

RURAL CULTURAL LANDSCAPES AS PATHWAYS TO SUSTAINABLE CULTURAL TRANSMISSION: GEOSITE TOURISM PERSPECTIVES FROM TRADITIONAL VILLAGES IN CENTRAL SHANDONG, CHINA

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Abstract: This study provides a comprehensive examination of the mechanisms through which rural cultural landscape identity and active community participation contribute to sustainable cultural transmission. By viewing these dynamics through the lens of geosite tourism, the research examines three distinct traditional villages in Central Shandong, China. To ensure a holistic analysis, the study adopted a rigorous mixed-methods design. This methodological approach integrated quantitative data obtained from a survey of local residents (n=286) with qualitative depth derived from semi-structured interviews (n=20). Advanced data analysis using Structural Equation Modelling (ADANCO) was employed to test the hypothesized relationships. The empirical results indicate that a strong sense of landscape identity significantly strengthens community participation. Furthermore, this participation, when integrated with geosite tourism development activities, acts as a crucial mediator that indirectly supports the long-term transmission of cultural heritage. A key finding of the research is the role of policy support; the study demonstrates that government backing amplifies this positive pathway, acting as a vital moderating variable. These findings offer important implications for heritage management. They suggest that geosite-based tourism is a viable strategy for sustaining living heritage, provided that it is implemented correctly. Specifically, the model shows that sustainable outcomes are most likely achieved when community roles are clearly defined and when explicit governance support is present to guide the development process.

Keywords: rural cultural landscape, geosite tourism, sustainable cultural transmission, traditional villages, Central Shandong, community participation, landscape identity

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INTRODUCTION

Research Background

Across China's countryside, traditional villages are undergoing rapid transformation driven by urbanization, outmigration, and land-use change. However, these settlements remain important repositories of vernacular architecture, ecological knowledge, and collective memory. The concept of rural cultural landscapes highlights the co-evolution of natural topography, human settlement, and symbolic meaning (Sauer, 1925; Cosgrove, 1998).

In the Central Shandong region—characterized by mountain–plain transitions and extensive stone-built village forms—landscape elements such as dwellings, terraces, and ritual spaces function as “archives” that embody historical land-use practices and local cultural values (Pan et al., 2024; Yu et al., 2016). In recent years, geotourism and geosite-based tourism have been proposed as tools to support rural revitalization while strengthening geoconservation and visitor education (Dowling, 2013; Dowling & Newsome, 2018; Farsani et al., 2011). Within UNESCO Global Geoparks, geological heritage is interpreted together with local culture and livelihoods, offering an institutional framework for integrating geoconservation, community development, and tourism management (Henriques & Brilha, 2017; Ólafsdóttir & Dowling, 2014).

This framing is particularly relevant in settings where geological features and vernacular building traditions are closely interlinked, such as the stone-built villages of Central Shandong (Pan et al., 2024). However, tourism-led revitalization also introduces risks. Heritage commodification, uneven benefit distribution, and “museumification” can undermine the living character of rural culture when local agency is weak (Goodwin, 2016; Smith & Waterton, 2009).

Ensuring that tourism development remains compatible with cultural integrity and ecological limits, therefore, requires careful governance arrangements and meaningful community participation (Scheyvens, 1999; Choi & Sirakaya, 2006). Existing work on rural revitalization and tourism development in China has tended to prioritize economic performance and infrastructure outcomes, while the cultural-landscape mechanisms that sustain identity and intergenerational transmission

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receive comparatively less empirical attention (Yu et al., 2016; Li et al., 2020). Likewise, tourism studies often assess impacts and destination management without modelling the psychosocial pathways through which residents' place identity motivates participation and, ultimately, cultural transmission (Proshansky et al., 1983; Scannell & Gifford, 2010).

This study addresses these gaps by testing an integrated model linking cultural landscape identity, community participation, geosite tourism development, and policy support. Therefore, there exists a crucial gap in understanding the psychosocial pathways linking landscape identity, community participation, and geosite tourism outcomes.

Without addressing these mechanisms, sustainability discourses risk being superficial—celebrating preservation rhetoric without ensuring intergenerational cultural vitality. This study attempts to bridge this gap by developing a rigorous empirical model that combines qualitative insights with quantitative SEM analysis.

Research Objectives and Questions

The study aims to identify and evaluate the key variables influencing sustainable cultural transmission within rural cultural landscapes. Its specific objectives are:

1. To examine how cultural landscape identity influences community participation and sustainable cultural transmission in traditional villages.
2. To analyze the mediating role of geosite tourism development in the relationship between landscape identity and cultural sustainability.
3. To assess the moderating impact of policy support on the link between participation and transmission.
4. To provide policy recommendations for balancing heritage conservation with rural economic revitalization in Central Shandong.

Accordingly, the core research questions are:

1. How do residents' attachments to rural cultural landscapes translate into active participation in heritage conservation?
2. In what ways does geosite tourism serve as a mediating mechanism for sustainable cultural transmission?
3. What role does supportive governance play in strengthening or weakening these relationships?

Research Contributions

This research contributes to the interdisciplinary intersection of cultural geography, sustainable tourism, and heritage management. Conceptually, it advances the understanding of rural cultural landscapes not merely as aesthetic environments but as living systems of cultural reproduction. In practice, it offers empirical guidance to policymakers, especially in Shandong's county-level planning units, on designing tourism interventions that reinforce local identity rather than replace it.

By positioning geosite tourism as both an economic catalyst and a cultural–educational process, the study explains how geoconservation-oriented interpretation (e.g., trails, signage, and storytelling) can reinforce residents' sense of place while enhancing visitor understanding (Gordon, 2018; Henriques & Brilha, 2017). The findings provide evidence to support geopark managers and rural revitalization programs in designing tourism interventions that strengthen—rather than displace—community-led heritage practices (Scheyvens, 1999; Lee & Jayakumar, 2021).

Hypothesis Model

The hypothesis model proposes an integrated pathway through which rural cultural landscapes support sustainable cultural transmission (Figure 1). Cultural Landscape Identity is conceptualized as an exogenous driver that shapes residents' perceptions, values, and engagement with their environment, thereby motivating greater involvement in community-level cultural and tourism activities. This influence operates primarily through Community Participation, which serves as the first mediating construct, transforming identity-driven attachment into collective action that supports heritage maintenance and local decision-making. Geosite Tourism Development forms the second mediating mechanism by converting participation into structured interpretive and livelihood activities that reinforce both geological and cultural knowledge. Sustainable Cultural Transmission is positioned as the ultimate outcome, reflecting the extent to which cultural practices, ecological wisdom, and collective memory are maintained across generations.

The model further incorporates Policy Support as a moderating factor that strengthens or weakens the influence of participation on cultural transmission. Supportive governance, training, and institutional frameworks are therefore expected to amplify the positive effects of participation, ensuring that tourism and heritage initiatives translate into long-term cultural continuity. Through these relationships, the model captures a social ecological system in which identity, participation, tourism development, and policy interact to sustain rural cultural landscapes.

