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Multi-level governance of low-carbon tourism in rural China: policy evolution, implementation pathways, and socio-ecological impacts

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Low-carbon rural tourism development presents a critical challenge for environmental governance in emerging economies, yet the multi-level dynamics of policy implementation remain underexplored. This study examines China's approach to this challenge, employing a mixed-methods approach including analysis of 16 central and 559 provincial policy documents, case studies in 15 rural villages across five provinces (Hunan, Guangdong, Zhejiang, Shanxi, and Hainan), and a survey of 637 stakeholders. Our findings reveal a complex policy landscape characterized by evolving national frameworks, varied provincial adoption patterns influenced by economic, environmental, and institutional factors, and three distinct local implementation pathways: technology-driven, community-based, and policy-led. We uncover significant variations in stakeholder perceptions and socio-economic impacts across different contexts, highlighting the critical role of adaptive governance mechanisms and local contextual factors in determining policy effectiveness. This study contributes to policy diffusion and multi-level governance theories by demonstrating the intricate interplay between top-down directives and bottom-up innovations in shaping sustainable tourism outcomes. Based on these insights, we propose evidence-based policy recommendations emphasizing flexible, context-sensitive approaches and improved stakeholder engagement to enhance low-carbon rural tourism governance. This research provides valuable guidance for policymakers and practitioners working towards sustainable rural development and environmental conservation in China and other developing countries.

KEYWORDS

environmental governance, low-carbon tourism, rural development, policy diffusion, multi-level governance, China

1 Introduction

1.1 Global significance of low-carbon rural tourism

Low-carbon rural tourism has emerged as a critical approach to addressing climate change while promoting sustainable development. The global tourism industry, accounting for approximately 8% of global greenhouse gas emissions (Lenzen et al., 2018), faces the dual challenge of contributing to economic development while mitigating its environmental

impacts. This predicament is particularly acute in rural areas, where tourism often represents a vital economic lifeline but can also pose threats to fragile ecosystems and traditional ways of life.

The concept of low-carbon tourism aligns closely with several United Nations Sustainable Development Goals (SDGs), particularly SDG 13 (Climate Action), SDG 8 (Decent Work and Economic Growth), and SDG 11 (Sustainable Cities and Communities). This alignment reflects the potential of low-carbon tourism to contribute to broader sustainable development objectives beyond mere emissions reduction (UNWTO, 2019).

Global perspectives on low-carbon tourism have evolved significantly over the past two decades. Initially focused primarily on technological solutions and emissions offsetting, the discourse has expanded to encompass broader considerations of sustainable consumption patterns, community engagement, and the preservation of natural and cultural heritage. This evolution is reflected in the United Nations World Tourism Organization's (UNWTO) approach, which increasingly emphasizes the need for systemic changes in tourism development to address climate change challenges (UNWTO, 2019).

The implementation of low-carbon tourism initiatives globally has revealed both promising approaches and significant challenges. In Europe, the Alpine Pearls network represents a successful model of cross-border collaboration in promoting sustainable mountain tourism. This initiative, spanning several Alpine countries, focuses on offering car-free holidays and promoting sustainable mobility options (Peeters et al., 2019). The success of Alpine Pearls demonstrates the potential of regional cooperation in developing coherent low-carbon tourism products.

In developing countries, low-carbon tourism initiatives often intersect with poverty alleviation and conservation efforts. For instance, Nepal's Great Himalaya Trail project aims to develop sustainable trekking routes that benefit remote mountain communities while minimizing environmental impacts (Mu and Nepal, 2016). This approach highlights the potential synergies between sustainable tourism, biodiversity conservation, and rural livelihood improvement.

However, the global implementation of low-carbon tourism faces several challenges. One significant barrier is the tension between the desire for economic growth through tourism and the need to reduce carbon emissions. This is particularly acute in developing countries where tourism is often viewed as a key driver of economic development. Addressing this tension requires a fundamental rethinking of tourism growth models and a shift towards quality-oriented rather than quantity-oriented development strategies (Gössling et al., 2015).

Another challenge lies in changing tourist behaviors and expectations. While awareness of sustainable travel options is growing, translating this awareness into consistent low-carbon travel choices remains difficult. Factors including cost, convenience, and deeply ingrained travel habits often override environmental considerations in tourist decision-making (Juvan and Dolnicar, 2014).

The COVID-19 pandemic has added new dimensions to the low-carbon tourism discourse. While the dramatic reduction in global travel during the pandemic led to temporary decreases in tourism-related emissions, it also highlighted the vulnerability of tourism-dependent communities and economies. As the sector recovers, there is both an opportunity and a challenge to "build back better" by integrating low-carbon principles more deeply into tourism development strategies (Ioannides and Gyimóthy, 2020).

1.2 China's role in global low-carbon tourism transition

As the world's largest tourism market, China's approach to low-carbon rural tourism provides valuable lessons for global sustainable development efforts. By 2019, China's tourism industry contributed 11.05% to the national GDP, supported nearly 80 million jobs, and generated over 6 billion domestic trips (UNWTO, 2021). However, this growth has come at a significant environmental cost, with tourism accounting for a substantial portion of China's total carbon emissions (Sun, 2019).

The Chinese government's commitment to peaking carbon emissions before 2030 and achieving carbon neutrality by 2060 has placed renewed emphasis on sustainable development across all sectors, including tourism. This national agenda, coupled with the ongoing rural revitalization strategy, has created a policy environment ripe for low-carbon tourism initiatives. Since 2009, China has introduced a series of policies aimed at promoting sustainable tourism practices, ranging from broad national directives to specific local implementations.

However, the transition to low-carbon tourism in rural China is far from straightforward. It involves navigating a complex multi-level governance system, where national policies must be translated and adapted across diverse provincial and local contexts. This process is further complicated by varying levels of economic development, institutional capacities, and environmental challenges across regions. Understanding how low-carbon tourism policies diffuse and are implemented across these multiple governance levels is crucial not only for China's sustainable development but also for informing global efforts in this domain.

1.3 Research objectives and approach

This study addresses critical gaps in the multi-level governance of low-carbon rural tourism in China. We advance the theoretical understanding of policy diffusion and multi-level governance in sustainable tourism by examining the complex interactions between national directives, provincial adaptations, and local implementations. Our research contributes to the literature by providing a holistic analysis of multi-scalar dynamics, exploring the role of place-based factors in policy outcomes, and integrating governance theories in the context of an emerging economy.

We pursue five interconnected objectives: (1) analyze the evolution of China's national low-carbon tourism policy framework within global sustainability efforts; (2) investigate provincial-level policy adoption patterns, considering internal and external diffusion factors; (3) identify and evaluate diverse implementation pathways in rural contexts; (4) assess the multifaceted socio-economic impacts on rural communities; and (5) explore cross-level governance interactions to enhance policy coherence and effectiveness.

Our mixed-methods approach combines policy document analysis, multi-site case studies, stakeholder interviews, and quantitative surveys. This comprehensive methodology enables us to capture the nuanced complexities of low-carbon tourism governance across scales and contexts, contributing to both theoretical advancement and practical policy insights.

1.4 Significance and contributions

The significance and contributions of this study lie in its potential to inform both theory and practice in sustainable tourism governance. Theoretically, it advances our understanding of how policy diffusion and multi-level governance dynamics interact in the context of sustainable development initiatives. By examining these processes in the world's largest emerging economy, we contribute to a more globally representative body of knowledge in tourism governance studies.

Practically, our research offers valuable insights for policymakers and practitioners worldwide who are grappling with the challenges of promoting sustainable tourism in rural areas. The identification of successful implementation pathways, common pitfalls, and context-specific factors influencing policy outcomes can guide more effective and equitable approaches to low-carbon tourism development. Moreover, by highlighting the role of local innovations and adaptations, our study emphasizes the importance of flexible, bottom-up approaches in complementing top-down policy directives.

