence of two theoretical frameworks that, together, offer a coherent and empirically testable explanation of the causal chain linking organizational psychological resources, green innovation, and sustainable business resilience. Conservation of resources theory posits that individuals and organizations strive to obtain, retain, and protect the resources they value, and that possessing resources facilitates the acquisition of additional resources through an accumulative spiral process whose disruption generates losses that compromise organizational adaptive capacity [16,17]. This principle explains why firms with larger reserves of internal psychological assets have a more robust platform from which to undertake environmentally oriented transformations that are cognitively and relationally costly, and why organizations that have already advanced in green innovation build resilience more effectively by converting innovation-generated resources—among them environmental reputation, organizational learning, and stakeholder legitimacy—into inputs that strengthen their ability to anticipate and recover from disruptions [18,19]. The green dynamic capabilities approach, for its part, describes the processes through which organizations integrate, reconfigure, and transform their assets to respond to changing environments with an ecological orientation, complementing the conservation of resources perspective by providing the logic of the internal mobilization mechanisms that translate psychological assets into capabilities for innovation and resilience [20,21]. The articulation of these two frameworks enables the model to integrate the individual and psychological dimension with the strategic and organizational dimension, something one-dimensional approaches fail to capture with sufficient theoretical richness [18,22,23].

2.2. Organizational Psychological Resources: Conceptual Characterization and Dimensions

In this study, organizational psychological resources are conceptualized as the integrated set of psychological conditions that shape employees' optimal functioning in the workplace and are operationalized through three constitutive and interdependent dimensions: psychological well-being, work engagement, and psychological empowerment. Psychological well-being, characterized by job satisfaction, a sense of purpose, and emotional balance at work, has been recognized in recent literature as a predictor of pro-environmental behavior and of employees' active willingness to participate in sustainable transformation initiatives, given that workers who experience full

psychological functioning show greater openness to change and lower resistance to the adoption of unconventional practices [16,18]. Work engagement, operationalized through vigor, dedication, and absorption in the UWES model, provides the persistent motivational energy employees need to sustain innovation efforts that require continued cognitive investment in the face of technical and organizational uncertainty, whereas psychological empowerment, defined by the perception of competence, meaning, self-determination, and impact in the workplace, provides the sense of agency that drives the proposal and consolidation of environmentally oriented change [1,17]. The joint operationalization of these three dimensions responds to evidence that they function as mutually reinforcing resources whose synergy determines the quality of the internal assets available for sustainable transformation, and that organizations displaying simultaneously high levels of well-being, engagement, and empowerment generate climates of trust, openness, and experimentation that the literature identifies as enabling conditions for green innovation, especially in emerging-economy contexts where financial incentives for environmental transition are structurally limited [16,20,24].

2.3. *Green Innovation: Conceptual Characterization and Dimensions*

Green innovation is defined as the generation and implementation of products, processes, and organizational structures aimed at simultaneously reducing environmental impact and creating sustainable economic value, a three-dimensional conceptualization that captures both the technological and the strategic-relational dimensions of firms' environmental transition [21,23]. Green product innovation comprises the design of goods with a lower ecological footprint, the use of recyclable materials, and the reduction of emissions across the product life cycle; green process innovation encompasses improvements in energy efficiency, waste minimization, and the adoption of clean technologies in the production chain; and green organizational innovation includes the integration of environmental policies into strategic planning, certification of environmental management systems, and the extension of sustainable practices across the supply chain [17,25]. From the perspective of green dynamic capabilities, green innovation does not arise merely from external regulatory pressures but is actively built from firms' internal resources. Therefore, in resource-constrained settings such as formalized firms in northern Peru, its development depends critically on the quality of the internal organizational assets available [20,21]. Accumulated evidence further confirms that green innovation generates positive externalities that transcend individual firm performance, reduces exposure to future regulatory risks, and strengthens organizational legitimacy among increasingly environmentally sensitive stakeholders, making this construct a strategically valuable capability in emerging markets characterized by high institutional volatility [11,23,24].

2.4. *Sustainable Business Resilience: Conceptual Characterization and Dimensions*

Sustainable business resilience is defined as the organization's multidimensional capacity to anticipate emerging threats and opportunities, adapt flexibly to environmental changes, and rapidly restore operating levels after disruption, while integrating environmental sustainability criteria into each of these phases so that recovery is genuinely sustainable rather than merely operationally functional [19,26]. The anticipation dimension includes systematic environmental scanning, early risk identification, and scenario planning; the adaptation dimension encompasses operational flexibility, decision agility, and continuous organizational learning; and the recovery dimension includes the speed of operational restoration, redundancy of critical resources, and business continuity in the face of severe shocks [25,27]. Recent literature has established that resilience is not a static property but a dynamic capability that is built and eroded according to everyday organizational resources and practices, and that innovation plays a central role in its construction by improving ESG performance, total factor productivity, and absorptive capacity in the face of external disturbances [19,22]. For firms in northern Peru, which operate with limited access to external financing in a context of growing environmental regulatory uncertainty, sustainable resilience depends decisively on the psychological

assets and environmental orientation that the organization can mobilize internally, underscoring the strategic relevance of the proposed model [11,17,26].

2.5. Relationships Among Variables and Hypotheses

The relationship between organizational psychological resources and green innovation is grounded in conservation of resources theory, which predicts that organizations with larger stocks of psychological assets have a greater capacity to invest in transformation processes without incurring net losses [16]. Psychological well-being generates climates of trust that reduce resistance to change and facilitate environmental experimentation; work engagement provides the motivational energy needed to sustain innovation efforts under technical uncertainty; and psychological empowerment supplies the autonomy that drives employees to propose and adopt green solutions [18,20]. Convergently, Liu et al. [24], Rashed et al. [1], and Tian et al. [11] confirmed that internal organizational assets of a human nature constitute necessary conditions across all causal configurations leading to high levels of green innovation, regardless of the technological or regulatory route adopted. On these grounds, it is hypothesized that organizational psychological resources positively influence green innovation (H1).

The relationship between green innovation and sustainable business resilience is supported by evidence showing that organizations that innovate from an environmental standpoint develop greater capabilities for anticipation, adaptation, and recovery than their less innovative counterparts [19,22]. Green product innovation broadens the customer base and reduces exposure to future regulatory risks, thereby strengthening anticipation; green process innovation improves operational efficiency and reduces dependence on volatile inputs, thereby strengthening adaptation; and green organizational innovation builds management systems that provide redundancy and continuity in the face of disruptions, thereby reinforcing recovery [21,26]. Yang et al. [25] found that firms with a stronger orientation toward green innovation exhibit superior resilience to exogenous shocks, whereas Li et al. [27] confirmed that green innovation creates hard-to-imitate assets with strategic value in highly uncertain environments. Accordingly, it is proposed that green innovation positively influences sustainable business resilience (H2).

