



Research on the Mechanisms and Pathways of Cultural-Tourism Integration in Driving Innovation of Guilin's Green and Low-Carbon Industries

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Abstract. In the context of achieving dual carbon goals and deepening cultural-tourism integration, Guilin—currently developing into a world-class tourism city—is also confronting challenges in its green and low-carbon transition. This study employs a four-dimensional driving model involving government, enterprises, residents, and tourists to examine the influencing factors of innovative development in green and low-carbon industries from multiple perspectives, proposing corresponding optimization measures. Empirical analysis reveals that cultural-tourism integration significantly drives innovation and progress in Guilin's green and low-carbon sectors, with green technology innovation serving as the primary mediating factor. Both policy support and green finance demonstrate positive regulatory effects. Currently, Guilin's low-carbon industries remain in an intermediate transition phase, exhibiting spatial disparities characterized by strong performance in core scenic areas, weaker development among small and medium-sized enterprises, rapid progress in urban areas, and slower advancement in county-level regions. The study further utilizes multiple regression and chain mediation models to validate the transmission pathway from cultural-tourism integration to green innovation and low-carbon performance, proposing innovative development strategies across five dimensions: industrial structure, technological advancement, policy frameworks, financial mechanisms, and social participation. These findings provide empirical evidence and decision-making guidance for Guilin's green and low-carbon transformation as a world-class tourism city, while offering valuable references for similar cultural-tourism hubs pursuing low-carbon transitions. .

Keywords: Integration of culture and tourism, Green and low-carbon industries, Technological innovation.

1 Introduction

Restricted by global climate change and the dual carbon goals, the economic and social transformation of countries has accelerated. As a significant contributor to carbon emissions, the tourism sector should prioritize low-carbon and green transformations to attain sustainable development. Cultural and tourism integration, as a crucial direction for the upgrading of the tourism industry in the new era, can effectively reduce energy

consumption and emissions through cultural empowerment, business model innovation, and intensive resource utilization, serving as an important means to promote the development of green and low-carbon industries[1].

China has clearly established the objectives of attaining a carbon peak prior to 2030 and achieving carbon neutrality prior to 2060. Under this policy framework, the cultural and tourism sector is required to carry out green transformation, give priority to ecological protection, and implement low-carbon development approaches. In this context, new business forms such as green and low-carbon tourism, zero-carbon scenic spots, green hotels, low-carbon travel, and ecological cultural and creative products have emerged rapidly. The green and low-carbon industry has become the core track for the high-quality development of the cultural and tourism sector[4].

As a globally well-known tourist spot, a national model city for ecological civilization, and a key area for the ecological protection of the Lijiang River, Guilin stands as a representative city for China's cultural and tourism sector. In recent years, Guilin has vigorously promoted the comprehensive governance of the Lijiang River, the replacement of green energy, the construction of zero-carbon scenic spots, and the digital transformation of culture and tourism [6]. It has initially established a regional model characterized by ecological priority, the integration of culture and tourism, and low-carbon development. However, numerous challenges persist in practice: (1) The integration of cultural tourism with low-carbon development remains insufficiently deep; (2) Enterprises lack adequate investment in green technology innovation, and the adoption rate of energy-saving equipment is low; (3) Small and medium-sized cultural tourism enterprises face significant financing constraints, with inadequate support from green finance; (4) There are disparities in low-carbon awareness among tourists and residents, resulting in low enthusiasm for participating in low-carbon behaviors; (5) Low-carbon standards, regulatory frameworks, and incentive mechanisms are still underdeveloped.

Current literature predominantly focuses on individual dimensions such as low-carbon tourism, green development, and cultural-tourism integration, with limited empirical studies that integrate cultural-tourism convergence, green low-carbon industries, technological innovation, and multi-stakeholder behaviors within a unified framework[2]. Questionnaire-based empirical research specifically targeting Guilin is particularly scarce. Building upon this, this paper adopts the three-dimensional mechanism analysis model involving tourists, residents, and enterprises to construct a driving mechanism framework for the innovative development of Guilin's green low-carbon industries. Through empirical validation using questionnaire surveys, the study identifies key influencing factors and critical bottlenecks, ultimately proposing systematic pathways for innovative development.