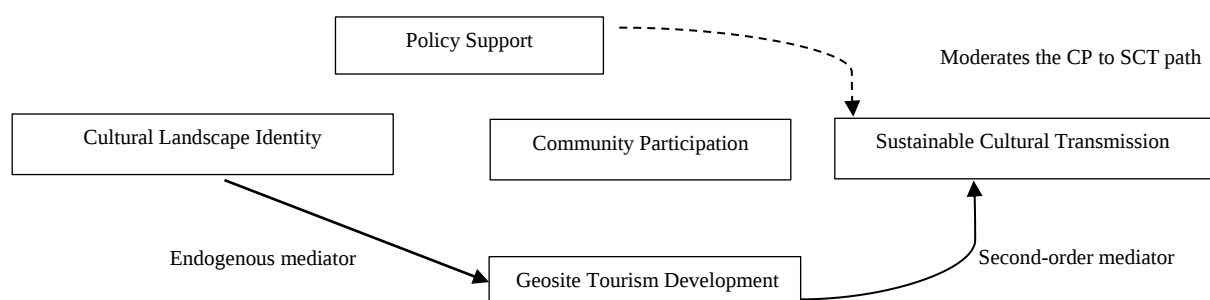


Figure 1. The hypothesized relationships among the variables

LITERATURE REVIEW

Cultural Landscape Identity and Community Participation

Rural cultural landscapes in traditional villages embody “living heritage” values that are enacted through everyday spatial practice, ritual routines, and community governance. Recent work reframes place/cultural landscape identity in traditional village conservation as a dynamic, enacted construct structured by emotional attachment, symbolic meaning, continuity, and behavioral commitment, with intergenerational transmission and collective obligation central to identity formation (Wang et al., 2025). In parallel, contemporary heritage scholarship on the social value of built heritage argues that local communities’ recognition of heritage value—and their position as legitimate “heritage communities”—is pivotal for shifting conservation from expert-centric control to participatory decision-making and stewardship (Rossitti et al., 2025). In rural revitalization and heritage preservation, community participation is sustained when governance arrangements and financing instruments enable genuine bottom-up involvement while coordinating across institutional levels (Li & Cantini, 2025). Domain-wide evidence further indicates that traditional village research has increasingly shifted from material protection to system governance and multi-actor coordination, with “community participation and governance resilience” and “land use and policy intervention” emerging as major thematic clusters (Bai et al., 2026).

Empirical evidence from cultural heritage conservation research also suggests that place attachment and differentiated perceptions of heritage value can shape participation intentions across generations (Wang et al., 2025). Conversely, when tourism or conservation interventions compress rehearsal windows, re-script rituals for display, or reproduce governance asymmetry, residents’ behavioral commitment may weaken, and participation becomes more fragile (Wang et al., 2025; Li & Cantini, 2025). Therefore, the following hypothesis is proposed:

H1: Cultural landscape identity significantly influences community participation.

Community Participation and Sustainable Cultural Transmission

Sustainable cultural transmission depends on the continuity of living practices, knowledge, and social relations that enable intergenerational learning and adaptation. Recent heritage research emphasizes that safeguarding living heritage requires community participation, as it anchors cultural practice in everyday routines and local governance rather than treating heritage as a static product (Rossitti et al., 2025; Li & Cantini, 2025). At the macro level, evidence from China shows that the development of intangible cultural heritage (ICH) and tourism interact dynamically over time, indicating a coupled evolution shaped by broader institutional and regional conditions (Du et al., 2024).

Participation supports cultural transmission through three mechanisms. First, it enables practice-based learning: cultural skills and narratives are acquired through doing—e.g., guiding, interpretation, ritual organization, and collective maintenance—rather than via passive observation. Second, it maintains governance continuity, protecting apprenticeship opportunities and community rules that structure the temporal rhythm of cultural practice (Wang et al., 2025). Third, it supports adaptive reinvestment when communities have stable roles and institutions to channel tourism-related benefits into cultural education and stewardship, a logic highlighted in revitalization policies that pair citizen-based initiatives with enabling finance and coordinated action (Li & Cantini, 2025; Bai et al., 2026). Accordingly:

H2: Community participation significantly influences sustainable cultural transmission.

The Mediating Role of Geosite Tourism Development

Geosite-based tourism development can act as an operational bridge between identity and cultural transmission by translating place meanings into interpretive encounters and locally embedded livelihood opportunities. The UNESCO geopark toolkit positions geotourism as an approach that integrates geoheritage conservation, education, and local sustainable development, while explicitly stressing that effective geotourism requires community engagement, stakeholder coordination, high-quality interpretation, and benefit-sharing (UNESCO, 2024). In geopark practice, community-based evidence indicates that local residents perceive greater economic, social, and environmental benefits when geopark initiatives align with community aspirations and involve meaningful participation (Louis et al., 2025).

Community-based geotourism research further shows that local wisdom, community participation, and geopark-oriented tourism can be combined to support destination stewardship and locally grounded development (Sumarmi et al., 2026).

The mediating mechanism can be conceptualized in three stages. First, interpret geological significance alongside cultural landscape narratives through geotrails, signage, guiding, and storytelling. Second, community participation strengthens this interpretive work when vernacular knowledge and locally rooted narratives are incorporated into interpretive design and communication products; recent studies show participatory tools can enhance a sense of belonging and improve the long-term effectiveness of geotourism initiatives (Guerini et al., 2026a; Guerini et al., 2026b).

Third, stakeholder arrangements determine whether participation is institutionalized: stakeholder analyses in geotourism development highlight the need to clarify roles and manage influence among government, community, and other actors to secure participatory planning and implementation (Hadian et al., 2025). Beyond geopark governance, geosite and geoheritage assessment research indicates that itineraries combining cultural heritage elements and geosite can support sustainable local development strategies, illustrating the feasibility of integrated cultural–geological products (Carrión-Mero et al., 2021). Taken together, these insights suggest that geosite tourism development can mediate the relationship between cultural landscape identity and sustainable cultural transmission.

H3: Geosite tourism development mediates the relationship between cultural landscape identity and sustainable cultural transmission.

Policy Support as Moderator

Policy frameworks shape whether participatory heritage and geotourism pathways can be sustained by influencing resources, regulatory clarity, institutional incentives, and the degree to which communities can exercise agency. Comparative evidence from heritage preservation in revitalization contexts indicates that community involvement is more effective when citizen-based initiatives are supported by enabling laws, financing mechanisms, and specialized agencies that coordinate multi-level action (Li & Cantini, 2025). At the research-domain level, policy intervention is now a major thematic cluster alongside participation and governance resilience in traditional village sustainability studies, reflecting a shift toward system governance and multi-actor coordination (Bai et al., 2026). Evidence from cultural-policy implementation also indicates that preservation outcomes depend on institutional coordination, community acceptance, and the translation of policy objectives into locally workable practices (Hai, 2025).