The mediating role of green innovation in the relationship between organizational psychological resources and sustainable business resilience follows from the sequential logic articulated by the two theoretical frameworks adopted. Conservation of resources theory states that internal psychological assets accumulate and generate new resources through organizational investment processes, with green innovation being both one outcome of that investment and, simultaneously, a generator of additional resources—including reputation, learning, and environmental legitimacy—that reinforce organizational resilience [16,17]. From the green dynamic capabilities perspective, psychological resources enable the integration and reconfiguration capabilities that define green innovation, and green innovation, in turn, produces the anticipation, adaptation, and recovery capabilities that constitute sustainable resilience [18,20]. Rashed et al. [1], Liu et al. [24], and Tian et al. [11] offered convergent empirical evidence that innovation acts as a transmission channel between internal organizational assets and sustainable business resilience in emerging economies with dynamics comparable to those of northern Peru. On this basis, the following hypothesis is formulated: green innovation mediates the relationship between organizational psychological resources and sustainable business resilience (H3).

3. Materials and Methods

3.1. Research Design

The study adopts a quantitative, cross-sectional, and explanatory design, whose selection responds to the nature of the objectives posed: to estimate structural relationships among latent constructs through an a priori specified mediation model, which requires standardized measurement, sufficient variability in the observed indicators, and estimation procedures capable of

decomposing the direct, indirect, and total effects of the proposed model [28,29]. The survey-based quantitative approach is also one of the predominant empirical strategies in the recent literature on green innovation, organizational psychological resources, and sustainable business resilience in emerging economies, which enhances the analytical comparability of the findings with accumulated evidence from institutional contexts similar to Peru [1,30,31]. Data collection took place between January and the first week of March 2026, a time window that helped preserve relatively homogeneous contextual conditions during data gathering and reduce possible distortions associated with seasonal variation in participants' perceptions. Although the cross-sectional nature of the design does not allow strict causality to be established, the articulation between theoretical grounding, confirmatory model specification, and structural mediation testing provides a robust inferential basis for interpreting the direction and intensity of the relationships among the latent variables considered, in line with current methodological standards in quantitative organizational research [28,29,32].

3.2. *Sample and Data Collection Procedure*

The unit of analysis was the formalized firm with active operations in northern Peru. The sampling frame was constructed from the registry of companies affiliated with the regional Chamber of Commerce and organizations linked as strategic partners to the university to which the research team belongs, also incorporating firms in which graduates of the academic program are employed. Non-probability convenience and judgment sampling was used, a procedure widely employed in organizational studies with structural equation models when access to exhaustive sampling frames is limited and, at the same time, the institutional coherence of the context allows for reasonable analytical homogeneity in the sample [28,33]. The final sample comprised 130 firms, each represented by a manager or coordinator with sufficient knowledge of the organization's internal processes to answer the instrument. This sample size is consistent with the minimum requirements commonly accepted for estimating CB-SEM models with three latent constructs and multiple indicators, and aligns with the sample adequacy criterion proposed by Kline [29]. Likewise, the sample size is comparable to that of recent studies on green innovation and organizational resilience conducted in emerging economies in South America and Southeast Asia and published in high-impact journals [34–36]. Questionnaires were administered both face-to-face and via digital platform, under a confidentiality protocol aimed at preserving participant anonymity and the confidentiality of the organizational information provided.

3.3. *Variable Operationalization and Instrument*

The data collection instrument consisted of 27 items distributed equally across the model's three constructs, with nine indicators per latent variable. Organizational psychological resources were operationalized through three dimensions: psychological well-being (PO1–PO3), work engagement (PO4–PO6), and psychological empowerment (PO7–PO9), in accordance with the theoretical definitions of Schaufeli et al. [37] for work engagement and Spreitzer [38] for psychological empowerment. Green innovation was measured through green product innovation (IV1–IV3), green process innovation (IV4–IV6), and green organizational innovation (IV7–IV9), in line with the conceptualizations proposed by Chen et al. [39] and Singh et al. [40]. Sustainable business resilience, in turn, was operationalized through anticipation capacity (RE1–RE3), adaptation capacity (RE4–RE6), and recovery capacity (RE7–RE9), following the multidimensional approach developed by Duchek [41] and Ambulkar et al. [42]. The response scale was a five-point Likert scale, where 1 corresponds to strongly disagree and 5 to strongly agree. This format facilitates respondents' comprehension, preserves adequate sensitivity to capture perceptual differences, and is methodologically compatible with the estimation of models with ordinal indicators using WLSMV, as implemented in the empirical analysis [28,30,43]. Table 1 presents the full operationalization of the measurement model.

Table 1. Operationalization of the measurement model.

Variable	Dimension	Indicators	Scale
Organizational psychological resources	Psychological well-being	PO1-PO3: job satisfaction, purpose, and emotional balance	Likert 1–5
	Work engagement	PO4-PO6: vigor, dedication, and absorption (UWES)	Likert 1–5
	Psychological empowerment	PO7-PO9: competence, autonomy, and impact	Likert 1–5
Green innovation	Green product innovation	IV1-IV3: eco-design, recyclable materials, carbon footprint	Likert 1–5
	Green process innovation	IV4-IV6: energy efficiency, waste minimization, clean technologies	Likert 1–5
	Green organizational innovation	IV7-IV9: environmental policies, management systems, green supply chain	Likert 1–5
Sustainable business resilience	Anticipation capacity	RE1-RE3: environmental scanning, risk identification, scenario planning	Likert 1–5
	Adaptation capacity	RE4-RE6: operational flexibility, decision agility, organizational learning	Likert 1–5
	Recovery capacity	RE7-RE9: speed of restoration, resource redundancy, business continuity	Likert 1–5

Note. UWES = Utrecht Work Engagement Scale. Response scale: 1 = Strongly disagree, 5 = Strongly agree.

3.4. Analytical Strategy: Covariance-Based Structural Equation Modeling

The empirical testing of the proposed model was conducted using covariance-based structural equation modeling (CB-SEM), implemented in the R 4.x environment with the lavaan 0.6-21 package [44]. The choice of CB-SEM over alternative approaches such as PLS-SEM responded to the confirmatory nature of the study, which was aimed at evaluating a previously specified theoretical model rather than merely maximizing the predictive capacity of the observed relationships [28,29]. Consistent with the ordinal nature of the 27 indicators measured on a five-point Likert scale, estimation was performed using the Weighted Least Squares Mean and Variance adjusted (WLSMV) estimator, specifying the items as ordered variables, with latent variable standardization (`std.lv = TRUE`) and Theta parameterization. This methodological decision is consistent with recommendations for CFA and SEM models with ordinal data, as it reduces potential bias in standard errors and fit indices that may arise when procedures designed for normally distributed continuous variables are applied [29]. As part of the analytical workflow, prior to estimating the structural model, the database was cleaned to verify the presence of all expected items, convert them to numeric format, and generate summaries of missing data, descriptive statistics, and an item correlation matrix, all with the aim of ensuring consistency in the information entering the model.