The innovations of this study are reflected in three key aspects: First, a perspective reform that establishes cultural-tourism integration as the dependent variable and green technology innovation as the mediating variable, constructing a chain-like transmission mechanism to advance the theoretical framework for low-carbon transformation in cultural tourism[3]; Second, methodological innovation involving the use of primary questionnaire data from Guilin to validate the reliability, validity, correlation, regression, and mediating effects, thereby enhancing the credibility of the conclusions; Third, a practical reform focused on developing Guilin into a world-class tourist city, proposing

a actionable "five-in-one" low-carbon industrial innovation pathway to support local policy formulation [5].

2 Theoretical Basis and Research Methods

2.1 Low-carbon Tourism, Green and Low-carbon Industries, and the Integration of Culture and Tourism

Low-carbon tourism is a tourism development model centered on reducing carbon emissions, minimizing resource consumption, and protecting the ecological environment, encompassing the entire chain of transportation, accommodation, sightseeing, shopping, and entertainment. The green and low-carbon industry is characterized by low energy consumption, low emissions, low pollution, and high efficiency; it represents an industrial ecosystem that achieves sustainable development through clean energy, energy-saving technologies, recycling, and green management practices [1].

The integration of culture and tourism refers to the deep integration of cultural resources and the tourism industry in terms of products, business models, technology, markets, and services, achieving efficient resource allocation, value enhancement, and low-carbon development. By optimizing spatial patterns, avoiding redundant construction, promoting green consumption behaviors, and advancing digital transformation, this integration significantly reduces carbon emissions per unit of output while improving green total factor productivity[2].

In the context of achieving carbon neutrality, the low-carbon transformation of the cultural and tourism industry is not merely about energy conservation and emissions reduction measures, but rather a systematic reform encompassing industrial structure, technological systems, consumption patterns, and governance mechanisms[4].

2.2 Theoretical Framework for Promoting Green and Low-Carbon Industrial Development through Cultural-Tourism Integration

The theoretical foundations of this paper primarily encompass the following aspects: (1) Stakeholder Theory: The effectiveness of the low-carbon transition is influenced collectively by governments, cultural and tourism enterprises, tourists, residents, and financial institutions; (2) Planned Behavior Theory: An individual's adoption of low-carbon behaviors is primarily determined by their attitudes, social norms, and perceived behavioral control; (3) Technological Innovation Theory: Green technology serves as the primary driver for low-carbon industrial development [3]; (4) Industrial Integration Theory: The convergence of culture and tourism gives rise to new business models and directs production factors toward low-carbon practices[1]; (5) Social-Ecosystem Theory (SES): Tourist destinations function as complex adaptive systems where social and ecological subsystems are interconnected, exhibiting strong characteristics of co-evolution.

Based on this premise, this paper establishes a model of a four-dimensional driving mechanism, as shown in Fig. 1:

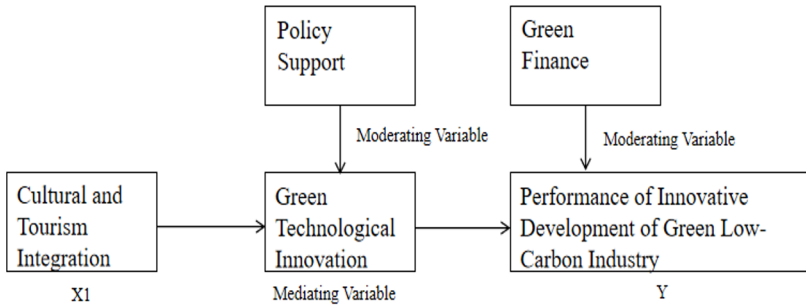


Fig. 1. Theoretical Framework of Tourism-Culture Integration Driving Innovative

2.3 Research Hypotheses

H1: The integration of culture and tourism exerts a significant positive impact on the innovative development of Guilin's green and low-carbon industries.

H2: Green technology reform serves as an intermediary between the integration of culture and tourism and the innovative advancement of low-carbon industries.

H3: Policy support exerts a positive moderating effect on the relationship between cultural-tourism integration and low-carbon industry development.

H4: The support of green finance exerts a positive moderating effect on the relationship between cultural-tourism integration and low-carbon industrial development.

H5: Tourists 'low-carbon behaviors, residents' low-carbon awareness, and enterprises 'green investments all positively contribute to the development of Guilin's low-carbon industry.