In the following sections, we first review the relevant literature and present our theoretical framework, integrating concepts from policy diffusion and multi-level governance theories. We then detail our research methodology, including data collection and analysis techniques. The results section presents our findings on national policy evolution, provincial adoption patterns, local implementation strategies, stakeholder perceptions, and socio-economic impacts. In the discussion, we explore the implications of these findings for understanding multi-level governance in sustainable tourism and identify areas for policy improvement. We conclude by summarizing the key contributions of our study and suggesting directions for future research in this critical area of sustainable development.

2 Literature review and theoretical framework

2.1 Global perspectives on low-carbon tourism development

Research on low-carbon tourism and environmental governance has evolved significantly over the past decades, reflecting broader transformations in environmental policy assessment. Recent studies highlight a shift from purely procedural approaches to more complex frameworks that emphasize stakeholder engagement, policy legitimacy, and implementation effectiveness (Nita, 2019; Caro-Gonzalez et al., 2023). This evolution in research approaches has enhanced our understanding of how sustainable tourism policies are developed, diffused, and implemented across different contexts. A systematic review of recent literature reveals several key theoretical advances and empirical insights that inform our analysis of low-carbon tourism governance.

First, studies increasingly recognize the importance of adaptive and context-sensitive approaches to policy implementation. Research from the European Union demonstrates how flexible policy frameworks that allow for local adaptation have been more successful in achieving sustainability goals compared to rigid, top-down approaches (Poyraz and Szalmáné Csete, 2022; Morgado Simões and European Parliament, 2024). Similarly, experiences from Southeast Asian countries highlight the critical role of local knowledge and institutions in shaping effective environmental governance (Miller et al., 2022).

Second, recent empirical work emphasizes the interconnected nature of environmental, social, and economic outcomes in tourism development. Studies from various contexts show that successful low-carbon initiatives often generate co-benefits across multiple dimensions, from emissions reduction to community empowerment and economic diversification (Bhaktikul et al., 2021; Ramkissoon, 2023). However, research also reveals persistent challenges in measuring and managing these complex interactions.

Building on these theoretical foundations and global experiences, this study examines how China's approach to low-carbon rural tourism governance navigates these challenges and opportunities. The evolution of low-carbon tourism research reveals several key themes and debates that inform our understanding of governance challenges and opportunities.

In the context of rural tourism, low-carbon development presents unique opportunities and challenges. Rural areas often possess natural and cultural assets that are well-suited to low-impact, experiential forms of tourism. However, these areas may also lack the infrastructure and capacity to implement sophisticated low-carbon technologies. Successful low-carbon rural tourism development requires approaches that are sensitive to local contexts and that build on existing community strengths and knowledge (Gössling, 2018).

The role of policy in promoting low-carbon tourism has gained increasing attention globally. Many countries have incorporated low-carbon tourism objectives into their national climate strategies and tourism development plans. For example, New Zealand's Tourism Industry Aotearoa has set ambitious carbon reduction targets for the sector and developed a sustainability commitment program for tourism businesses (Becken et al., 2021). Such initiatives demonstrate the potential for industry-led approaches in driving low-carbon transitions.

However, the implementation of low-carbon tourism policies remains challenging, particularly in contexts with weak governance structures or limited resources. Effective low-carbon tourism policies require not only clear targets and regulatory frameworks but also mechanisms for monitoring, enforcement, and adaptive management. Moreover, these policies must consider the diverse needs of different stakeholders and local contexts, as well as the complex interplay between climate change, tourism demand, and consumer behavior (Gössling et al., 2012).

The financing of low-carbon tourism initiatives is another critical global challenge. While there is growing interest in green investment opportunities, many low-carbon tourism projects,

particularly in rural or developing areas, struggle to access capital. Innovative financing mechanisms, including green bonds and carbon offset schemes, offer potential solutions but require further development and scaling (Dogan et al., 2017).

As we examine China's approach to low-carbon rural tourism development, it is essential to situate this within the global context. China's experiences offer valuable lessons for other countries grappling with similar challenges, particularly in balancing rapid tourism growth with environmental sustainability. At the same time, global best practices in low-carbon tourism governance and implementation can inform China's ongoing efforts in this area.

The global perspective on low-carbon tourism underscores the complexity of transitioning towards more sustainable forms of tourism development. It highlights the need for integrated approaches that address not only technological solutions but also behavioral change, policy innovation, and sustainable financing mechanisms. As we delve into China's multi-level governance of low-carbon rural tourism, these global insights provide a crucial backdrop for understanding the country's challenges and opportunities in this domain.

2.2 Policy diffusion in sustainable tourism governance

Policy diffusion theory provides a valuable lens for examining the spread of sustainable tourism practices across governance levels and jurisdictions. The concept of policy diffusion posits that policy choices in one polity are influenced by the choices made in other polities, through mechanisms including learning, competition, coercion, and mimicry (Shipan and Volden, 2008). In the context of sustainable tourism, this framework helps explain how innovative practices and regulatory approaches propagate across regions and countries.

Sustainable tourism governance has increasingly become a focus of policy diffusion studies, reflecting the growing recognition of tourism's role in both economic development and environmental challenges. Berry and Berry's work on policy innovation and diffusion provides a foundation for understanding how sustainable tourism policies spread (Berry and Berry, 2018). They identify internal determinants (including economic, political, and social characteristics) and external influences (including geographic proximity and policy networks) as key factors driving policy adoption.

In the realm of sustainable tourism, policy diffusion often manifests in the spread of eco-certification schemes, sustainable tourism standards, and low-carbon initiatives. For instance, the diffusion of sustainable tourism certification programs across European countries has been found to be significantly influenced by policy learning and regional networks (Font, 2002; Bowman, 2011). Similarly, the spread of low-carbon tourism policies among Chinese provinces has been shown to be driven by economic competition and institutional isomorphism (Liu et al., 2019).

The multi-scalar nature of tourism governance adds complexity to policy diffusion processes. Vertical diffusion occurs between different levels of government, including the adoption of national sustainability frameworks by local authorities. Horizontal diffusion involves the spread of policies among peer jurisdictions, often facilitated by policy networks and knowledge-sharing platforms. These vertical and horizontal diffusion processes often interact, creating complex policy landscapes in sustainable tourism governance (Benson and Jordan, 2011).

In the context of rural tourism, policy diffusion takes on additional nuances. Rural areas often face unique challenges in adopting and implementing sustainable tourism policies, including limited resources, weaker institutional capacities, and distinct socio-cultural contexts. The diffusion of sustainable tourism practices in rural areas has been found to be significantly influenced by local power structures, community attitudes, and the perceived compatibility of policies with local values (Nunkoo and Gursoy, 2016).

The role of non-state actors in policy diffusion has gained increasing attention in sustainable tourism research. International organizations, NGOs, and industry associations often act as policy entrepreneurs, facilitating the spread of sustainable tourism practices across borders. For example, the United Nations World Tourism Organization (UNWTO) has been instrumental in diffusing sustainable tourism policies globally, particularly through its Sustainable Tourism-Eliminating Poverty (ST-EP) initiative (Zapata and Hall, 2012).

However, policy diffusion in sustainable tourism is not without challenges. The potential for policy transfer failures when contextual factors are not adequately considered has been highlighted in the literature. This underscores the need for a more nuanced approach to policy diffusion that accounts for the complex, multi-stakeholder nature of tourism governance and the need for adaptive policy approaches (Dredge and Jamal, 2015).

In the Chinese context, the study of policy diffusion in sustainable tourism governance must consider the country's unique political and administrative structure. China's governance system is characterized by a complex interplay between central directives and local implementations. While national policies provide overarching guidelines, local governments often have considerable discretion in interpreting and adapting these policies to fit their specific contexts. This dynamic has led to diverse outcomes in environmental policy implementation across different regions in China. Research has shown that local governments' responses to national environmental policies vary significantly, influenced by factors such as local economic conditions, institutional capacity, and political priorities. This variation in policy implementation underscores the importance of understanding both top-down and bottom-up processes in China's environmental governance, including in the realm of sustainable tourism (Lo, 2015).