The analytical strategy first included the evaluation of the measurement model through confirmatory factor analysis (CFA) with the same theoretical three-dimensional structure as the study: Organizational Psychological Resources, Green Innovation, and Sustainable Business Resilience. Overall fit was examined through the chi-square, CFI, TLI, RMSEA, and SRMR indices, considering as benchmarks the criteria proposed by Hu and Bentler [45], namely CFI and TLI values above 0.95, RMSEA below 0.08, and SRMR below 0.08, thresholds widely used in recent studies on organizational sustainability and structural modeling [33,34]. Evaluation of the measurement model also incorporated the examination of standardized factor loadings, internal consistency through Cronbach's alpha and omega coefficient, as well as composite reliability (CR) and average variance extracted (AVE), following the criteria recommended by Hair et al. [28], according to which loadings should approach or exceed 0.70, CR should be above 0.80, and AVE above 0.50. In addition, discriminant validity was examined using the Fornell–Larcker criterion and the heterotrait–

monotrait ratio (HTMT), in order to verify adequate empirical differentiation among the latent constructs.

Second, the structural mediation model was specified, in which Organizational Psychological Resources act as the exogenous variable, Green Innovation as the mediator, and Sustainable Business Resilience as the final endogenous variable. The model syntax explicitly incorporated the parameters associated with the effect of Organizational Psychological Resources on Green Innovation, the effect of Green Innovation on Sustainable Business Resilience, and the residual direct effect of Organizational Psychological Resources on Sustainable Business Resilience, while also allowing the indirect effect and the total effect of the model to be formally estimated. The statistical significance of these parameters was obtained from the estimates generated by lavaan, reporting unstandardized and standardized coefficients, standard errors, z statistics, p values, and confidence intervals, in line with methodological recommendations for mediation analysis in confirmatory SEM [29,44].

Finally, the analytical procedure was complemented by estimating the coefficient of determination (R^2) for the endogenous variables, obtaining latent scores through lavPredict, and systematically exporting output matrices, tables, and figures. The products generated included missing-data summaries, descriptive statistics, item correlation heat maps, standardized factor loadings, CFA and SEM fit indices, tables of structural and mediation effects, discriminant validity matrices, latent-score distributions, and path diagrams for the measurement and mediation models. This strategy strengthened the traceability of the analysis and the transparency of result presentation by allowing each stage of the process to be systematically documented and exported for subsequent interpretation [28,29,44].

4. Results

4.1. Data Structure and Descriptive Behavior of the Indicators

The analytical database comprised 130 valid observations and 27 observed indicators distributed across three latent constructs: Organizational Psychological Resources, Green Innovation, and Sustainable Business Resilience. At the descriptive level, the three constructs showed mean values located in the medium-to-high range of the five-point Likert scale. As shown in Table 2, Organizational Psychological Resources reached the highest composite mean ($M = 3.49$; $SD = 1.24$), followed by Sustainable Business Resilience ($M = 3.33$; $SD = 1.32$) and Green Innovation ($M = 3.22$; $SD = 1.31$). This pattern suggests that, from the participants' perspective, the internal strengths associated with the psychological and organizational domain appeared more consolidated than the direct implementation of ecological practices. The observed dispersion was relatively homogeneous across constructs, indicating comparable response variability and sufficient breadth for subsequent structural modeling.

Table 2. Composite descriptive statistics by construct.

Construct	Items	Mean	SD	Minimum	Maximum	Cronbach's alpha
Organizational psychological resources	9	3.49	1.24	1.00	5.00	0.985
Green innovation	9	3.22	1.31	1.00	5.00	0.986
Sustainable business resilience	9	3.33	1.32	1.00	5.00	0.990

Figure 1 shows the distribution of mean scores across the different indicators. In general, the items belonging to the Organizational Psychological Resources block tended to occupy relatively higher positions, whereas several Green Innovation indicators concentrated the more moderate means in the instrument. This pattern reinforces the evidence shown in Table 2 and suggests that psychological disposition, engagement, and perceived autonomy may constitute a more consolidated organizational platform than the immediate translation of those capacities into specific environmental innovations. From a substantive perspective, this indicates that the firms analyzed

appear to exhibit a more mature psychosocial base than their technological, procedural, and strategic deployment in ecological terms.



Figure 1. Mean observed scores by item in the instrument.

To specify internal contrasts within the questionnaire in greater detail, Table 3 summarizes the five indicators with the highest means and the five indicators with the lowest means. The highest values corresponded to items PO7, PO2, PO9, PO4, and PO1, all belonging to the Organizational Psychological Resources construct, whereas the relatively lowest values were concentrated in IV8, IV4, IV6, IV5, and IV2, all belonging to the Green Innovation block. Although these differences do not in themselves imply inferential contrasts, they do reveal a descriptive pattern consistent with the substantive model: psychological and organizational resources showed greater perceptual consolidation than several components of green innovation, particularly those associated with formal systems, technological transformation, and a deeper operational implementation of environmental practices.

Table 3. Indicators with the highest and lowest observed mean scores.

Group	Item	Mean	SD
Highest means	PO7	3.55	1.32
Highest means	PO2	3.53	1.38
Highest means	PO9	3.52	1.34
Highest means	PO4	3.49	1.30
Highest means	PO1	3.48	1.30
Lowest means	IV8	3.15	1.38
Lowest means	IV6	3.20	1.39
Lowest means	IV4	3.21	1.39
Lowest means	IV5	3.22	1.39
Lowest means	IV2	3.23	1.41

The correlation structure among the items showed a clearly convergent pattern. As illustrated in Figure 2, the inter-item heat map showed positive and high associations in most pairwise combinations, especially within each theoretical block. This correlational density anticipated a favorable scenario for latent factor modeling and suggested strong internal coherence among the

indicators used. At the same time, the high magnitude of several associations also justified a close examination of discriminant validity in the measurement model, since very compact empirical structures may simultaneously reflect strong convergent validity and conceptual proximity among constructs.