Within geopark management, UNESCO guidance emphasizes that geotourism development requires explicit governance arrangements for community involvement and benefit-sharing (UNESCO, 2024). In traditional village conservation, policy misalignment and governance asymmetry can undermine behavioral commitment; conversely, policy instruments that protect practice spaces, support training and interpretation capacity, and stabilize participation rules can strengthen participation-to-transmission outcomes (Wang et al., 2025; UNESCO, 2024). Therefore:

H4: Policy support significantly moderates the relationship between community participation and sustainable cultural transmission.

Integrated Pathways among Identity, Participation, and Tourism

An integrated approach to rural cultural sustainability requires analyzing identity, participation and geosite tourism as a coupled socio-cultural system. Place identity research in traditional villages increasingly frames identity as enacted through ritual practice, communal labor and everyday stewardship, and proposes operational levers to translate identity into governance and conservation action (Wang et al., 2025). Social-value scholarship likewise argues that heritage significance is sustained through community recognition and participation, aligning conservation with social well-being rather than fabric-focused protection alone (Rossitti et al., 2025). In geopark contexts, community perspective research shows that perceived benefits and social cohesion are strengthened when communities are meaningfully engaged in geotourism initiatives (Louis et al., 2025), while participatory tool studies highlight how integrating vernacular knowledge into interpretive design fosters belonging and supports the long-term success of geotourism (Guerini et al., 2026a). Together, these studies suggest a cyclical pathway: cultural landscape identity motivates participation; participation enables geosite interpretation and tourism development through stakeholder coordination; and well-governed tourism reinforces identity and supports cultural continuity through recognized roles, learning opportunities, and reinvestment into practice (UNESCO, 2024; Bai et al., 2026). Hence:

H5: Cultural landscape identity exerts an indirect effect on sustainable cultural transmission through the combined mediation of community participation and geosite tourism development.

Theoretical Framework

This study integrates recent theory and evidence from three complementary strands to explain how rural cultural landscapes influence community behavior and cultural continuity in geosite-based tourism settings. First, contemporary place-identity work in traditional village conservation conceptualizes identity as an embodied, enacted assemblage structured by emotional attachment, symbolic meaning, continuity and behavioral commitment, foregrounding intergenerational mechanisms and governance conditions as key determinants of identity outcomes (Wang et al., 2025).

Second, people-centered heritage governance and social-value scholarship argue that heritage significance is sustained through community recognition and meaningful involvement in assessment, decision-making and management, rather than through expert-centric or fabric-focused protection alone (Rossitti et al., 2025; Li & Cantini, 2025). Third, geopark and geotourism management guidance frames geotourism as an approach that links geoheritage conservation and education with local development, requiring participatory governance, clear stakeholder roles, and benefit-sharing to deliver sustainable outcomes (UNESCO, 2024; Hadian et al., 2025; Louis et al., 2025). On this basis, cultural landscape identity is treated as a motivating condition that activates behavioral commitment and willingness to participate in heritage and tourism governance (Wang et al., 2025). Community participation is conceptualized as meaningful involvement in planning, interpretation and management that sustains practice-based learning and living-heritage continuity (Rossitti et al., 2025). Geosite tourism development is operationalized as the organizational and interpretive process that translates geological and cultural meanings into tourism products. Recent evidence shows that integrating participatory tools and vernacular knowledge can strengthen community belonging and improve long-term effectiveness in geotourism initiatives (Guerini et al., 2026a; Guerini et al., 2026b). Policy support is positioned as an enabling condition that shapes the durability of participation-to-transmission pathways, consistent with emerging evidence that policy intervention and multi-actor coordination are increasingly central to traditional village sustainability governance (Li & Cantini, 2025; Bai et al., 2026).

Accordingly, the theoretical model in Figure 2 posits that cultural landscape identity initiates community participation, thereby promoting geosite tourism development and supporting sustainable cultural transmission. Community Participation and Geosite Tourism Development serve as sequential mediators, while Policy Support moderates the influence of participation on cultural outcomes. This structure aligns with recent geopark guidance emphasizing participatory governance and with the broader evolution of traditional village research toward system governance and multi-subject coordination (UNESCO, 2024; Bai et al., 2026).

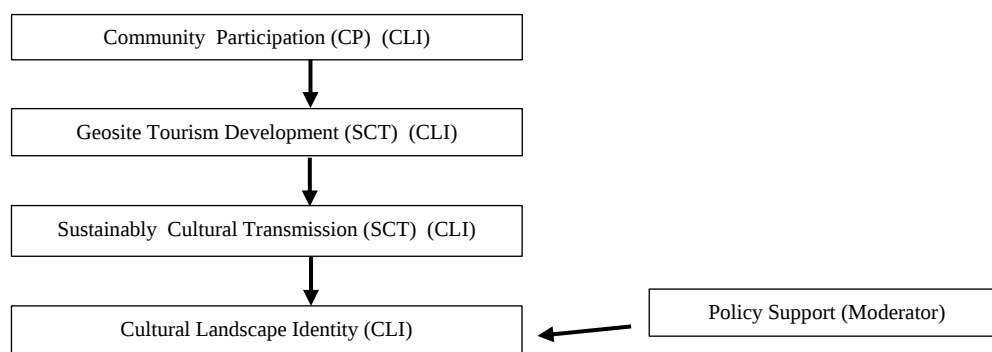


Figure 2. Theoretical model of rural cultural landscape sustainability

MATERIALS AND METHODS

Research Design

This study adopts a mixed-methods design combining quantitative survey analysis with qualitative interviews to examine the relationships among cultural landscape identity (CLI), community participation (CP), geosite tourism development (GTD), policy support (PS), and sustainable cultural transmission (SCT). Following the model structure outlined in Figure 2, partial least squares structural equation modelling (PLS-SEM) was conducted using ADANCO 2.3 to evaluate direct, indirect, and moderating effects. The qualitative follow-up phase was used to clarify the mechanisms underlying the statistical relationships, and the two strands were integrated during interpretation. This design supports methodological triangulation between statistical testing and contextual explanation (Creswell & Plano Clark, 2018). The methodological workflow is summarized in Figure 3.