The concept of "policy mobility" offers a useful complement to traditional policy diffusion theories in understanding the spread of sustainable tourism practices. This approach emphasizes the transformation and adaptation of policies as they move across contexts, rather than viewing diffusion as a simple replication process. In the context of low-carbon rural tourism in China, this perspective helps explain how national policies are reinterpreted and reshaped at local levels to fit diverse rural contexts (McCann and Ward, 2013).

As we examine the multi-level governance of low-carbon tourism in rural China, policy diffusion theory provides a framework for understanding how sustainable tourism practices

spread across the country's vast and diverse landscape. It helps us identify the mechanisms driving policy adoption at different governance levels, the role of various actors in facilitating diffusion, and the factors influencing the success or failure of policy transfer in different contexts.

2.3 Multi-level governance in tourism development

The concept of multi-level governance (MLG) offers a valuable framework for understanding the complex interactions between various actors and institutions involved in shaping tourism policies and practices. Originally developed in the context of European Union studies, MLG has been increasingly applied to tourism research, reflecting the sector's inherently multi-scalar nature and the diverse stakeholders involved in its governance (Liesbet and Gary, 2003).

MLG recognizes that policymaking and implementation occur across multiple, interconnected levels of government and involve a range of non-state actors. In tourism development, this typically includes national tourism authorities, regional development agencies, local governments, private sector entities, NGOs, and community organizations. The MLG perspective emphasizes the dispersion of decision-making away from central states, both vertically to supranational and subnational institutions, and horizontally to non-state actors (Bache and Flinders, 2004).

In the context of sustainable tourism development, MLG becomes particularly relevant due to the need to balance global environmental concerns with local economic and social realities. Effective sustainable tourism governance requires coordination across multiple levels and sectors, as well as the involvement of diverse stakeholders in decision-making processes. MLG approaches have the potential to facilitate more adaptive and responsive policy-making in tourism (Bramwell and Lane, 2011).

The application of MLG to tourism studies has revealed several key insights. First, it highlights the tension between centralized policy-making and the need for local adaptation in tourism development. National tourism policies are often reinterpreted and implemented differently across regions, reflecting local priorities and capacities. This underscores the importance of considering both top-down and bottom-up processes in tourism governance (Zahra, 2011).

Second, MLG research in tourism has emphasized the role of networks and partnerships in facilitating coordination across governance levels. Tourism destination networks involving public and private actors can enhance policy coherence and implementation effectiveness. These networks often transcend traditional governance hierarchies, creating new spaces for collaboration and innovation (Baggio et al., 2010).

Third, MLG studies have highlighted the challenges of achieving policy coherence in tourism development. Different governance levels often have divergent priorities and capacities, leading to potential conflicts and implementation gaps. This underscores the need to develop mechanisms for vertical and horizontal policy integration in tourism governance (Dredge and Jenkins, 2016).

In the context of low-carbon tourism development, MLG offers a particularly useful lens. The transition to low-carbon practices in tourism involves actions at multiple scales, from international climate agreements to national policy frameworks, regional planning, and local implementations. MLG approaches can help address the complex challenges of reducing carbon emissions in tourism by facilitating coordination between transport, energy, and tourism policies across governance levels (Gössling et al., 2008).

The subsidiarity principle offers important insights for understanding multi-level governance in tourism development. This principle suggests that decisions should be taken at the lowest possible governance level where effective action can be achieved. In tourism governance, subsidiarity implies that while national authorities should provide overall policy frameworks and coordination, detailed implementation decisions are often best made at local levels where specific contextual factors can be fully considered. Subsidiarity in tourism governance can enhance policy effectiveness by ensuring decisions reflect local conditions and capabilities while maintaining necessary coordination across governance levels (Zahra, 2011).

The Chinese context presents unique characteristics for MLG in tourism development. China's administrative system, characterized by a strong central government and a hierarchical structure, creates distinct patterns of multi-level interactions. However, there is increasing recognition of the need for more flexible and collaborative governance approaches in addressing complex sustainability challenges, including in the tourism sector (Wu et al., 2018).

The concept of "fragmented authoritarianism" provides insights into how MLG operates within China's political system. This perspective recognizes that while the central government sets overarching policy directions, there is significant bargaining and negotiation among various bureaucratic actors in policy implementation. In tourism governance, this can lead to diverse interpretations and implementations of national policies across regions and localities (Lieberthal and Oksenberg, 1988).

Recent research has highlighted the evolving nature of tourism governance in China, particularly in rural areas. The implementation of tourism policies at the local level involves a complex network of actors, including government agencies, private businesses, and community organizations. This multi-stakeholder approach has led to more diverse and localized interpretations of national tourism policies. While the central government continues to play a significant role in setting overall policy directions, there is growing evidence of bottom-up initiatives and local innovations in tourism development. These local adaptations often reflect the specific socio-economic conditions and cultural contexts of rural areas, demonstrating the need for flexible governance approaches that can accommodate regional differences while still aligning with national sustainability goals (Wang and Ap, 2013).

The application of MLG to low-carbon rural tourism in China must consider several key factors. First, the interplay between national climate goals, provincial development priorities, and local tourism strategies creates a complex policy landscape that requires careful navigation. Second, the varying capacities of local governments and communities to implement low-carbon initiatives necessitate flexible and adaptive governance approaches. Third, the role of traditional cultural norms and power structures in rural areas

adds another layer of complexity to multi-level governance dynamics.

As we examine the governance of low-carbon tourism in rural China, the MLG perspective provides a framework for understanding how policies and practices are shaped through interactions across different governance levels and among diverse actors. It helps us identify the mechanisms of coordination, the sources of conflict and collaboration, and the opportunities for enhancing policy coherence and effectiveness in promoting sustainable tourism development.

2.4 Research gaps and rationale

Despite the growing body of literature on low-carbon tourism and sustainable development, several significant research gaps remain, particularly in the context of rural China and multi-level governance. This study aims to address these gaps and contribute to a more comprehensive understanding of low-carbon tourism governance.

First, while previous research has examined specific low-carbon tourism policies or initiatives in China (He et al., 2018), there is a lack of holistic analysis that captures the multi-scalar interactions and dynamics across national, regional, and local levels. This study seeks to fill this gap by providing a comprehensive examination of the policy landscape from central government directives to local implementations.

Second, the place-based configurations and contingencies of policy implementation in diverse rural contexts remain underexplored. Rural areas in China vary significantly in terms of their economic development, environmental conditions, and cultural contexts. Understanding how these local factors influence the adoption and effectiveness of low-carbon tourism policies is crucial for developing more targeted and effective governance approaches (Su et al., 2019).

Third, there is a need for greater integration of policy diffusion and multi-level governance theories in the context of sustainable tourism development, especially in emerging economies like China. While research has examined various aspects of tourism governance in China, there is still a lack of studies that specifically apply policy diffusion and multi-level governance frameworks to low-carbon rural tourism. By applying these theoretical frameworks to the case of low-carbon rural tourism in China, this study aims to contribute to the refinement and expansion of these theories in non-Western contexts (Su et al., 2016).

Fourth, while the impacts of tourism development on rural communities have been widely studied, there is limited research on the specific socio-economic effects of low-carbon tourism initiatives in rural China. This study addresses this gap by examining both the positive and negative impacts of low-carbon tourism development on rural livelihoods, community structures, and local environments.

Fifth, the role of local innovations and adaptations in shaping low-carbon tourism outcomes is an area that requires further investigation. By focusing on the diverse implementation pathways and local solutions developed in different rural contexts, this study aims to highlight the importance of bottom-up approaches in complementing top-down policy directives.

Lastly, there is a need for more empirical research that combines quantitative policy analysis with qualitative case studies to provide a nuanced understanding of low-carbon tourism governance. This study's mixed-methods approach aims to address this gap by offering both breadth and depth in its analysis of policy diffusion and implementation processes.

By addressing these research gaps, this study seeks to contribute to both the theoretical understanding of multi-level governance in sustainable tourism and the practical knowledge needed to enhance policy effectiveness in promoting low-carbon rural tourism development. The findings from this research have the potential to inform policy-making not only in China but also in other countries grappling with similar challenges in balancing tourism development with environmental sustainability and rural revitalization.