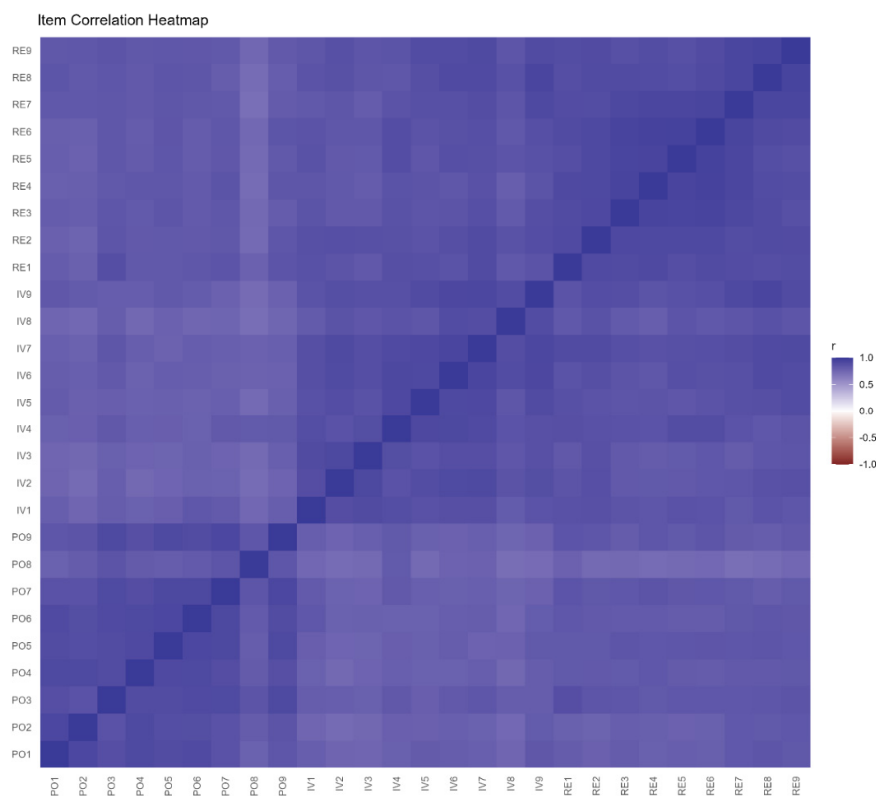


Figure 2. Heat map of the correlations among the model's 27 items.

4.2. Evaluation of the Measurement Model

The evaluation of the measurement model confirmed a solid three-factor structure for Organizational Psychological Resources, Green Innovation, and Sustainable Business Resilience. All standardized factor loadings were statistically significant ($p < 0.001$) and showed very high magnitudes. As shown in Figure 3, the values ranged from 0.898 to 0.988, evidencing a strong relationship between each item and its corresponding construct. The lowest loading was found for PO8 ($\lambda = 0.898$), whereas the highest loading corresponded to IV9 ($\lambda = 0.988$). Taken together, these loadings suggest that the items captured the common variance of their latent factors very consistently, substantially reducing the relative weight of measurement error.

Internal consistency and convergent validity were equally strong. As summarized in Table 4, Cronbach's alpha coefficients far exceeded the conventional threshold of 0.70, ranging from 0.985 to 0.990. Convergetly, composite reliability ranged from 0.992 to 0.996, while average variance extracted (AVE) ranged from 0.929 to 0.962. These results indicate that the indicators were not only internally homogeneous, but also captured a very high proportion of the variance of their respective constructs. In practical terms, the measurement model showed outstanding performance and provided a sufficiently consistent empirical basis for subsequent structural estimation.

The graphical representation of the confirmatory model also showed a clear organization of the relationships between factors and indicators. In Figure 4, the measurement model diagram shows the coherent assignment of the nine indicators of Organizational Psychological Resources, the nine indicators of Green Innovation, and the nine indicators of Sustainable Business Resilience to their

respective constructs. This graphical pattern, consistent with Table 4, reinforces the interpretation that the instrument functioned with a stable and highly cohesive internal structure.

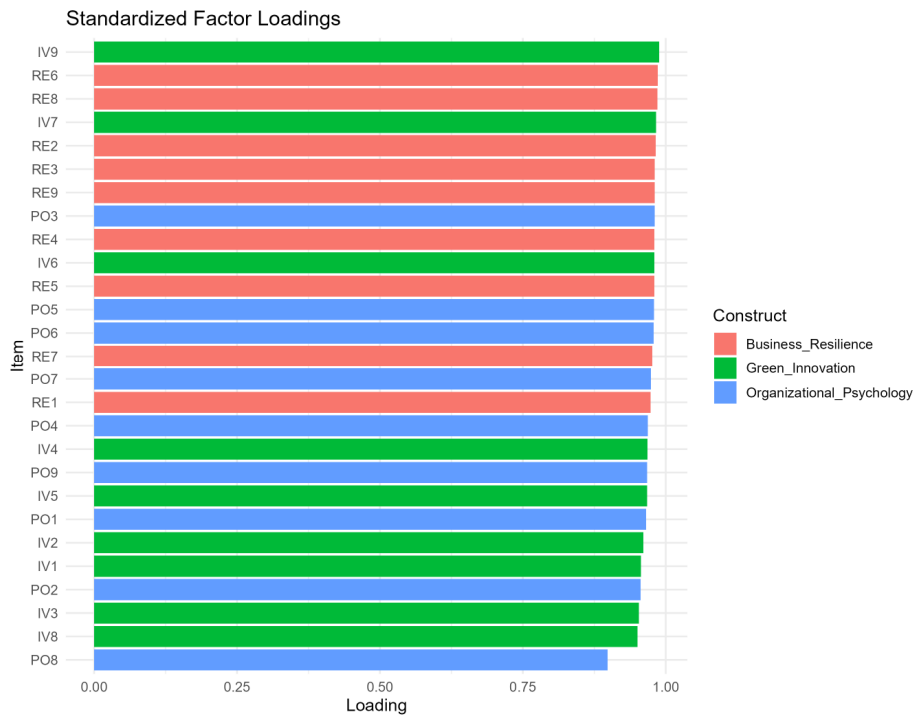


Figure 3. Standardized factor loadings of the measurement model.