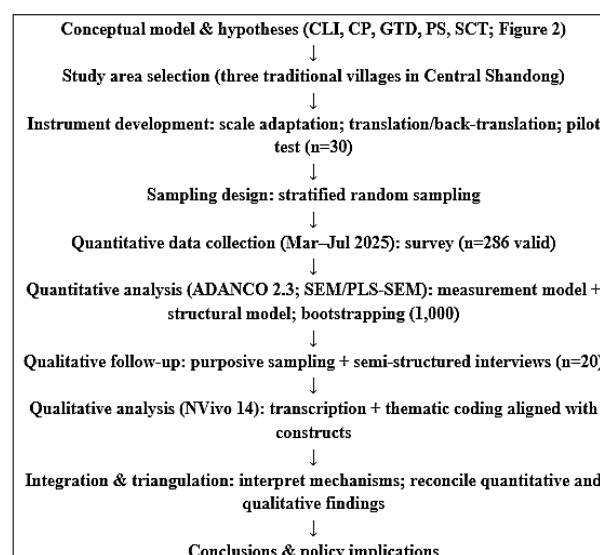


Figure 3. Methodological flow chart of the study (Note: CLI = cultural landscape identity; CP = community participation; GTD = geosite tourism development; PS = policy support; SCT = sustainable cultural transmission)

Study Area: Traditional Villages in Central Shandong

The study was conducted across three representative heritage villages in Central Shandong Province, each reflecting distinct geomorphological and cultural characteristics. Zhujiayu Village is a well-preserved Ming and Qing-era Mountain village located about 45 km east of Jinan in Shandong Province, known for its historic architecture and scenic landscape. Fangyu Village, situated in a valley in Xiaoli Town of Changqing District, Jinan, is characterized by its traditional stone-built layout and rich Qing-era architectural heritage. Lijiatuan Village, located southwest of Wangcun Town in Zibo City, is noted for its more than 400 preserved Ming and Qing buildings and is designated as a nationally famous historical and cultural village. All three sites lie within a radius of approximately 120 kilometres, collectively spanning a range of landforms from karst environments to alluvial plains. Each village is officially recognized on provincial-level Traditional Village Protection Lists, reflecting its cultural and environmental significance.

Population and Sampling

The study targeted residents, tourism practitioners, and local officials directly involved in heritage conservation or tourism management. Using stratified random sampling, 286 valid questionnaires were collected between March and July in 2025. Strata included (a) villagers engaged in cultural or tourism activities (65 %), (b) small business operators (20 %), and (c) local administrative representatives (15 %). The sample size satisfies SEM recommendations of at least 10 observations per indicator (Hair et al., 2017). Demographic characteristics are summarized in Table 1.

Table 1. Demographics of respondents (n=286)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	150	52.4
	Female	136	47.6
Age	18–30 years	62	21.7
	31–50 years	144	50.3
	Above 50 years	80	28.0
Education	Primary	58	20.3
	Secondary	148	51.7
	Tertiary	80	28.0
Occupation	Farmer / artisan	120	42.0
	Tourism worker	76	26.6
	Local official / committee member	90	31.4

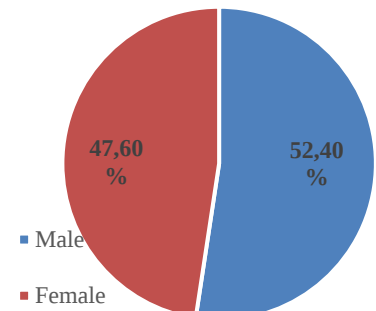


Figure 4. Gender

As shown in Figure 4, the sample was relatively balanced by gender, with 52.4% male and 47.6% female respondents. Figure 5 indicates that respondents aged 31–50 formed the largest age group (50.3%), followed by those above 50 (28.0%) and those aged 18–30 (21.7%). Figure 6 shows that 51.7% of respondents had secondary education, 28.0% had tertiary education, and 20.3% had primary education. Figure 7 presents the occupational distribution: farmers and artisans accounted for 42.0% of the sample, local officials or committee members for 31.4%, and tourism workers for 26.6%. Together, these distributions represent resident, heritage-practice, tourism, and administrative stakeholder groups.

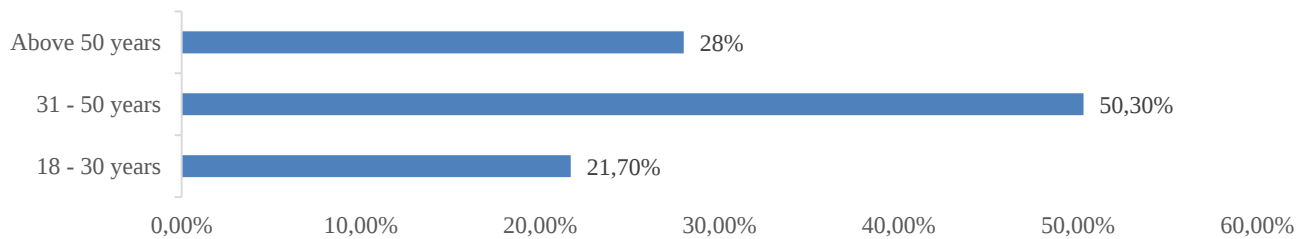


Figure 5. Age

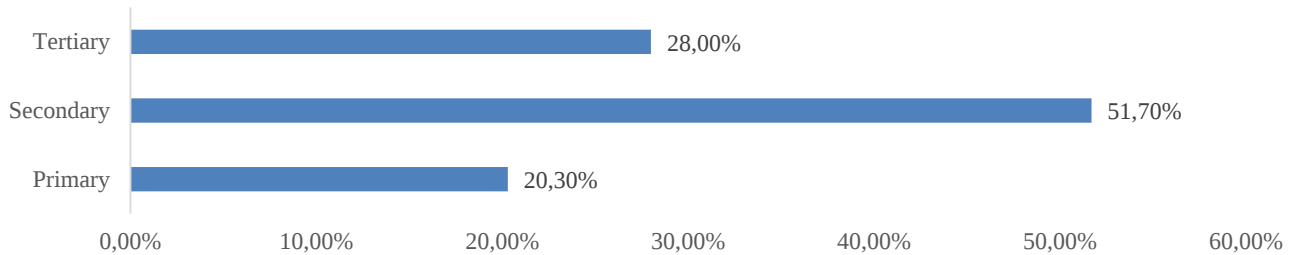


Figure 6. Educational Background

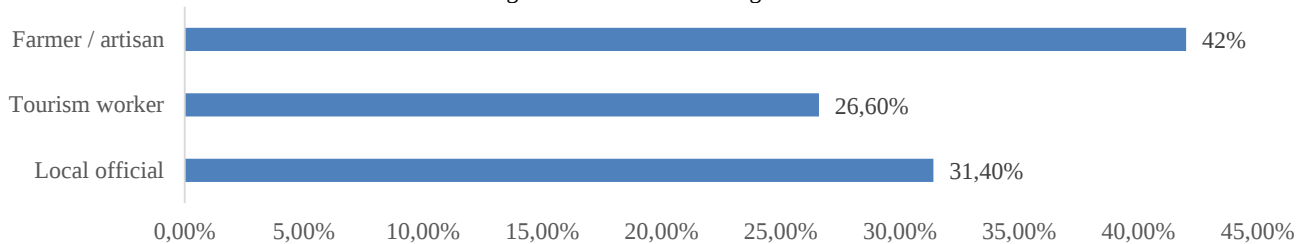


Figure 7. Occupational Diversity

Instrumentation and Measurement Scales

Questionnaires were developed from validated scales adapted to the rural Chinese context. Items used a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The instrument underwent translation–back-translation and pretesting with 30 respondents to ensure clarity. Reliability was ensured through Cronbach's $\alpha > 0.70$, and validity was confirmed via factor analysis.