3 Methodology

3.1 Research design and data collection

This study employs a mixed-methods approach to provide a comprehensive understanding of low-carbon rural tourism governance in China. Our research design integrates policy document analysis, case studies, stakeholder interviews, and a quantitative survey to capture the complexity of policy processes across different governance levels while examining the nuanced realities of implementation in varied local contexts.

We conducted a systematic analysis of 575 policy documents related to low-carbon tourism development issued between 2009 and 2024. These documents were obtained from the Peking University Law Database (北大法宝), which is widely recognized as China's most authoritative and commonly used database for legal and policy documents (Guo and Li, 2024). Using the keyword 'low-carbon tourism' (低碳旅游), we identified 16 central government policies and 559 provincial policies (Table 1).

To examine local implementation, we conducted in-depth case studies of 15 rural villages across five provinces (Hunan, Guangdong, Zhejiang, Shanxi, and Hainan). These provinces were selected to represent diverse geographic, economic, and cultural contexts within China. The case study villages were chosen based on criteria including the presence of low-carbon tourism initiatives, diversity in tourism development stages, variation in economic conditions, and research accessibility.

We conducted 90 semi-structured interviews with key stakeholders representing different governance levels and sectors. The interviews explored perceptions, experiences, and challenges related to low-carbon tourism development and governance. To complement the qualitative data, we administered a structured questionnaire survey to a broader sample of stakeholders across the case study villages. The survey aimed to assess awareness, attitudes, and practices related to low-carbon tourism among local residents, tourism employees, and visitors. We distributed 750 questionnaires across the 15 villages, targeting approximately 50 respondents per village. The final sample included 637 valid responses, representing a response rate of 84.9%.

This multi-faceted data collection approach allows us to triangulate findings from different sources and perspectives, providing a robust and nuanced understanding of low-carbon tourism governance in rural China (Figure 1).

TABLE 1 Overview of data collection methods and sample characteristics.

Method	Sample size	Details		
Policy Document Analysis	575 documents	16 central, 559 provincial		
Stakeholder Interviews	90 interviews	Diverse stakeholder groups		
Questionnaire Survey	637 responses	84.9% response rate		
Case Studies	15 villages	Province	Village	Location and Description
		Guangdong	Fuyue Village	Located in Fengkai County, Zhaoqing City; a traditional ecological village known for its ancient banyan trees and sustainable farming practices.
			Lingtou Village	Situated in Dabu County, Meizhou City; renowned for its tea plantations and community-driven eco-tourism projects.
			Qingao Village	Found in Nan'ao County, Shantou City; a coastal village famous for its marine biodiversity and eco-friendly fishing practices.
		Zhejiang	Yucun Village	Located in Anji County, Huzhou City; a model village for green development and the origin of China's "Two Mountains" theory.
			Huangfu Village	Situated in Deqing County, Huzhou City; known for its bamboo forests and innovative low-carbon tourism initiatives.
			Bailianqiao Village	Found in Tongxiang City, Jiaxing; a water village preserving traditional architecture and promoting eco-cultural tourism.
		Shanxi	Qiaojia Village	Located in Qixian County, Jinzhong City; a historical village with well-preserved ancient courtyard homes and local crafts.
			Liujiapu Village	Situated in Linxian County, Lüliang City; recognized for its proximity to the Yellow River and focus on heritage conservation.
			Nuanquan Village	Found in Zuoyun County, Datong City; famous for its traditional "Dashuhua" firework performances and eco-tourism initiatives.
		Hainan	Dongyu Village	Located in Qionghai City; a wetland village emphasizing mangrove protection and community-based tourism.
			Qinglan Village	Situated in Wenchang City; known for its coastal scenery and development of renewable energy projects.
			Yalong Village	Found in Sanya City; a cultural tourism destination that integrates ethnic minority heritage with eco-friendly tourism.
		Hunan	Laodong Village	Located in Fenghuang County, Xiangxi; a Miao ethnic village rich in traditional music and eco-tourism activities.
			Shadao Village	Situated in Yongding District, Zhangjiajie City; a gateway to Wulingyuan Scenic Area and an advocate for sustainable tourism.
			Shaoshan Village	Found in Shaoshan City, Xiangtan; birthplace of Mao Zedong, blending revolutionary heritage with low-carbon tourism development.

3.2 Data analysis methods

Our data analysis employed a combination of qualitative and quantitative techniques to provide a comprehensive and nuanced understanding of low-carbon tourism governance processes and impacts.

Policy Document Analysis: We conducted a systematic content analysis of the 575 policy documents. This analysis focused on identifying temporal evolutions in policy content, cross-jurisdictional variations, and linkages between national and provincial policies. We used NVivo software for coding and thematic analysis, employing both deductive codes based on our theoretical framework and inductive codes emerging from the data.

Case Study Analysis: The qualitative data from the case studies were analyzed using thematic analysis techniques. Interview transcripts, observation notes, and focus group records were analyzed to identify common patterns, unique features, and contextual variations in low-carbon tourism implementation across the different villages. We used a combination of manual coding and NVivo software to facilitate this process.

Stakeholder Interview Analysis: Stakeholder interviews were transcribed verbatim and analyzed using a thematic analysis approach. We analyzed the data to identify patterns, convergences, and divergences in stakeholder perceptions and experiences across different governance levels and stakeholder groups. This process involved multiple rounds of coding and theme refinement.