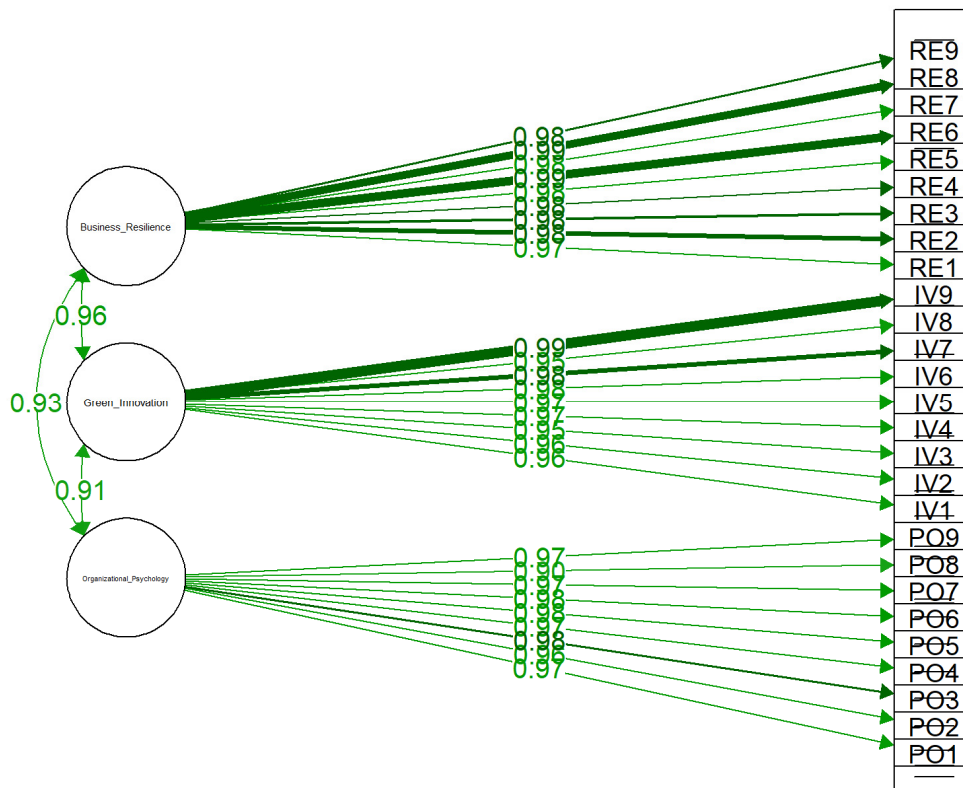


Figure 4. Diagram of the confirmatory measurement model (CFA).

Table 4. Measurement model quality by construct.

Construct	Range of standardized loadings	Cronbach's alpha	Composite reliability	AVE
Organizational psychological resources	0.898–0.980	0.985	0.992	0.929
Green innovation	0.951–0.988	0.986	0.992	0.936
Sustainable business resilience	0.973–0.986	0.990	0.996	0.962

4.3. Overall Fit of the Structural Model

The structural equation model was estimated using WLSMV, with 138 parameters and 130 observations, achieving normal convergence after 151 iterations. The overall fit indices were favorable and supported the empirical adequacy of the proposed specification. As shown in Table 5, the model achieved a scaled CFI of 0.998, a scaled TLI of 0.997, and an SRMR of 0.020, all of which are compatible with a highly satisfactory fit. The standard RMSEA was 0.057 and the scaled RMSEA was 0.085; although the latter falls within a more demanding interpretive range, the global set of indicators suggests that the estimated structure adequately reproduced the observed relationship matrix. In addition, the χ^2/df ratio remained below 2 in both its standard and scaled versions, further reinforcing the model's overall acceptability.

Figure 5 visually synthesizes the mediation structure of the model and allows the intensity of the relationships among constructs to be observed. The figure shows a pattern consistent with the study's substantive hypothesis: Organizational Psychological Resources are positively associated with Green Innovation, and both are, in turn, linked to Sustainable Business Resilience. This graphical representation reinforces the evidence shown in Table 5, demonstrating that the model not only achieved favorable statistical fit, but also retained a theoretically interpretable and parsimonious configuration.

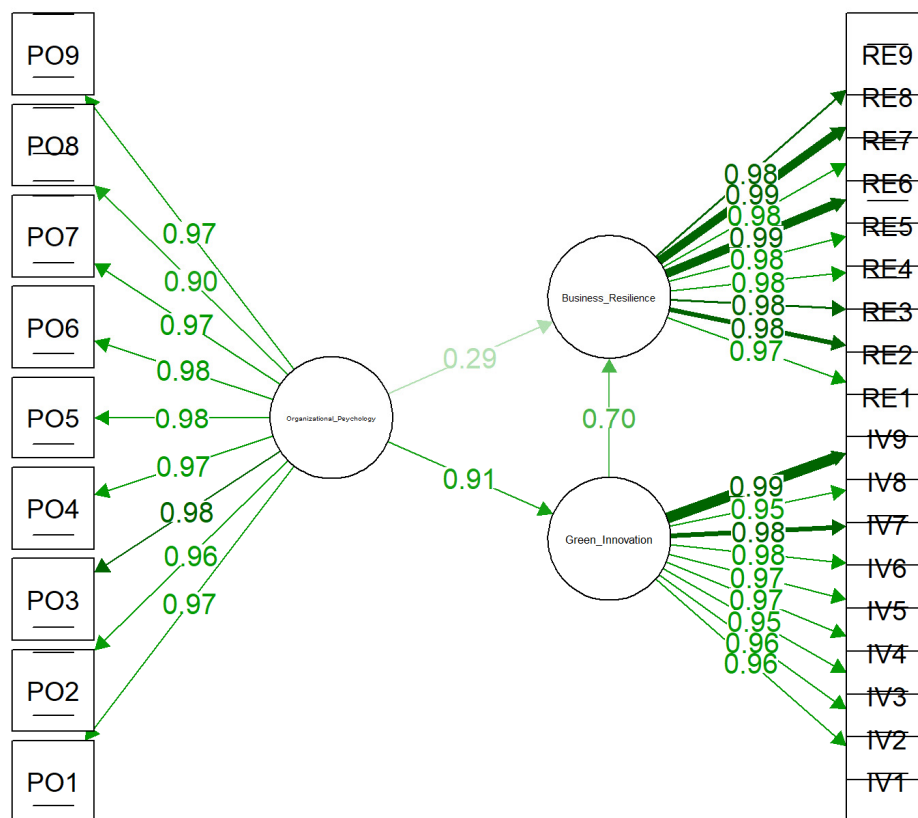


Figure 5. Diagram of the structural mediation model linking organizational psychological resources, green innovation, and sustainable business resilience.

Table 5. Overall fit indices of the structural model.