Interview Design

To complement quantitative results, 20 semi-structured interviews were conducted with local artisans, tourism entrepreneurs, elders, and policy officers. The aim was to capture nuanced perceptions of landscape identity and cultural transmission. The interview component of the study was guided by a series of open-ended questions designed to capture residents' perceptions of landscape, culture, and tourism. Participants were asked to describe the relationship between their village landscape and local traditions, as well as the changes introduced by geosite tourism to daily life and cultural practices. They were invited to explain how villagers participate in decision-making related to heritage conservation or tourism development, and to discuss the types of government or policy support available to them. Additional questions focused on how

traditional skills, rituals, and stories are transmitted to younger generations, and whether tourism is perceived as a force that supports or threatens cultural values. Finally, participants reflected on how their village might achieve a balance between economic growth and cultural preservation. Interviews were conducted in Mandarin and local dialects, audio-recorded with consent, and later coded thematically using NVivo 14 to identify recurring themes aligned with model constructs. Table 2 summarizes the constructs, item counts, adapted sources, and representative questionnaire statements.

Table 2. Questionnaire Profile

Construct	Items	Scale Source (Adapted)	Example Statement
Cultural Landscape Identity (CLI)	5	Proshansky et al. (1983); Scannell & Gifford (2010)	"The landscape of my village represents who we are as a community."
Community Participation (CP)	5	Choi & Sirakaya (2006); Su & Wall (2014)	"I am actively involved in decisions concerning village tourism."
Geosite Tourism Development (GTD)	6	Dowling & Newsome (2018); Gordon (2018); Ólafsdóttir & Dowling (2014)	"Geosite tourism projects in our village highlight geological and cultural heritage together."
Policy Support (PS)	4	Xu & Wu (2022); He et al. (2025)	"Local government provides sufficient support for cultural landscape conservation."
Sustainable Cultural Transmission (SCT)	5	Smith & Waterton (2009); Ingold (2011); Wang et al. (2024)	"Traditional crafts and stories are being passed effectively to younger generations."

Data Collection and Analysis

Data collection proceeded in two sequential phases aligned with the mixed-methods design. In the quantitative phase, enumerators distributed printed questionnaires during village meetings and tourism-related workshops, and respondents completed the forms anonymously to reduce social desirability bias. In the qualitative follow-up phase, participants were purposively selected from different stakeholder groups to deepen the interpretation of the quantitative relationships. Quantitative data were analyzed using ADANCO 2.3. The assessment covered Dijkstra–Henseler’s rho A, composite reliability, average variance extracted, Cronbach’s alpha, the Heterotrait–Monotrait (HTMT) ratio, R², Q²predict, RMSE, and MAE. Bootstrapping with 1,000 resamples was used to assess the significance of structural paths and specific indirect effects. Qualitative interview data were analyzed thematically in NVivo 14, and the resulting themes were used to contextualize how cultural landscape identity motivates participation and how policy support shapes cultural transmission practices.

Ethical and Validity Considerations

Ethical protocols included anonymity, informed consent, and voluntary withdrawal. Construct validity was strengthened through pilot testing, expert consultation, and triangulation across data types. Internal validity was maintained by controlling for socio-demographic variables (age, gender and education). External validity is supported through multiple case-site comparisons within Central Shandong.

RESULTS AND DISCUSSION

This section presents the empirical findings from the quantitative analysis, enriched by qualitative insights. The results are organized into measurement reliability and validity, the measurement model, structural model fit, and hypothesis testing via path analysis. Consistent with the analytical framework, we examined direct effects (CLI → CP and CP → SCT), a mediating effect (CLI → GTD → SCT), and a moderating effect (PS × CP → SCT). Bootstrapping (1,000 resamples) confirmed the significance of these relationships at the 0.05 or 0.01 levels. The detailed results are presented below.

Reliability and Validity Assessment

We first assessed the reliability and convergent validity of all constructs. Table 3 shows that Dijkstra–Henseler’s rho A, composite reliability (pc), and Cronbach’s α for each latent construct all exceed the recommended threshold of 0.70, and average variance extracted (AVE) values are above 0.50. For example, Cronbach’s α values range from 0.80 (CLI) to 0.89 (SCT), and AVEs range from 0.589 to 0.640, indicating sufficient internal consistency and convergent validity. These results confirm that the survey indicators reliably represent their intended latent constructs (Hair et al., 2019).

Table 3. Variables Reliability and Validity

Construct	Dijkstra–Henseler’s ρA	Jöreskog’s pc	Cronbach’s α	Average Variance Extracted (AVE)
Cultural Landscape Identity (CLI)	0.812	0.848	0.801	0.589
Community Participation (CP)	0.864	0.875	0.857	0.612
Geosite Tourism Development (GTD)	0.887	0.901	0.879	0.623
Policy Support (PS)	0.820	0.853	0.806	0.592
Sustainable Cultural Transmission (SCT)	0.894	0.915	0.885	0.640

Measurement Model Evaluation

The assessment of the measurement model indicates strong item loadings for each construct. As shown in Table 4, almost all indicator factor loadings exceed 0.70, indicating that each measured item has a high shared variance with its construct. The few slightly lower loadings (e.g., 0.68) were still close to the cutoff and did not detract from overall model fit. In sum, all items demonstrate high loadings, validating the specified measurement structure.

Table 4. Measurement Items Fitness Statistics

Indicator	CLI	CP	GTD	PS	SCT
CLI1	0.76				
CLI2	0.71				
CLI3	0.82				
CLI4	0.68				
CLI5	0.75				
CP1		0.79			
CP2		0.83			
CP3		0.77			
CP4		0.84			
CP5		0.81			
GTD1			0.86		
GTD2			0.78		
GTD3			0.82		
GTD4			0.74		
GTD5			0.80		
GTD6			0.84		
PS1				0.79	
PS2				0.77	
PS3				0.83	
PS4				0.82	
SCT1					0.85
SCT2					0.83
SCT3					0.77
SCT4					0.79
SCT5					0.82

Discriminant Validity

Discriminant validity was evaluated using the Heterotrait–Monotrait (HTMT) ratio. All inter-construct HTMT values were below 0.85 (Table 5), satisfying the criterion for discriminant validity. This suggests that each construct is empirically distinct from the others (Henseler et al., 2015). No excessive inter-correlation was observed, indicating no issues of construct redundancy.

Table 5. Discriminant Validity (HTMT Ratios)

Constructs	CLI	CP	GTD	PS	SCT
CLI	—				
CP	0.64	—			
GTD	0.58	0.62	—		
PS	0.41	0.49	0.43	—	
SCT	0.68	0.66	0.59	0.54	—

Model Fit and Explained Variance

The structural model exhibits strong fit and predictive power (Table 6). The R^2 values indicate that the model explains 51.2% of the variance in Community Participation (CP), 66.7% in Geosite Tourism Development (GTD), and 80.3% in Sustainable Cultural Transmission (SCT). In particular, the R^2 for SCT is 0.803, suggesting that over 80% of the variance in the key outcome is accounted for by the integrated model – a substantial effect (Chin, 2010). Predictive relevance (Q^2) values for the endogenous constructs are also high (e.g., $Q^2 = 0.653$ for SCT), and the model's low RMSE and MAE further confirm its accuracy. Collectively, these metrics demonstrate a robust model with excellent explanatory capability.