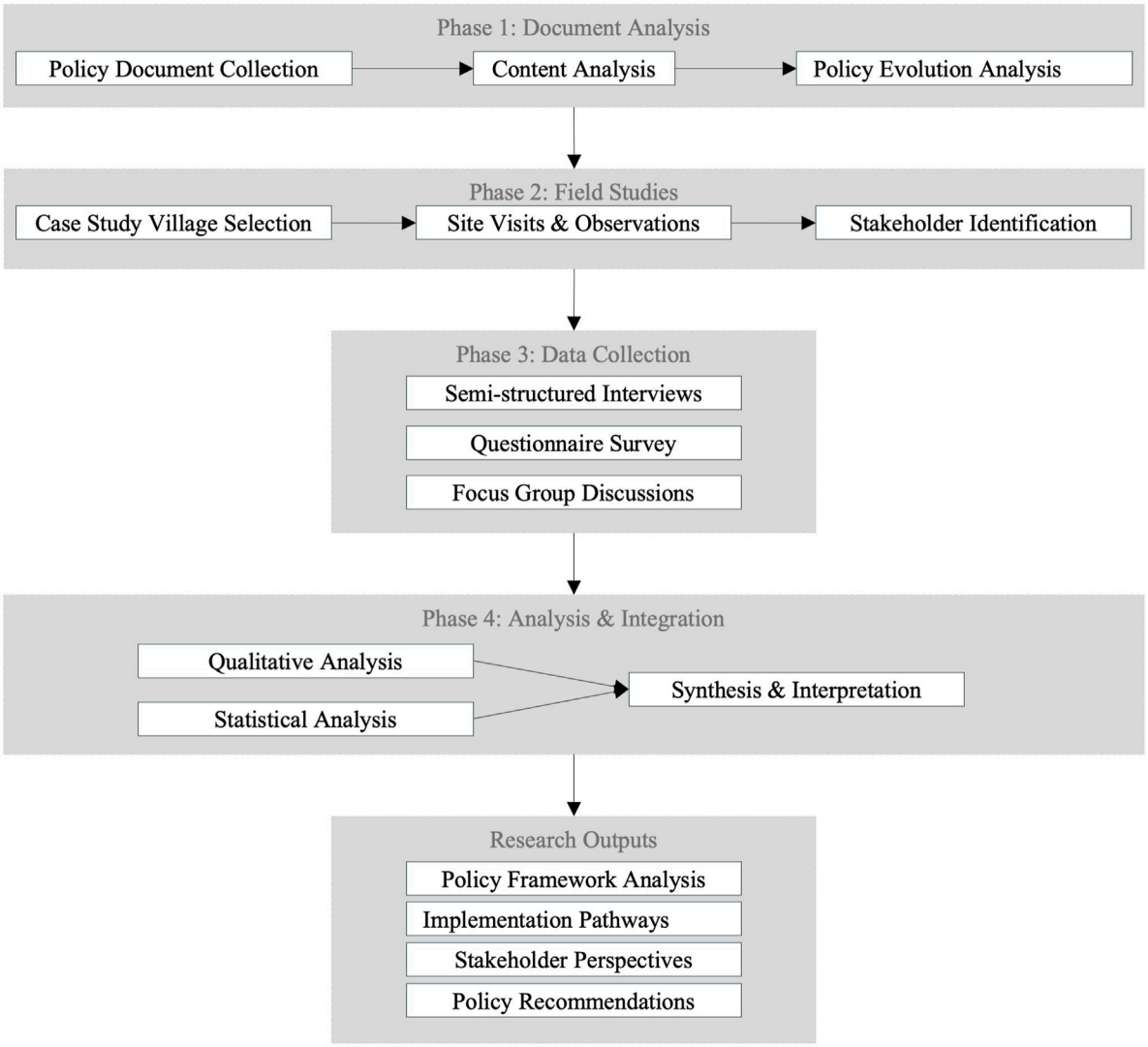

FIGURE 1
Research methodology framework showing the four phases of data collection and analysis in studying low-carbon tourism governance in rural China.

Survey Data Analysis: We analyzed the survey data using descriptive and inferential statistical techniques to summarize respondent characteristics, awareness levels, attitudes, and reported practices related to low-carbon tourism. We used SPSS software for statistical analysis, including frequency distributions, cross-tabulations, and chi-square tests to examine relationships between variables (Table 2).

The survey questionnaire covered several key areas:

1. Awareness and understanding of low-carbon tourism concepts and policies.
2. Attitudes and perceptions towards low-carbon tourism development.
3. Practices and behaviors related to low-carbon tourism.
4. Perceptions of policy effectiveness and governance.
5. Socio-demographic information.

The interview protocol explored similar themes to the survey but allowed for more in-depth exploration of stakeholder experiences and perspectives. Key topics included policy awareness and understanding, implementation processes and challenges, stakeholder engagement and collaboration, local innovations and adaptations, perceived impacts and outcomes, and recommendations for policy improvement.

We integrated the results from these different data sources and analysis methods to provide a comprehensive and holistic understanding of low-carbon tourism governance in rural China. This integration process involved iterative cycles of data comparison, synthesis, and interpretation, guided by our theoretical framework.

3.3 Methodological considerations

This study employs a multi-method approach to provide a comprehensive analysis. While our research covers a diverse range of rural tourism contexts across multiple provinces, it does

TABLE 2 Overview of survey respondent characteristics.

Characteristic	Category	Percentage
Gender	Male	52.3%
	Female	47.7%
Age	18–30	28.6%
	31–45	35.2%
	46–60	25.9%
	Over 60	10.3%
Education	Primary school or below	15.7%
	Middle school	32.5%
	High school	28.9%
	College or above	22.9%
Role in Tourism	Direct involvement	37.8%
	Indirect involvement	25.6%
	No involvement	36.6%

not claim to be exhaustive or representative of all rural areas in China. Our findings should be understood as context-specific insights that may have broader relevance and transferability.

To ensure the reliability and validity of our research, we have taken several measures. First, we used multiple data sources and methods, allowing for triangulation of findings. Second, our research team included native Chinese speakers to ensure accurate interpretation of data across cultural contexts. Third, we conducted pilot testing of our survey instrument and interview protocol to refine our data collection tools. Finally, we employed member checking, sharing preliminary findings with key informants to verify our interpretations.

We acknowledge potential limitations in our study. The selection of case study villages, while based on clear criteria, may not capture the full diversity of rural tourism contexts in China. Additionally, our reliance on self-reported data in surveys and interviews may be subject to social desirability bias. We have attempted to mitigate these limitations through our mixed-methods approach and careful interpretation of findings.

Ethical considerations were carefully addressed throughout the research process, including obtaining informed consent, protecting participant privacy, and ensuring data anonymity.

4 Results

4.1 Evolution of national low-carbon tourism policy framework (2009–2024)

The temporal classification of China's low-carbon tourism policy evolution into three distinct phases (2009-2015, 2016-2020, and 2021–2024) is based on several key analytical criteria. First, we examined significant shifts in policy objectives and instruments, identifying points where fundamental changes occurred in how low-carbon tourism was conceptualized and approached. Second, we analyzed the alignment of tourism policies with China's broader environmental and development strategies, particularly the Five-Year Plans that serve as critical policy anchors. Third, we considered the introduction of major policy innovations or regulatory frameworks that substantially altered the governance landscape. For instance, 2016 marked a transition point with the explicit integration of carbon reduction targets into tourism planning, while 2021 saw the emergence of more ambitious climate goals aligned with China's national carbon peaking targets.

The evolution of China's national low-carbon tourism policy framework is characterized by a progressive shift from broad environmental principles to more targeted, innovative policies designed to reduce carbon emissions within the tourism sector. Our analysis reveals three distinct phases in this policy evolution, each reflecting the changing priorities and challenges in promoting sustainable tourism.

The evolution of China's national low-carbon tourism policy framework is characterized by a progressive shift from broad environmental principles to more targeted, innovative policies designed to reduce carbon emissions within the tourism sector. Our analysis reveals three distinct phases in this policy evolution, each reflecting the changing priorities and challenges in promoting sustainable tourism (Table 3).

4.1.1 Phase 1: initial conceptualization (2009–2015)

The initial phase of policy development (2009–2015) was marked by a growing recognition of the need to integrate sustainability into tourism. Key policies during this period, such as the "Opinions on Accelerating the Development of Tourism Industry" (Document C1, 2009; see Supplementary Material S1, S2, hereafter the same), laid the foundational concepts of "green tourism" and emphasized resource efficiency and environmental protection. However, these early policies were largely declarative, focusing on raising awareness rather than providing concrete guidelines or mechanisms for enforcement. During this phase, the central government's primary goal was to introduce the concept of sustainable tourism to a rapidly growing sector. Policies like the "12th Five-Year Plan for Tourism Development" (Document C4, 2011) reflected a strategic alignment with broader environmental goals, but they fell short of specifying clear targets or implementation strategies. The emphasis was on encouraging local governments and enterprises to consider environmental impacts, without mandating specific actions or outcomes.

4.1.2 Phase 2: systematic development (2016–2020)

The second phase (2016–2020) represented a shift towards a more structured approach to low-carbon tourism. The "13th Five-Year Plan for Tourism Development" (Document C5, 2016) was a pivotal document, explicitly integrating low-carbon objectives into the national tourism strategy. This plan introduced specific targets for energy conservation and emissions reduction, signaling a commitment to embedding sustainability within the tourism sector's development framework. This period also saw the introduction of policies such as the "Guidelines on Promoting All-for-One Tourism" (Document C6, 2018), which advocated

TABLE 3 Evolution of key national low-carbon tourism policies (2009–2024).

Year	Policy title	Key themes
2009	Opinions on Accelerating the Development of Tourism Industry (Document C1)	Initial mention of green tourism development
2011	12th Five-Year Plan for Tourism Development (Document C4)	Promotion of resource efficiency and green tourism
2016	13th Five-Year Plan for Tourism Development (Document C5)	Integration of low-carbon concepts in national tourism strategy
2018	Guidelines on Promoting All-for-One Tourism (Document C6)	Holistic approach to sustainable tourism development
2021	14th Five-Year Plan for Culture and Tourism Development (Document C7)	Specific targets for low-carbon tourism; emphasis on digital innovation
2023	Action Plan for Carbon Peaking in the Tourism Sector (Document C9)	Detailed roadmap for achieving carbon reduction in tourism

for a holistic approach to sustainable tourism. This approach recognized that isolated efforts at individual sites or businesses would be insufficient to achieve significant environmental benefits. Instead, it called for integrated regional planning and cross-sectoral coordination, emphasizing the need for comprehensive strategies that encompass entire tourism destinations.