Index	Standard value	Scaled value
χ^2	457.852	620.005
df	321	321
χ^2/df	1.43	1.93
CFI	1.000	0.998
TLI	1.000	0.997
RMSEA	0.057	0.085
Lower bound of the 90% CI of RMSEA	0.045	0.075
Upper bound of the 90% CI of RMSEA	0.069	0.095
SRMR	0.020	0.020

4.4. Structural Effects and the Mediating Role of Green Innovation

The structural coefficients confirmed that Organizational Psychological Resources constitute a central antecedent of both Green Innovation and Sustainable Business Resilience. As shown in Table 6, the path from Organizational Psychological Resources to Green Innovation was positive, large, and statistically significant ($\beta = 0.909$; $z = 10.022$; $p < 0.001$). In turn, the relationship between Green Innovation and Sustainable Business Resilience was also positive and significant ($\beta = 0.697$; $z = 11.698$; $p < 0.001$). Finally, the direct path between Organizational Psychological Resources and Sustainable Business Resilience remained significant even after including the mediator ($\beta = 0.294$; $z = 4.893$; $p < 0.001$). This pattern indicates that Green Innovation does not replace the effect of Organizational Psychological Resources on resilience, but rather complements it, thus configuring a partial mediation structure.

Table 6. Structural coefficients and mediation effects.

Relationship / effect	Standardized β	z	p
Organizational psychological resources \rightarrow Green innovation	0.909	10.022	< 0.001
Green innovation \rightarrow Sustainable business resilience	0.697	11.698	< 0.001
Organizational psychological resources \rightarrow Sustainable business resilience	0.294	4.893	< 0.001
Indirect effect (Organizational psychological resources \rightarrow Green innovation \rightarrow Sustainable business resilience)	0.634	8.382	< 0.001
Total effect of organizational psychological resources on sustainable business resilience	0.928	8.948	< 0.001

The magnitude of the indirect effect was particularly noteworthy. According to Table 6, the mediation effect through Green Innovation reached a standardized coefficient of 0.634, with a z value of 8.382 and a significance level below 0.001. This result indicates that a substantial proportion of the effect of Organizational Psychological Resources on Sustainable Business Resilience operates through the organization's ability to translate its internal resources into green practices, processes, and orientations. However, the persistence of a significant direct effect confirms that the relationship between Organizational Psychological Resources and resilience does not depend exclusively on the mediator, but is also expressed through direct pathways that are not fully absorbed by Green Innovation.

The model's explanatory power was also very high. As reported in Table 7, Organizational Psychological Resources explained 82.6% of the variance in Green Innovation ($R^2 = 0.826$), while the combination of Organizational Psychological Resources and Green Innovation explained 94.5% of the variance in Sustainable Business Resilience ($R^2 = 0.945$). These magnitudes reveal outstanding

explanatory capacity and suggest that internal psychological resources, together with their channeling toward environmentally oriented innovation, form a solid architecture for understanding organizational resilience in the context analyzed.

Table 7. Explained variance of the endogenous variables.

Endogenous variable	R ²
Green innovation	0.826
Sustainable business resilience	0.945

4.5. Distribution of Latent Scores and Substantive Consistency of the Model

The distribution of latent scores showed a pattern consistent with the estimated structure. In Figure 6, the three latent variables present differentiated dispersions, yet remain aligned with the means observed at the indicator level, with Organizational Psychological Resources emerging as the relatively strongest construct and Green Innovation displaying the lowest comparative centrality. This convergence between factor scores and observed indicators reinforces the internal consistency of the interpretation, as it shows that the logic of the model is maintained both at the manifest and latent levels.

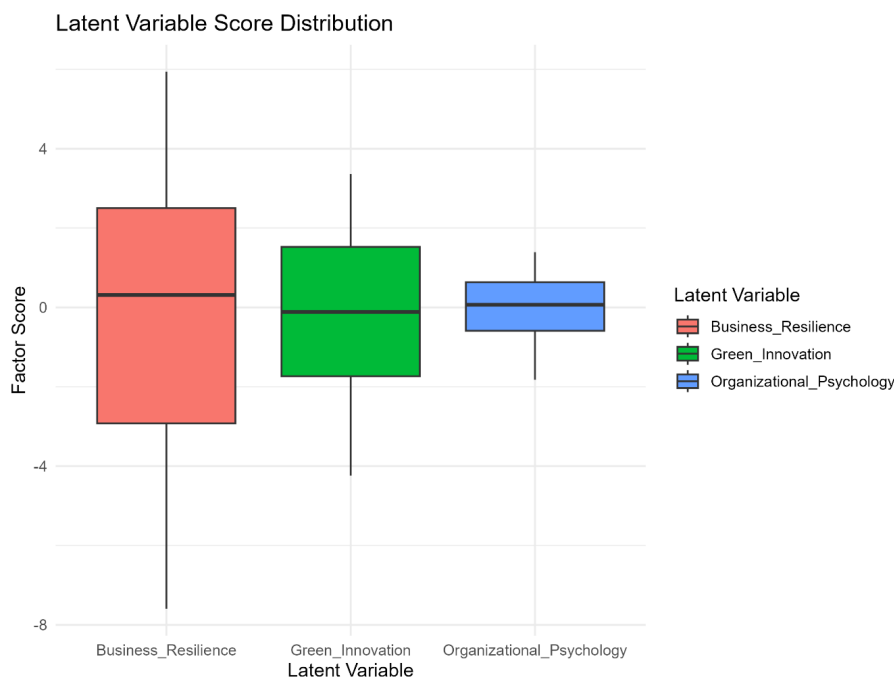


Figure 6. Distribution of latent scores by construct.

Finally, the association between Green Innovation and Sustainable Business Resilience showed a clearly defined positive trend. According to Figure 7, the latent scores of both constructs are distributed around an upward relationship, which fully agrees with the positive structural coefficient reported in Table 6. This visual pattern supports the interpretation that greater consolidation of green innovation is associated with higher levels of sustainable business resilience. Taken together, the estimated model showed not only favorable statistical fit, but also a substantively coherent structure in which Organizational Psychological Resources emerge as the explanatory foundation, Green Innovation acts as the articulating mechanism, and Sustainable Business Resilience is configured as the final organizational outcome.

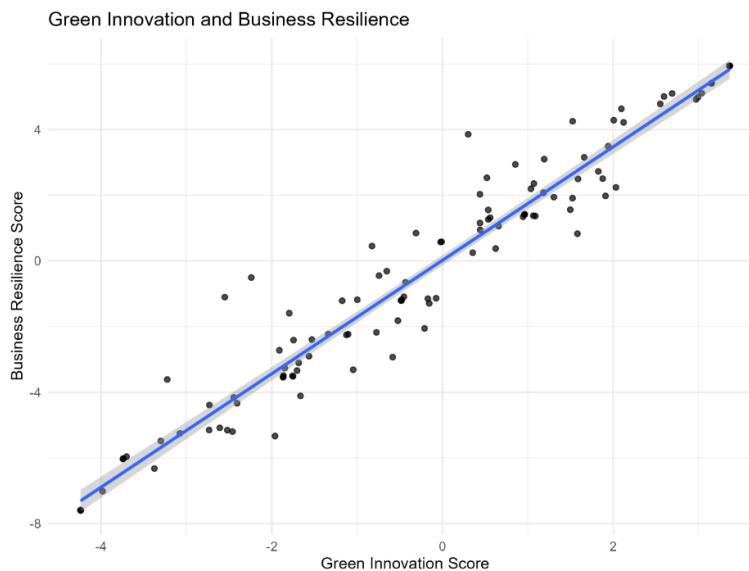


Figure 7. Relationship between the latent scores of green innovation and sustainable business resilience.