Table 6. R-square Statistics and Model Goodness-of-Fit

Construct	R^2	Adjusted R^2	Q^2_{predict}	RMSE	MAE
Community Participation (CP)	0.512	0.507	0.412	0.063	0.079
Geosite Tourism Development (GTD)	0.667	0.662	0.518	0.056	0.074
Sustainable Cultural Transmission (SCT)	0.803	0.799	0.653	0.052	0.071

Variables Effects Overview

Table 7 summarizes the direct, indirect, and total effects among the constructs, along with effect size (Cohen's f^2). All path coefficients are positive and statistically significant, as hypothesized. For instance, cultural landscape identity (CLI) has a strong direct influence on community participation ($\beta = 0.715$) and also a sizable total effect on sustainable cultural transmission ($\beta_{\text{total}} = 0.765$), combining direct and indirect paths. Community participation shows a moderate direct effect on cultural transmission ($\beta = 0.462$), while geosite tourism development has a comparable direct effect ($\beta = 0.503$). The interaction term ($PS \times CP$) for policy support and participation has a positive coefficient ($\beta = 0.294$), indicating a strengthening effect. Cohen's f^2 values for the significant paths are all above 0.25, denoting medium to large effect sizes.

Table 7. Variables Effects Overview

Effect	Direct Effect (β)	Indirect Effect (β)	Total Effect (β)	Cohen's f^2
CLI $\rightarrow$ CP	0.715	—	0.715	0.51
CLI $\rightarrow$ GTD	0.428	0.219 (via CP)	0.647	0.37
CP $\rightarrow$ SCT	0.462	—	0.462	0.42
GTD $\rightarrow$ SCT	0.503	—	0.503	0.46
CLI $\rightarrow$ SCT	0.237	0.528 (via CP, GTD)	0.765	0.63
PS $\times$ CP $\rightarrow$ SCT (moderation)	0.294	—	0.294	0.29

Structural Model Estimation

Figure 8 illustrates the standardized path coefficients in the structural model. All hypothesized paths are supported by the data at $p < 0.05$ based on bootstrapped standard errors. The overall pattern of relationships confirms a well-fitting structural model. In summary, cultural landscape identity drives community participation, which in turn stimulates geosite tourism development, ultimately leading to sustainable cultural transmission. Moreover, policy support reinforces the link between participation and cultural transmission. This indicates that the presence of supportive policies enhances the positive impact of community engagement on sustainability outcomes. The significance of all key paths suggests that the proposed model is both statistically robust and substantively meaningful.

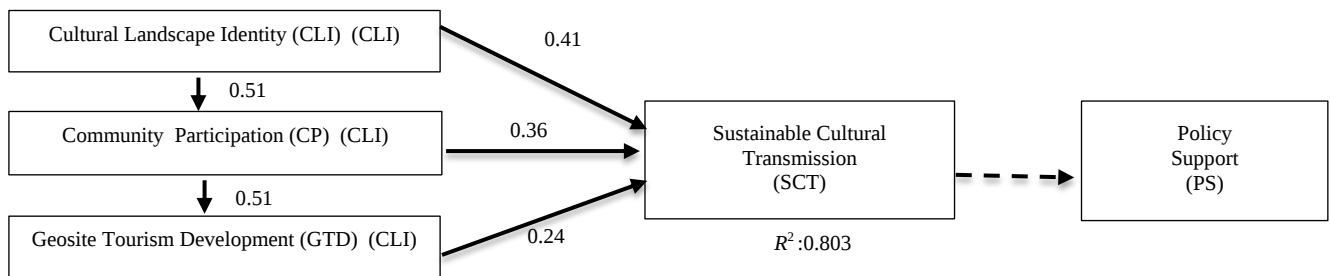


Figure 8. Estimated Structural Model for Path Analysis

Path Analysis

We tested five specific hypotheses (H1–H5) corresponding to the direct, mediated, and moderated relationships in the framework. The path analysis results (Table 8) show that all hypothesized effects are statistically significant (t-values well above 2.0, $p < 0.05$). In line with expectations, there are significant direct effects of CLI on CP (H1) and CP on SCT (H2), a significant mediating effect of GTD in the CLI $\rightarrow$ SCT relationship (H3), and a significant moderating effect of PS on the CP $\rightarrow$ SCT relationship (H4). The compound indirect pathway CLI $\rightarrow$ CP $\rightarrow$ GTD $\rightarrow$ SCT (H5) is also supported ($\beta_{\text{indirect}} \approx 0.24$, $p < 0.05$), confirming a sequential mediation through participation and tourism. These findings align with our analytical framework. All five hypotheses (H1–H5) are supported by the data, and the presence of both mediation and moderation effects is confirmed, consistent with prior theoretical expectations.

Table 8. Path Analysis Results

Path	β (Standardized)	STDEV	t-statistic	p-value	Hypothesis Supported?
H1: CLI $\rightarrow$ CP	0.715	0.091	7.857	0.000	Yes
H2: CP $\rightarrow$ SCT	0.462	0.128	3.609	0.000	Yes
H3: GTD mediates CLI $\rightarrow$ SCT	0.528	0.156	3.385	0.001	Yes
H4: PS moderates CP $\rightarrow$ SCT	0.294	0.137	2.146	0.032	Yes
H5: CLI $\rightarrow$ CP $\rightarrow$ GTD $\rightarrow$ SCT (indirect)	0.237	0.104	2.279	0.023	Yes

Interpretation of Key Findings

To interpret the practical meaning of these results, we examine each relationship in turn, integrating interview evidence to illustrate the dynamics:

(a) Cultural Landscape Identity $\rightarrow$ Community Participation: The coefficient for CLI $\rightarrow$ CP is $\beta = 0.715$ ($p < 0.001$), indicating that residents with strong attachment to their cultural landscape are substantially more active in community tourism and heritage initiatives. Interview narratives corroborate this pattern. One villager expressed a deep pride in the village's limestone architecture and heritage, stating: *"Our stone houses show the strength of our ancestors."* This quote exemplifies how a strong sense of place-based identity can serve as an intrinsic motivator for collective action: when residents feel that their environment and traditions are part of who they are, they are more likely to participate in communal efforts to sustain them (Proshansky et al., 1983; Scannell & Gifford, 2010).