4.1.3 Phase 3: ambitious targets and innovation focus (2021–2024)

The current phase (2021–2024) is characterized by ambitious targets and a strong focus on technological and institutional innovation. The "14th Five-Year Plan for Culture and Tourism Development" (Document C7, 2021) and the "Action Plan for Carbon Peaking in the Tourism Sector" (Document C9, 2023) set explicit carbon reduction goals aligned with China's broader commitments to peak carbon emissions by 2030 and achieve carbon neutrality by 2060. These policies reflect a strategic shift towards leveraging technology and innovation as critical tools for achieving low-carbon tourism. The emphasis on smart tourism infrastructure, digital platforms, and big data analytics in the "Action Plan for Carbon Peaking" illustrates the government's recognition that modern technology can play a pivotal role in reducing the sector's carbon footprint. Moreover, these policies prioritize the integration of green technologies and practices across the entire tourism value chain, from transportation to accommodation and attractions.

4.2 Provincial policy implementation and diffusion

Our analysis of 559 provincial low-carbon tourism policies reveals significant variations in adoption patterns and focus areas across China's provinces. These variations reflect differences in economic development levels, tourism resource endowments, environmental pressures, and local governance capacities (Table 4).

The number of provincial low-carbon tourism policies has increased significantly over the study period, with notable spikes in policy adoption in 2011, 2016, and 2021. These spikes coincide with the issuance of key national policies, such as the 12th and 13th Five-Year Plans and the 14th Five-Year Plan, suggesting a strong influence of national policy signals on provincial policy adoption.

Provinces with higher levels of economic development, such as Guangdong, Zhejiang, and Jiangsu, tend to have a larger number of low-carbon tourism policies compared to less developed provinces in central and western China. However, some resource-rich provinces in western China, such as Yunnan and Sichuan, also stand out with a high number of policies, indicating the importance of tourism resource endowments in driving policy adoption.

Our analysis reveals clusters of high policy adoption in the eastern coastal regions and certain tourism-intensive western provinces. However, this pattern is not uniform, with some neighboring provinces showing markedly different levels of policy engagement.

Provincial low-carbon tourism policies cover a wide range of issues, including energy conservation, emission reduction, ecological protection, green transportation, and sustainable consumption. However, there are notable variations in policy focus across provinces. For example, provinces with significant ecological resources, such as Hainan and Yunnan, place greater emphasis on ecological conservation and eco-tourism development. In contrast, more industrialized provinces, such as Guangdong and Jiangsu, focus more on promoting green transportation and low-carbon technologies in the tourism sector.

4.3 Local implementation strategies and challenges

The comparative case studies of 15 rural tourism villages provide rich insights into the local implementation of low-carbon policies and the challenges encountered in translating these policies into practice. Our findings reveal three distinct implementation pathways:

The technology-driven pathway, prevalent in economically advanced villages, emphasizes the adoption of innovative low-carbon technologies, aligning with ecological modernization approaches. The community-based pathway, common in villages with strong social capital, leverages traditional knowledge and cultural assets, resonating with community-based natural resource management theories. The policy-led pathway, observed in resource-constrained settings, relies heavily on top-down interventions, reflecting more traditional governance models. These pathways demonstrate the importance of contextually grounded approaches in translating national policies into local action, contributing to our understanding of policy implementation in multi-level governance systems (Table 5). Despite the diversity of implementation strategies, the case study

TABLE 4 Characteristics of provincial low-carbon tourism policy adoption.

Characteristic	Key findings
Temporal Patterns	Policy adoption increased over time, with spikes in 2011, 2016, and 2021
Spatial Patterns	More developed eastern provinces and resource-rich western provinces have more policies
Drivers	Economic level, tourism resources, environmental pressures, governance capacity, policy diffusion
Policy Focus	Varies by provincial context, e.g., eco-tourism in Yunnan, green transport in Guangdong

villages faced several common challenges in translating low-carbon tourism policies into practice.

Financial constraints posed a significant barrier, particularly for villages in less developed regions. The high upfront costs associated with adopting low-carbon technologies, upgrading infrastructure, and building capacity often exceeded available local resources. Limited local human resources and technical capacities were another major challenge, with many villages lacking the necessary skills and knowledge to operate and maintain low-carbon technologies, develop sustainable tourism products, or monitor environmental impacts.

4.4 Stakeholder perceptions and experiences

The analysis of stakeholder interviews and surveys reveals a complex tapestry of perceptions, experiences, and expectations related to low-carbon tourism development in rural China. Stakeholders across different groups and levels expressed a mix of optimism and concern, highlighting both the potential benefits and the challenges of low-carbon tourism transition. Government officials and tourism operators generally demonstrated higher levels of awareness compared to local residents and visitors, with 78% of government officials and 65% of tourism operators indicating a high level of familiarity with low-carbon tourism concepts, compared to only 32% of local residents and 25% of visitors.

The survey results indicate that over 80% of respondents agreeing that low-carbon tourism can bring environmental and socio-economic benefits, but also noting significant implementation challenges. The most frequently cited challenges were lack of funding (62%), limited technical know-how (58%), and difficulty in changing established practices (55%).

The survey findings suggest a general perception of progress in low-carbon tourism policy and governance, with 65% of respondents agreeing that policies have become more supportive and effective in recent years. However, a significant share of respondents also indicated that there is still room for improvement in terms of policy implementation (48%), stakeholder participation (42%), and monitoring and evaluation (55%) (Table 6).

These stakeholder perspectives underscore the complex and multi-faceted nature of low-carbon tourism governance in China. They point to the need for more adaptive, participatory, and context-sensitive approaches that can bridge the gap between policy intent and local realities.

5 Discussion and analysis

5.1 Multi-level interactions in low-carbon tourism governance

Our analysis reveals complex multi-level interactions in low-carbon tourism governance, characterized by interplay between top-down policy transmission, bottom-up innovation, and horizontal policy diffusion. These interactions play a crucial role in shaping the outcomes and effectiveness of low-carbon tourism initiatives across China's diverse rural landscapes.

Vertical Policy Transmission: The analysis highlights the importance of vertical policy transmission processes, whereby national low-carbon tourism directives are interpreted, adapted, and implemented at provincial and local levels. The evolution of China's national policy framework has provided an overarching strategic direction for low-carbon tourism development. However, the study also reveals significant variations in how these national policies are translated and operationalized across different provinces and localities, reflecting differences in local contexts, priorities, and capacities. Our analysis highlights the importance of applying the subsidiarity principle, which suggests that decisions should be taken at the lowest possible governance level where effective action can be achieved. The most successful cases in our study were those where higher governance levels focused on providing enabling frameworks and support while empowering local authorities to make context-appropriate implementation decisions. For example, in Yucun village, Zhejiang, the provincial government established broad sustainability guidelines but allowed local authorities to develop specific low-carbon initiatives based on their unique ecological and cultural resources.

This finding underscores the importance of policy flexibility and adaptability in multi-level governance systems. While national policies set the overall direction and targets, they need to allow for local interpretation and innovation to ensure their relevance and feasibility in diverse social-ecological contexts. The study suggests that more effective vertical policy transmission requires not only

TABLE 5 Characteristics of implementation pathways.

Pathway	Key features	Enabling factors	Challenges
Technology-driven	Focus on low-carbon technologies and infrastructure	Financial resources, technical expertise	High costs, maintenance issues
Community-based	Emphasis on local participation and traditional knowledge	Community cohesion, local leadership	Balancing development and culture
Policy-led	Reliance on top-down interventions and government support	Political will, institutional capacity	Policy rigidity, limited local ownership

TABLE 6 Key stakeholder perceptions on low-carbon tourism development.