2.4 Data Processing and Indicator Design

Based on the "Guidelines for Green and Low-Carbon Development of the Cultural and Tourism Industry (Trial)" and relevant literature[2], this study establishes an evaluation system for green and low-carbon industrial development across four dimensions: environmental performance, innovation-driven achievements, economic impact, and sustainability outcomes. The weights were determined using the Analytic Hierarchy Process (AHP) and expert scoring methods, with values of 0.60, 0.20, 0.12, and 0.08 respectively after consistency verification. This weight allocation reflects the underlying principles of prioritizing low-carbon initiatives, fostering innovation-driven growth, achieving synergistic benefits, and ensuring sustainable support.

3 Research Designs

3.1 Study Area and Survey Subjects

Low-carbon tourism is a tourism development model centered on reducing carbon emissions, minimizing resource consumption, and protecting the ecological environ-

ment, encompassing the entire chain of transportation, accommodation, sightseeing, shopping, and entertainment. The green and low-carbon industry is characterized by low energy consumption, low emissions, low pollution, and high efficiency; it represents an industrial ecosystem that achieves sustainable development through clean energy, energy-saving technologies, recycling, and green management practices.

This study covers the entire territory of Guilin City, with its core areas including the urban district of Guilin, Yangshuo County, the Lijiang River region, and key cultural and tourism sites in counties such as Xing'an and Longsheng.

3.2 Questionnaire Design and Data Sources

The survey questionnaire consists of four sections: basic information, cultural-tourism integration, green innovation and policy finance, and low-carbon achievements. A five-point Likert scale is employed.

Research period: March to April 2026.

3.3 Measurement Model Settings

Benchmark Regression Model

$$Y = \beta_0 + \beta_1 X1 + \beta Controls + \varepsilon$$

Mediation Effect Model

$$M = \alpha_0 + \alpha_1 X1 + \alpha Controls + \varepsilon_1$$

$$Y = \gamma_0 + \gamma_1 X1 + \gamma_2 M + \gamma Controls + \varepsilon_2$$

Regulation Effect Model

$$Y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 (X1 \times X2) + \beta Controls + \varepsilon$$

4 Empirical Analysis

4.1 Descriptive Statistics

Low-carbon tourism is a tourism development model centered on reducing carbon emissions, minimizing resource consumption, and protecting the ecological environment, encompassing the entire chain of transportation, accommodation, sightseeing, shopping, and entertainment. The green and low-carbon industry is characterized by low energy consumption, low emissions, low pollution, and high efficiency; it represents an industrial ecosystem that achieves sustainable development through clean energy, energy-saving technologies, recycling, and green management practices.

This study covers the entire territory of Guilin City, with its core areas including the urban district of Guilin, Yangshuo County, the Lijiang River region, and key cultural

and tourism sites in counties such as Xing'an and Longsheng. The basic characteristics of the 306 valid samples collected in this paper are shown in Table 1.

Table 1. Distribution of basic sample characteristics (N=306).

Feature Category	Classify	Quantity	Proportion(%)
Company Size	Small and micro businesses	178	58.2
	Medium-lot producer	86	28.1
	Large-lot producer	42	13.7
Business Type	Scenic spot	69	22.5
	Hotel / Homestay	124	40.5
	Travel agency / Cultural and Creative Industries	63	20.6

4.2 Validity and Reliability Testing

According to Table 2, The results indicate that the α -coefficient exceeds 0.7 across all dimensions, the KMO value is greater than 0.7, and the Bartlett test reveals significant homogeneity, demonstrating good reliability and validity of the questionnaire.

Table 2. Results of Reliability and Validity Tests.

Variable	Cronbach's α	KMO	Bartlett
Cultural and Tourism Integration	0.872	0.851	0.000
Green Technology Innovation	0.865	0.826	0.000
Policy support	0.841	0.822	0.000
Green finance	0.833	0.815	0.000
Low Carbon Performance	0.894	0.868	0.000
Variable	Cronbach's α	KMO	0.000

4.3 Relevance Analysis

According to the results of the Pearson correlation analysis, Table 3 shows that all the variables in this study have significant positive correlations, which initially supports the research hypothesis.

Table 3. Pearson correlation analysis.

Variable	X1	M	X2
Cultural and Tourism Integration	1		
Green Technology Innovation	0.692***	1	
Policy support	0.571***	0.608***	1
Green finance	0.536***	0.536***	0.655***
Low Carbon Performance	0.685***	0.712***	0.596***
Variable	X1	M	X2

4.4 Benchmark Regression Analysis

The Table 4 regression results indicate that: Hypothesis H1 is validated, demonstrating that the integration of culture and tourism has a significant positive impact on low-carbon performance; Hypothesis H5 is also confirmed, with green innovation, policy support, and financial resources all showing pronounced positive effects.