(b) Community Participation $\rightarrow$ Sustainable Cultural Transmission: The positive link between participation and cultural transmission ($\beta = 0.462$, $p < 0.001$) confirms that active community engagement leads to more effective intergenerational knowledge transfer. Villagers who take part in tourism committees, local festivals, or craft cooperatives tend to be the ones imparting traditions and skills to the youth. One interviewee described how involving young people in tourism activities becomes a form of education: *"Younger villagers join guide teams and learn stories of the mountains."* By guiding visitors

around local geosites and cultural landmarks, young residents can learn oral histories and stewardship practices from elders while building capacities for community-based tourism. Such participation functions as a “living classroom,” supporting both learning and transmission through practice (Su & Wall, 2014; Wang et al., 2024). In essence, when community members—especially the younger generation—are actively engaged, they become both learners and transmitters of culture.

(c) **Mediating Role of Geosite Tourism Development:** The mediation analysis shows that CLI influences SCT in part through geosite tourism development (indirect effect $\beta \approx 0.53$, $p = 0.001$). In practice, this means geosite-focused tourism provides a critical pathway for translating landscape identity into sustainable cultural practices. Through geosite tourism, the unique geological features of the village (such as caves, springs, and stone formations) are leveraged in tourism narratives that also highlight local history and customs. As one resident observed, the geological attractions often draw visitors initially, but it is the living culture that truly engages them: *“Tourists come for rocks but stay for our culture.”*

This insight illustrates how geosite tourism can act as a bridge between natural heritage and cultural exchange. By integrating geo-interpretation with local storytelling, tourism development can create educational encounters for visitors and livelihood opportunities for residents, while maintaining attention to geoconservation principles (Dowling, 2013; Gordon, 2018). This dynamic aligns with UNESCO Global Geopark practice, which emphasizes the integration of geoscience education, local culture, and sustainable development (Henriques & Brilha, 2017; Lee & Jayakumar, 2021).

(d) **Moderating Role of Policy Support:** Policy support significantly strengthens the impact of community participation on cultural transmission (interaction effect $\beta = 0.294$, $p = 0.032$). In villages where local government and institutions provide subsidies, grants, or training programs, the positive effects of community efforts are amplified. Conversely, without supportive policies, even enthusiastic local initiatives may struggle to sustain momentum. One villager highlighted the value of government subsidies for heritage projects: *“Subsidies help us repair old roofs and create exhibits.”* This finding underscores the importance of enabling governance and multi-level policy alignment in sustaining rural cultural landscapes. Policy instruments such as maintenance grants, training programs, and regulatory protection can transform community enthusiasm into durable capabilities for heritage management and tourism service quality (Xu & Wu, 2022; He et al., 2025).

(e) **Integrated Effects and Model Strength:** Finally, the combined model demonstrates a powerful integrated effect. The high R^2 for sustainable cultural transmission (0.803) indicates that about 80% of the variance in cultural sustainability outcomes is explained by the joint influence of landscape identity, community participation, geosite tourism, and policy support. This highlights that none of these factors alone is sufficient; rather, it is their interaction in a coherent system that produces strong results. In traditional village settings, a self-reinforcing cycle appears to take hold: identity drives participation, participation facilitates tourism development, and supportive policies enhance all these efforts, creating a virtuous circle for cultural transmission. In summary, the quantitative findings, together with qualitative evidence, verify that the presence of all these elements leads to exceptionally robust sustainability of local culture.

Qualitative Triangulation

Qualitative findings from interviews and field observations provide additional depth to the statistical results and illuminate the mechanisms through which cultural sustainability emerges in the study villages. Three major thematic patterns were identified, each aligning closely with the structural relationships in the quantitative model.

First, villagers consistently described the landscape as a form of pedagogy, noting that local mountains, rivers, stone dwellings, and agricultural terraces act as living repositories of history, environmental ethics, and ancestral values. Daily interactions with the landscape enable elders to teach the younger generation about traditional practices and moral principles, reinforcing the role of place in cultural education.

Second, tourism was widely viewed as a bridge that connects the community with outsiders, offering both livelihood opportunities and a channel for cultural storytelling. Residents observed that guiding visitors and demonstrating crafts or rituals helped transmit intangible cultural knowledge and enhanced community pride.

Third, participants emphasized that supportive government policies act as catalysts for cultural preservation by providing resources, recognition, and legitimacy to local heritage initiatives. Subsidies for restoration work and training programs were perceived as validating cultural identity and motivating youth participation. Together, these insights demonstrate that sustainable cultural transmission arises where emotional attachment to place, active community engagement, and enabling governance intersect, thereby reinforcing the patterns observed in the quantitative analysis.

Summary of Results

Overall, the study's results provide strong empirical support for all five hypotheses and confirm the proposed integrated model of cultural sustainability in rural geosite contexts. Cultural landscape identity has a significant and positive influence on community participation, which, in turn, contributes directly and indirectly to sustainable cultural transmission. Geosite tourism development serves as a key mediating mechanism, transforming identity-driven participation into culturally meaningful and economically viable practices. Policy support serves as an important moderating factor, enhancing the positive effects of participation by strengthening the institutional and resource foundations for heritage preservation. The structural model exhibits strong explanatory power, accounting for more than 80% of the variance in sustainable cultural transmission, driven by the combined effects of identity, participation, tourism development, and policy support. These findings confirm that cultural sustainability in traditional villages is most effectively achieved when community attachment to place, participatory action, geosite-centered tourism, and supportive governance operate in synergy. By illustrating how these elements interact to sustain both tangible and intangible heritage, the study contributes valuable insights for theory, policy, and rural revitalization practice.

DISCUSSION

This study examined how cultural landscape identity (CLI), community participation (CP), geosite tourism development (GTD), and policy support (PS) jointly shape sustainable cultural transmission (SCT) in traditional villages of Central Shandong, China. Using SEM and triangulated interviews, the findings reveal a coherent, multi-layered process: strong landscape identity motivates local engagement; participation fosters tourism development; geosite tourism mediates the transformation of heritage into sustainable practice; and policy support amplifies these dynamics.

The model achieved an R^2 of 0.803, indicating that the combined influence of identity, participation, geosite tourism, and policy support explains more than 80% of the variance in sustainable cultural transmission. This underscores that cultural transmission in rural landscapes is an integrated socio-ecological process linking people, place, and governance rather than an isolated act of preservation (Antrop, 2005; Soini & Dessein, 2016). The significant positive path ($\beta = 0.715$, $p < 0.001$) affirms that residents with strong identification toward their landscape are more inclined to participate in community and tourism initiatives. This supports *place-identity theory* (Proshansky et al., 1983), which holds that emotional bonds with place drive pro-environmental and communal behaviors. In Central Shandong, villagers' attachment to limestone dwellings, ancestral terraces, and geomantic village layouts provides intrinsic motivation for stewardship.