Aspect	Government officials	Tourism operators	Local residents	Tourists
Awareness of low-carbon tourism concepts	High (78%)	High (65%)	Moderate (32%)	Low (25%)
Perceived benefits	Environmental protection, economic growth	New business opportunities	Job creation, environmental improvement	Enhanced travel experience
Main challenges	Policy coordination, funding	Implementation costs, market demand	Changing traditional practices	Higher costs, limited options
Policy effectiveness	Positive (72%)	Mixed (58%)	Uncertain (45%)	Low awareness (30%)
Future outlook	Optimistic (85%)	Cautiously optimistic (70%)	Mixed (55%)	Interested but uncertain (40%)

clear and consistent national guidelines but also mechanisms for two-way communication, learning, and feedback between different levels of governance.

Bottom-up Innovation: The analysis reveals the critical role of bottom-up innovation and experimentation in driving low-carbon tourism transformations. Many of the successful low-carbon tourism practices identified in the case study villages emerged from local actors' creative responses to sustainability challenges and opportunities. These grassroots innovations often drew on local knowledge, resources, and values to develop context-specific solutions that may not have been anticipated or prescribed by top-down policies.

The study highlights the need for multi-level governance arrangements that create enabling conditions for bottom-up innovation, such as capacity building, financial support, and platforms for knowledge sharing and upscaling. It also points to the importance of recognizing and valuing the role of local communities, entrepreneurs, and civil society organizations as active agents of change in low-carbon tourism transitions, rather than merely as passive recipients of policy interventions.

Horizontal Policy Diffusion: In addition to vertical interactions, the analysis also reveals the significance of horizontal policy diffusion processes in shaping low-carbon tourism governance. The study finds evidence of policy learning and transfer across provinces and localities, facilitated by regional networks, knowledge exchange platforms, and mimetic pressures. However, the study also cautions against the uncritical transfer of 'best practices' without considering their fit with local contexts and capacities.

Adaptive Governance: The multi-level governance perspective advanced in this study offers a valuable lens for understanding the complex and dynamic interactions between national policies, provincial strategies, and local actions in shaping low-carbon tourism transitions. It highlights the need for more integrated and adaptive governance approaches that can foster synergies and address tensions between top-down guidance and bottom-up innovation.

The findings suggest that effective low-carbon tourism governance in China requires a balance between centralized coordination and decentralized experimentation, as well as the creation of enabling conditions for policy learning and diffusion across scales and locations. This implies a shift from hierarchical and sectoral governance models towards more networked, collaborative, and adaptive governance arrangements that can respond to the inherent complexity and uncertainty of sustainability transitions.

Place-based Approaches: The study also underscores the importance of place-based and contextually grounded approaches to low-carbon tourism governance. While national and provincial policies provide essential framing and support, their implementation and impact ultimately depend on the specific social, economic, political, and ecological conditions of each locality. Effective multi-level governance thus requires a deep understanding of local realities, needs, and capacities, as well as the engagement and empowerment of local stakeholders in policy design and implementation processes.

5.2 Policy implementation gaps and local innovations

The study reveals significant gaps between policy intentions and on-the-ground practices in low-carbon tourism development, alongside innovative local responses to implementation challenges. Recent advances in environmental policy assessment suggest that effective implementation requires consideration of multiple dimensions beyond procedural compliance, including substantive outcomes, resource efficiency, and social legitimacy (Nita, 2019; Caro-Gonzalez et al., 2023). This multi-dimensional framework helps explain the complex challenges observed in translating sustainable tourism policies into practice across diverse rural contexts.

Implementation Gaps: The analysis identifies several common implementation gaps across the case study villages, reflecting the interplay between procedural, substantive, and legitimacy aspects of policy effectiveness. These include limited financial resources, technical capacity constraints, policy coordination issues, and stakeholder resistance. The persistence of these gaps, despite strong procedural frameworks, underscores the importance of considering implementation effectiveness through a more comprehensive lens that accounts for local contexts and stakeholder dynamics.

These implementation gaps underscore the need for more targeted and contextualized policy support mechanisms that can address the specific needs and constraints of rural communities. This may include dedicated funding streams, capacity building

programs, technical assistance services, and policy coordination platforms that are tailored to the realities of rural tourism development.

Local Innovations: At the same time, the study also reveals a wealth of local innovations and adaptive responses to implementation challenges, which often emerge from the creative agency and resourcefulness of rural communities. The case studies showcase a range of grassroots initiatives, such as community-based renewable energy cooperatives, participatory carbon monitoring systems, and eco-cultural tourism products, which demonstrate the potential for bottom-up solutions to sustainability challenges.

These local innovations are often rooted in place-based knowledge, values, and practices, and are finely attuned to the specific social-ecological conditions of each village. They reflect the capacity of rural communities to experiment, learn, and adapt to changing circumstances, often in the face of significant resource and institutional constraints.

The study suggests that these local innovations play a crucial role in bridging policy gaps and driving transformative change towards low-carbon tourism development. They offer valuable lessons and models for sustainable tourism practices that are grounded in local realities and priorities, and that can inspire wider replication and upscaling.

Enabling Environments: However, the analysis also reveals significant variations in the innovation capacities and outcomes across different villages, shaped by factors such as social capital, leadership, external networks, and institutional support. Villages with stronger social cohesion, proactive leaders, and linkages to external resources and expertise tend to have greater success in developing and sustaining local innovations compared to those with more limited capacities and support systems.

These findings highlight the importance of creating enabling environments for local innovation and adaptive capacity in low-carbon tourism governance. This may involve strategies such as fostering community empowerment and ownership, investing in local leadership and entrepreneurship, facilitating peer-to-peer learning and knowledge exchange, and providing flexible and responsive policy frameworks that can accommodate and nurture grassroots experimentation.

Participatory Approaches: The study also underscores the need for more participatory and collaborative approaches to policy design and implementation that can harness the knowledge, creativity, and agency of local communities. This implies a shift from top-down, expert-driven models of policymaking towards more inclusive and co-productive processes that engage diverse stakeholders in joint problem-solving and decision-making.

The analysis of policy implementation gaps and local innovations presented in this study offers valuable insights for advancing sustainable tourism governance in rural China and beyond. It highlights the need for more adaptive, place-based, and participatory approaches that can harness the agency and creativity of local communities, while providing the necessary support and enabling conditions for transformative change.

5.3 Balancing development objectives

The implementation of low-carbon tourism in rural China presents a complex challenge of balancing economic, environmental, and social objectives. Our research reveals that successful low-carbon tourism initiatives can generate significant economic benefits for rural communities, including increased tourism revenue, job creation, and infrastructure improvements. These economic gains are crucial for sustaining rural livelihoods and reducing poverty in areas facing declining agricultural incomes and rural-urban migration pressures.

Simultaneously, well-designed low-carbon tourism strategies contribute to environmental conservation and climate change mitigation. The case studies demonstrate how practices such as renewable energy adoption, waste reduction, and ecosystem conservation can generate positive environmental outcomes and enhance the ecological resilience of rural areas. This alignment of tourism development with environmental protection addresses a key concern raised in the literature regarding the tourism industry's carbon footprint.

However, our findings also highlight the potential risks and trade-offs involved in this development process. In some instances, the pursuit of economic growth through tourism expansion has led to unintended environmental consequences, such as over-development and ecosystem degradation, particularly in ecologically sensitive areas. This tension between economic aspirations and environmental carrying capacity underscores the need for careful planning and management of tourism development.

The social and cultural dimensions of low-carbon tourism development add another layer of complexity. While many communities benefit from the revitalization of traditional practices and increased cultural pride, others face challenges such as the commodification of local traditions and social disruptions from rapid tourism growth. These findings align with concerns raised in the literature about the potential negative impacts of tourism on local cultures and social structures.

To address these challenges, our research points to the importance of integrated and adaptive governance approaches. Successful low-carbon tourism development requires mechanisms that can maximize synergies and minimize trade-offs between economic, environmental, and social objectives. This includes adopting participatory planning processes that engage diverse local stakeholders, developing context-specific tourism products that build on local strengths, and implementing robust monitoring systems that allow for continuous learning and adjustment.