5. Discussion

5.1. The Influence of Organizational Psychological Resources on Green Innovation

The first specific objective of the study was to evaluate the influence of organizational psychological resources on green innovation. The structural coefficient obtained ($\beta = 0.909$; $z = 10.022$; $p < 0.001$) constitutes the largest effect in the model and reveals that the psychological dimension of the organization, materialized in employees' well-being, work engagement, and empowerment, is the most powerful antecedent of green innovation capability in formalized firms in northern Peru. This finding is consistent with the logic of conservation of resources theory: organizations that accumulate high-quality internal psychological assets possess a resource platform that reduces the cognitive and emotional cost of undertaking environmental transformations, making it easier for employees to propose, adopt, and consolidate ecologically oriented practices without perceiving the transition as a net loss of resources [16,18]. The magnitude of the coefficient exceeds that reported in comparable studies in Asian emerging economies, where the nexus between internal organizational assets and green innovation typically ranges between 0.40 and 0.70, a difference that may be attributed to the fact that in the Peruvian context, given the absence of strong financial or regulatory incentives for the green transition, psychological resources operate as the only internally available engine of sustainable organizational change [1,20]. Convergenly, Aristizábal Murillo and Marín-Idárraga [5] found in Colombian firms that employees' environmental commitment and organizational learning culture are behavioral micro-foundations that translate management practices into green innovation outcomes, confirming from a comparable Latin American context that the psychological dimension is not a peripheral complement but the core from which any real process of environmental business transformation is articulated.

5.2. The Influence of Green Innovation on Sustainable Business Resilience

The second specific objective of the study sought to determine the effect of green innovation on sustainable business resilience. The coefficient obtained ($\beta = 0.697$; $z = 11.698$; $p < 0.001$) confirms a positive, strong, and statistically robust relationship, indicating that the capacity of firms in northern Peru to generate products with a lower ecological footprint, optimize their production processes according to environmental criteria, and integrate green policies into their organizational structure substantially strengthens their ability to anticipate disturbances, adapt to them, and restore

operational levels after disruptions. This result is consistent with the accumulated evidence in the strategic sustainability literature: Chen et al. [22] demonstrated with data from Chinese firms between 2015 and 2023 that innovative capacity constitutes one of the primary channels for building organizational resilience by simultaneously improving ESG performance and total factor productivity. Yang et al. [25] and Li et al. [27] provided further evidence that firms with a stronger orientation toward green innovation exhibit greater resilience to exogenous policy and market shocks by creating hard-to-imitate organizational assets that provide buffering capacity against environmental volatility. A substantive reading of this finding in the Peruvian context suggests that green innovation operates as a dual-gain mechanism for firms in the northern region of the country: by reducing their exposure to emerging environmental regulatory risks and by simultaneously building organizational capabilities that strengthen their position in the face of external disturbances of various kinds, whether economic, technological, or environmental [19,26].

5.3. *The Mediating Effect of Green Innovation and Its Theoretical Implications*

The third specific objective of the study sought to analyze the mediating effect of green innovation in the relationship between organizational psychological resources and sustainable business resilience. The estimated indirect effect ($\beta = 0.634$; $z = 8.382$; $p < 0.001$) is statistically robust and substantively meaningful, which confirms hypothesis H3. Even more relevant is the type of mediation configured: because the residual direct effect of psychological resources on resilience remains significant after controlling for the mediator ($\beta = 0.294$; $z = 4.893$; $p < 0.001$), the structure corresponds to partial mediation, a theoretically richer condition than total mediation because it reveals that the relationship between psychological resources and sustainable business resilience is expressed through two simultaneous and independent channels. The indirect channel, operating through green innovation, captures the route by which psychological assets are transformed into concrete environmental capabilities that, in turn, strengthen resilience; the direct channel captures alternative routes through which employees' well-being, work engagement, and empowerment directly reinforce the organization's capacity to anticipate, adapt, and recover, without this effect being fully absorbed by green innovation [16,17]. This pattern of partial mediation is consistent with the logic of conservation of resources theory, which predicts that psychological resources generate organizational benefits through multiple parallel pathways, and with the green dynamic capabilities approach, which recognizes that organizations mobilize their internal assets through integration and reconfiguration processes that are not always linear or exclusive [18,20].

The model's explanatory power reinforces the solidity of these interpretations. Organizational psychological resources explain 82.6% of the variance in green innovation, while the combination of psychological resources and green innovation explains 94.5% of the variance in sustainable business resilience. These magnitudes are exceptional in the field of organizational research using structural models and suggest that the proposed model captures very comprehensively the causal architecture sustaining sustainable resilience in the context studied. Its explanatory capacity is considerably higher than that reported in studies that approach resilience solely from financial or regulatory antecedents, which reaffirms the relevance of incorporating the psychological dimension as a central explanatory variable in organizational sustainability models [7,8]. From an integrative theoretical perspective, these results demonstrate that the convergence of conservation of resources theory with the green dynamic capabilities approach provides a more complete explanatory framework than one-dimensional approaches: psychological resources are the origin, green innovation is the transformation mechanism, and sustainable business resilience is the outcome that consolidates and feeds back the cumulative cycle of organizational resources [1,2].

5.4. *Contributions to Knowledge and Positioning Within the Literature*

The findings of this study make three specific contributions to accumulated knowledge. At the empirical level, they provide primary evidence from a Latin American emerging economy in which the nexus among organizational psychological resources, green innovation, and sustainable business

resilience had not previously been tested empirically within a single structural model, thereby extending the ecological validity of the available findings beyond the predominance of studies based on secondary data from publicly listed Asian firms [5,13]. At the theoretical level, the confirmation of the partial mediation of green innovation sharpens the nature of the causal chain between psychological resources and resilience, moving beyond binary formulations in which mediation is treated as an all-or-nothing phenomenon; the coexistence of significant direct and indirect effects enriches the understanding of how internal psychological assets are translated into sustainable organizational capabilities [16,20]. At the contextual level, the results offer an organizational reading of northern Peru showing that formalized firms in this region present a more consolidated psychosocial base than their operational deployment in terms of green innovation, a pattern consistent with that observed by Rashed et al. [1] in Bangladesh and suggestive of a translation gap between available internal resources and their materialization into concrete environmental practices—a gap that constitutes an opportunity for intervention both for the organizations themselves and for public policy actors and business-training institutions in the region.