Table 4. Basic Regression Results (Dependent Variable: Low-Carbon Performance Y).

Variable	Coefficient	T price	P price
Cultural and Tourism Integration	0.412***	6.326	0.000
Green Technology Innovation	0.305***	4.891	0.000
Policy Support	0.124**	2.316	0.021
Green Finance	0.108**	2.107	0.036
controlled variable	control	-	-
R?	0.673	-	-

4.5 Mediation Effect Test

Table 5 shows the test results, indicate that green technology innovation plays a significant partial mediating role, confirming the validity of Hypothesis H2.

Table 5. Testing of the Mediating Effect of Green Technology Innovation.

Way	Coefficient	95% Confidence interval	Effect Ratio
X1-Y (Total Effect)	0.412***	[0.301, 0.523]	100%
X1-M	0.526***	[0.415, 0.637]	-
M-Y	0.305***	[0.204, 0.406]	-
X1-M-Y (indirect)	0.160***	[0.098, 0.222]	38.8%
way	coefficient	95% confidence interval	Effect Ratio
X1-Y (Total Effect)	0.412***	[0.301, 0.523]	100%

4.6 Testing of the Regulatory Effect

As shown in Table 6, the test results indicate that both H3 and H4 are effective.

Table 6. Regulatory Effects of Policy Support and Green Finance.

Interaction Item	Coefficient	T price	P price	Conclusion
X1×X2	0.097**	2.421	0.016	Significant positive regulation
X1×X3	0.084**	2.203	0.028	Significant positive regulation

4.7 Conclusion of Heterogeneity Analysis

The heterogeneity analysis revealed that the low-carbon transition scores across Guilin's regions followed this order: Yangshuo (68.2 points)> urban area (65.8 points)>

county level (54.5 points), with the county-level transition process lagging significantly. By business type, scenic areas achieved the highest low-carbon score (67.5 points), followed by hotels and homestays (63.2 points), while travel agencies and cultural and creative enterprises scored the lowest (56.8 points), highlighting distinct differences among sectors.

5 Research Conclusion and Innovation Development Path

5.1 Research Conclusion

The integration of culture and tourism has significantly positive impetus for the innovative development of Guilin's green and low-carbon industries. In this process, green technology innovation plays a primary mediating role, accounting for 38.8% of the total effect. Meanwhile, policy support and green finance both exhibit notable positive regulatory impacts. Currently, Guilin's low-carbon industries are generally at an intermediate level, reflecting an imbalanced pattern where Yangshuo outperforms county-level regions, and scenic areas surpass small and micro enterprises. Additionally, there is insufficient synergy among enterprises, tourists, and residents, and the low-carbon governance system requires further refinement.

5.2 Innovative Development Path for Green and Low-Carbon Industries in Guilin

First, promote the deep integration of culture and tourism by incorporating cultural experiences, intangible cultural heritage preservation, and scenic tours into low-carbon business models, thereby creating regionally distinctive low-carbon cultural tourism IPs. Second, leverage green technology reforms to reduce carbon emissions across the entire process, promoting the adoption of energy-saving devices, clean energy sources, intelligent management systems, and improvements in low-carbon buildings. Third, strengthen the policy support framework by establishing incentive mechanisms that include low-carbon subsidies, tax incentives, low-carbon certification, and carbon credit systems. Fourth, demonstrate the targeted effectiveness of green finance through green loans, green insurance, and carbon finance products to alleviate financing constraints for small and micro cultural tourism enterprises. Finally, establish a multi-stakeholder collaboration mechanism to encourage low-carbon travel among tourists, motivate residents to adopt low-carbon practices, and foster corporate green self-discipline.

5.3 Policy Recommendations

The proposal calls for launching a Guilin low-carbon cultural and tourism demonstration project, with a focus on establishing a zero-carbon demonstration zone along the Lijiang River. Concurrently, efforts will be accelerated to develop Guilin's low-carbon standards and evaluation system for the cultural and tourism sectors, while enhancing targeted support for county-level governments and small and micro enterprises in their

low-carbon transition. Finally, a collaborative governance framework integrating the government, enterprises, financial institutions, residents, and tourists will be established to promote the high-quality development of Guilin's green and low-carbon industries.

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