Furthermore, our findings emphasize the critical role of supportive policy frameworks at higher governance levels. National and provincial policies can create enabling environments for sustainable tourism by providing targeted financial and technical support, mainstreaming sustainability criteria into tourism planning, and fostering innovation in low-carbon practices. This multi-level governance perspective addresses a key gap in the literature by demonstrating how national policies and local implementations can be effectively aligned to promote sustainable tourism development.

6 Conclusion and policy recommendations

6.1 Key findings and theoretical contributions

This study offers several significant contributions to the understanding of low-carbon tourism governance in rural contexts. First, it provides a comprehensive analysis of the evolution of China's low-carbon tourism policy framework, revealing a progression from broad conceptualization to more targeted and ambitious strategies. This temporal analysis contributes to the literature on policy development in sustainable tourism, offering insights into how national strategies evolve in response to changing environmental and economic priorities. For example, our analysis reveals how provinces like Zhejiang pioneered innovative practices in community-based tourism that were later incorporated into national policy frameworks, while the central government's carbon reduction targets stimulated new waves of provincial policy experiments.

Second, our research illuminates the complex dynamics of policy diffusion and implementation across multiple governance levels. By examining how national policies are interpreted and adapted at provincial and local levels, we contribute to the theoretical understanding of multi-level governance in sustainable tourism. This analysis reveals the importance of both top-down directives and bottom-up innovations in shaping policy outcomes, addressing a gap in the literature regarding the interplay between different governance scales.

Third, the identification of distinct implementation pathways - technology-driven, community-based, and policy-led approaches - provides a nuanced understanding of how low-carbon tourism strategies are operationalized in diverse rural contexts. Our case studies demonstrate how these pathways reflect different local conditions and capabilities: technology-driven approaches flourishing in more developed villages with stronger financial resources, community-based approaches succeeding in areas with rich cultural heritage and strong social cohesion, and policy-led approaches emerging in regions with robust institutional support. This typology contributes to the literature on sustainable tourism implementation, offering a framework for analyzing the varied approaches to low-carbon development in rural areas.

Fourth, our examination of stakeholder perceptions and experiences adds depth to the understanding of how low-carbon tourism policies are received and enacted on the ground. By highlighting the diverse perspectives of government officials, tourism operators, local residents, and tourists, we contribute to the literature on stakeholder engagement in sustainable tourism governance.

Finally, our analysis of the socio-economic impacts of low-carbon tourism initiatives provides empirical evidence of both the potential benefits and challenges of this development approach. For instance, our survey data reveals that while 80% of respondents recognize environmental benefits, significant implementation challenges persist, including funding constraints (62%), technical capacity limitations (58%), and resistance to changing established practices (55%). This evidence-based analysis contributes to the ongoing debate in the literature regarding the efficacy of sustainable tourism as a tool for rural development and environmental conservation.

These findings collectively advance the theoretical understanding of sustainable tourism governance by demonstrating the complex interplay between policy design, multi-level implementation, local innovation, and socio-economic outcomes. They provide a more nuanced picture of how low-carbon tourism can be effectively governed in diverse and challenging rural contexts, addressing key gaps in the existing literature.

6.2 Policy recommendations

Based on our empirical findings, we propose a suite of policy recommendations to enhance the effectiveness of low-carbon tourism governance in rural China. We advocate for the development of adaptive national policy frameworks that provide overarching guidance while allowing for local innovation, reflecting principles of polycentric governance. Strengthening vertical and horizontal coordination mechanisms through multi-stakeholder forums can address the challenges of policy fragmentation identified in our study. Investing in targeted capacity-building programs is crucial to bridge the implementation gaps observed at local levels. Promoting community-based approaches can enhance policy legitimacy and effectiveness by leveraging local knowledge and fostering ownership. Developing innovative financing mechanisms tailored to rural contexts can help overcome the resource constraints that often impede sustainability transitions. Enhancing monitoring and evaluation systems, including participatory approaches, can improve adaptive governance capacities. Finally, integrating low-carbon tourism principles into broader rural development strategies can promote more holistic and sustainable outcomes, addressing the complex challenges faced by rural communities in China's rapidly changing socio-economic landscape.

6.3 Future research directions

Building on our findings, we identify several promising avenues for future research that can further advance the theoretical and practical understanding of low-carbon tourism governance. Longitudinal studies are needed to assess the long-term impacts and policy evolution, contributing to theories of sustainability transitions. Comparative analyses with other emerging and developed economies can yield insights into the transferability and context-specificity of governance models. Investigating tourist behavior and demand patterns related to low-carbon options can inform both policy design and market development strategies. Exploring the potential of emerging technologies in governance can shed light on the role of innovation in sustainability transitions. Examining the integration of low-carbon tourism with climate adaptation efforts can contribute to our understanding of policy integration and resilience-building in vulnerable rural areas. Developing refined metrics for assessing policy effectiveness across diverse contexts can enhance our ability to evaluate and compare governance outcomes. Finally, investigating innovative economic models for resource-

constrained settings can contribute to theories of sustainable rural development. These research directions will not only build on this study's findings but also contribute to advancing the broader fields of sustainable tourism governance and rural development studies.

6.4 Limitations and ethical considerations

The study provides a snapshot of low-carbon tourism governance and impacts at a particular point in time and does not fully capture longitudinal dynamics and longer-term policy evolutions. Future research could benefit from longitudinal studies to track changes over time and assess the long-term impacts of low-carbon tourism initiatives.

We recognize that the interviews and surveys rely on participants' self-reported perceptions, experiences, and practices, which may be subject to various biases and not always align with actual behaviors or outcomes. To mitigate this limitation, we triangulated data from multiple sources and methods, including policy document analysis and direct observations during field visits.

The selection of case study villages, while based on clear criteria, may not capture the full diversity of rural tourism contexts in China. Additionally, our reliance on self-reported data in surveys and interviews may be subject to social desirability bias. We have attempted to mitigate these limitations through our mixed-methods approach and careful interpretation of findings.

Ethical considerations were paramount throughout our research process. All participants were provided with clear information about the study's purpose, procedures, and potential risks and benefits, and informed consent was obtained before data collection. Participants' identities and personal information were kept confidential, and data were anonymized in the reporting of findings. Our research team was mindful of local cultural norms and sensitivities and sought to ensure reciprocity and beneficence in the study's outcomes.

The findings underscore the importance of adaptive, place-based approaches that can balance multiple development objectives while empowering local communities to shape their own sustainable futures. As the global community continues to grapple with the dual challenges of climate change and sustainable development, the lessons drawn from China's experiences in low-carbon rural tourism governance offer valuable perspectives for policymakers, practitioners, and researchers worldwide.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical approval was not required for the studies involving humans because This study primarily involved analysis of publicly available policy documents and surveys/interviews with adult participants on non-sensitive topics related to their professional roles or general experiences with tourism. The research did not involve any interventions, sensitive personal information, or vulnerable populations. Participants were informed about the study's purpose and their right to withdraw at any time. All data was anonymized and confidentiality was maintained throughout the research process. Given these factors, and in accordance with our institution's guidelines, formal ethical approval was not required for this type of low-risk social science research. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements because Written informed consent was not required for this study due to the following reasons: The research involved low-risk activities such as surveys and interviews on non-sensitive topics related to tourism development and policy perceptions. All participants were adults capable of providing consent, and no vulnerable populations were involved. Participants' identities were kept confidential and all data was anonymized in the reporting of findings. The study did not involve any interventions or collection of sensitive personal information. Verbal informed consent was obtained from all participants after they were provided with clear information about the study's purpose, procedures, and their rights as participants. Participants were informed that their participation was voluntary and they could withdraw at any time without consequences. The research adhered to our institution's guidelines for low-risk social science research, which do not require written consent for this type of study. The nature of the data collection (including some telephone interviews and online surveys) made obtaining written consent impractical in some cases. These measures ensured that ethical standards were maintained while conducting the research in a manner appropriate to its low-risk nature and the cultural context of the study areas.

Author contributions

YG: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing–original draft, Writing–review and editing. SL: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing–original draft, Writing–review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fenvs.2024.1482713/full#supplementary-material

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