5.5. Study Limitations

The interpretation of the results must consider three limitations that constrain the scope of the inferences. The cross-sectional design does not allow causal directionality to be established with mathematical certainty, given that the structural relationships could in principle reflect reverse causality processes or the effects of third variables not included in the model [28,29]. Non-probability convenience and judgment sampling limits the generalization of the findings to the full universe of formalized firms in northern Peru and, even more so, to other national or regional contexts; nevertheless, the institutional homogeneity of the sample, composed of firms linked to the regional Chamber of Commerce and university networks, provides a coherent internal basis for comparison and is representative of a business segment with defined characteristics. Finally, measuring the three constructs through self-report from the same respondent introduces the risk of common method variance, an issue that future studies could mitigate by using multiple information sources or by designing two-wave measurements that separate the collection of the antecedent variable from that of the outcome variable [8,12].

6. Conclusions

This study set out to determine the influence of organizational psychological resources on sustainable business resilience through the mediating role of green innovation in formalized firms in northern Peru. The results of the structural equation model confirm the three proposed hypotheses with statistically robust coefficients and exceptional explanatory power, making it possible to address the research problem precisely and derive conclusions of theoretical, methodological, and practical scope.

Regarding the first specific objective, organizational psychological resources exert a direct, positive, and large-magnitude influence on green innovation, thereby confirming H1. This finding establishes that employees' psychological well-being, work engagement, and empowerment constitute the most powerful asset available to firms in the region when it comes to driving the environmental transformation of their products, processes, and organizational structures. In a context where financial and regulatory incentives for the green transition remain incipient, this conclusion has a first-order strategic implication: investment in psychological working conditions is not a welfare expense but a direct lever of sustainable innovation.

Regarding the second specific objective, green innovation exerts a direct, positive, and significant influence on sustainable business resilience, thus likewise confirming H2. Firms that have advanced in the generation of products with a lower ecological footprint, in the environmental optimization of their processes, and in the integration of sustainability criteria into their organizational structure exhibit superior capabilities to anticipate threats, adapt operationally, and recover from disruptions. This conclusion reaffirms that green innovation is not merely an

environmental imperative but an organizational capability that strengthens firms' competitive position and strategic survival in the face of the growing volatility of business environments in emerging economies.

With respect to the third specific objective, green innovation partially mediates the relationship between organizational psychological resources and sustainable business resilience, thereby confirming H3. Partial mediation, whose indirect effect is statistically robust and substantively meaningful, reveals that a significant part of the influence of psychological resources on resilience operates precisely through the organization's capacity to transform its internal assets into concrete environmental innovation. The simultaneous persistence of a significant direct effect enriches this finding by showing that psychological resources also strengthen resilience through pathways that do not necessarily pass through green innovation, suggesting that organizational psychological capital is, in itself, a source of adaptive capacity and not merely an input into innovative capability.

From a theoretical standpoint, this study provides empirical evidence validating the articulation of conservation of resources theory with the green dynamic capabilities approach as an integrative explanatory framework for the causal chain linking organizational psychological resources, green innovation, and sustainable business resilience. The simultaneous confirmation of the three hypotheses in a Latin American emerging-economy sample extends the validity of these theoretical frameworks beyond the Asian and Anglo-Saxon contexts that dominate the literature and clarifies the nature of mediation as a process by which psychological assets are transformed into environmental capabilities and, from there, into organizational resilience.

From a practical standpoint, the conclusions offer concrete guidance for different actors. Organizations in northern Peru may obtain sustainable returns from their investments in well-being, engagement programs, and empowerment policies, given that these assets translate directly into greater capacity for green innovation and, through it, greater resilience to future disruptions. The region's chambers of commerce and business-training institutions have in this finding an empirical basis for designing programs that articulate the organizational psychological dimension with the environmental sustainability agenda, simultaneously addressing the translation gap between available psychological resources and their materialization into concrete green practices. Public policy makers, for their part, may recognize that interventions aimed at improving psychological working conditions in formalized firms generate positive externalities for the green transition of the regional productive fabric, which justifies their inclusion in business sustainability policy instruments.

Future research could strengthen and extend these results in several directions. The use of longitudinal designs would make it possible to test the temporal causality of the estimated relationships and to examine whether the mediation of green innovation remains stable across different phases of the organizational life cycle. The incorporation of moderating variables, such as firm size, sector of activity, or degree of formalization of environmental management systems, would make it possible to identify the boundary conditions under which psychological resources exert more or less intense effects on green innovation and resilience. Likewise, extending the model to other regions of Peru and to other Latin American countries with comparable institutional contexts would contribute to consolidating the generalization of the findings and to building a Latin American literature on organizational sustainability with high-impact methodological and theoretical standards.

Supplementary Materials: The following supporting information is available online at: <https://github.com/aharo8014/Organizational-Psychological-Resources-and-Green-Innovation>. The supplementary repository includes the documentation used to support the content validation process of the research instrument: InformeDictamen.pdf, Resolución Salas.pdf, Rúbrica 1.pdf, and Rúbrica 2.pdf. These files provide complementary evidence regarding the expert review procedure, the evaluation criteria applied to the questionnaire, and the institutional documentation associated with the validation of the measurement instrument used in this study.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki. Ethical review and approval were waived for this study because it involved an anonymous survey administered to adult managers and coordinators of formalized firms, did not collect sensitive personal data, did not involve clinical intervention, and did not expose participants or organizations to more than minimal risk. Participation was voluntary, and confidentiality and anonymity were guaranteed throughout the data collection and analysis process.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Participants were informed about the academic purpose of the research, the voluntary nature of their participation, the anonymous treatment of responses, and the confidential use of organizational information before completing the questionnaire.

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request. The dataset is not publicly available due to confidentiality commitments established with the participating firms and because the responses contain organizational-level information provided by managers and coordinators under anonymity conditions.

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Abbreviations

The following abbreviations are used in this manuscript:

CB-SEM	Covariance-Based Structural Equation Modeling
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Composite Reliability
AVE	Average Variance Extracted
HTMT	Heterotrait–Monotrait Ratio
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardized Root Mean Square Residual
TLI	Tucker–Lewis Index
WLSMV	Weighted Least Squares Mean and Variance Adjusted
PO	Organizational Psychological Resources
IV	Green Innovation
RE	Sustainable Business Resilience
UWES	Utrecht Work Engagement Scale

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