This result is consistent with place-identity and place-attachment scholarship, which argues that place-based meanings can translate into stewardship and civic engagement, especially when participation structures are credible and inclusive (Proshansky et al., 1983; Scannell & Gifford, 2010). Evidence from heritage management research further suggests that residents' willingness to participate increases when decision-making is transparent and communities perceive tangible cultural and livelihood benefits (Li et al., 2020; Scheyvens, 1999). The positive relationship ($\beta = 0.462$, $p < 0.001$) verifies that participatory governance and collaboration foster sustainable cultural transmission. This resonates with community-based tourism (CBT) theory (Goodwin, 2016) and empowerment theory (Scheyvens, 1999), both arguing that genuine participation generates ownership and resilience. Comparable patterns have been reported in Chinese heritage tourism settings where residents participate in guiding and management at heritage sites, enabling learning and strengthening attachment among younger generations (Su & Wall, 2014). Recent practitioner-based research also suggests that tourism can reshape intergenerational practice of intangible cultural heritage by providing new spaces and incentives for transmission (Wang et al., 2024). The mediation effect ($\beta = 0.528$, $p = 0.001$) confirms that geosite tourism translates cultural identity into sustainability outcomes. By combining geomorphological appreciation with cultural storytelling, tourism enables both economic viability and cultural continuity. This aligns with geotourism theory (Dowling & Newsome, 2018) and landscape ecology principles (Antrop, 2005). The mediation finding is consistent with international geopark and geotourism research showing that geo-interpretation, when connected to local culture, can support both visitor learning and local development (Gordon, 2018; Ólafsdóttir & Dowling, 2014). Studies of UNESCO Global Geoparks also indicate that economic impacts and territorial identity effects are stronger when governance arrangements recognize community roles and foster local ownership (Lee & Jayakumar, 2021; Stoffelen et al., 2019). The moderating role of policy support demonstrates that institutional backing strengthens the link between participation and cultural transmission.

In the geopark and protected-area literature, funding stability, administrative coordination, and participatory governance are repeatedly identified as enabling conditions for community engagement and long-term heritage outcomes (Henriques & Brilha, 2017; Xu & Wu, 2022; Zhuang et al., 2024). Qualitative insights reinforce this: respondents reported that policy programs legitimized their cultural work and encouraged youth involvement. The implication is that decentralized yet consistent governance can transform participation from ad hoc volunteerism into structured cultural entrepreneurship.

The indirect path (CLI $\rightarrow$ CP $\rightarrow$ GTD $\rightarrow$ SCT) illustrates a holistic sustainability chain where identity fuels participation, participation fosters tourism, and tourism ensures transmission. This supports the cultural sustainability framework of Soini & Dessein (2016), highlighting feedback loops between cultural meaning and socio-economic systems. The cyclical reinforcement observed in Shandong—identity strengthened by tourism, tourism sustained by identity—exemplifies what Smith and Waterton (2009) call dynamic heritage reproduction. The study makes theoretical contributions in three interrelated domains. First, it advances Cultural Landscape Theory by operationalizing landscape identity as a measurable construct capable of predicting participatory and behavioural outcomes, thereby extending Sauer's (1925) descriptive work into an empirically testable model. Second, it strengthens the linkage between geotourism and cultural transmission by demonstrating how geological heritage serves as a medium for sustaining intangible cultural knowledge, and by illustrating the interconnectedness of the physical and symbolic dimensions of sustainability, as suggested by Dowling (2013) and Farsani et al. (2011). Third, the study enriches governance perspectives by confirming the moderating influence of policy support, thereby connecting macro-level institutional frameworks with micro-level community participation and adding conceptual clarity to discussions of sustainable rural development.

In comparison with earlier work, our findings reinforce arguments that cultural meaning and local participation are central to sustainable heritage tourism, and that geotourism in protected-area contexts can strengthen place identity when communities are engaged in interpretation and governance (Su & Wall, 2014; Li et al., 2020). While many prior studies focus primarily on built heritage, this study foregrounds the integration of geological heritage with cultural landscape narratives, aligning with geotourism scholarship emphasizing education and geoconservation (Dowling, 2013; Gordon, 2018).

CONCLUSIONS

Theoretical Implications

The study makes several theoretical contributions across interconnected domains. It advances Cultural Landscape Theory by operationalizing landscape identity as a measurable construct that predicts participatory and behavioural

outcomes, thereby extending Sauer's (1925) descriptive foundations into an empirically testable model. It also strengthens the linkage between geotourism and cultural transmission by demonstrating that geological heritage serves as a conduit for sustaining intangible cultural knowledge, thereby illustrating the interdependence of the physical and symbolic dimensions of sustainability, as described by Dowling (2013) and Farsani et al. (2011). In addition, the findings enrich governance perspectives by confirming the moderating role of policy support, which connects macro-level institutional structures with micro-level community participation, and clarifying how sustainable rural development emerges through such interactions. These contributions broaden cultural landscape and geotourism research by integrating geomorphological heritage and vernacular cultural landscapes within an empirically testable framework, and by showing how enabling governance can amplify community-based cultural transmission (Antrop, 2005; Gordon, 2018; Zhuang et al., 2024).

Practical Implications

For policymakers, the findings underscore the need to embed cultural transmission indicators into rural revitalization assessment systems so that cultural continuity is evaluated with the same rigor as economic development and infrastructure improvements. Incorporating such indicators ensures that policy interventions remain sensitive to heritage dynamics rather than focusing solely on material growth. In addition, providing microgrants and specialized training for community-led interpretive initiatives and craft cooperatives can empower residents to take ownership of heritage stewardship and strengthen local capacities for cultural entrepreneurship. Policy makers should also promote inter-village networks that enable communities to share best practices, jointly develop tourism products, and coordinate landscape-level management strategies, thereby reducing fragmentation and fostering collective resilience. For local communities, the results highlight the importance of integrating youth into heritage tourism activities through structured apprenticeship programs that facilitate hands-on learning and allow younger generations to acquire cultural knowledge directly from experienced elders. Communities can also enhance cultural vitality by developing storytelling platforms that connect geological features with oral histories, ensuring that both the physical environment and its associated meanings are communicated to residents and visitors alike. Furthermore, participatory mapping and community-based monitoring of cultural landscape changes can strengthen local awareness of environmental transformations and support informed decision-making.

For tourism planners and geopark managers, the study demonstrates the value of designing interpretive trails that weave together geomorphological and cultural narratives, helping visitors understand how geological formations and human traditions co-evolve over time. Planners must carefully balance visitor capacity with community well-being and ecological thresholds to prevent overuse and maintain authenticity. Finally, collaborations with academic institutions can support systematic documentation of heritage assets, the development of digital archives, and the creation of innovative interpretive materials that enhance the visibility and long-term preservation of rural cultural landscapes.

Research Limitations and Future Research Directions

Although this study provides important insights into the relationships among cultural landscape identity, community participation, geosite tourism development, and policy support, several limitations indicate directions for future investigation. The research's regional scope is confined to Central Shandong, an area characterized by limestone geomorphology, Confucian landscape traditions, and long-established village settlement patterns. These features may not mirror the cultural–environmental dynamics found in other rural regions of China, such as the karst plateaus of the southwest, the river terrace systems of the Yangtze Basin, or the high-altitude pastoral landscapes of the Tibetan Plateau. Conducting comparative studies across multiple geomorphological and cultural settings would therefore strengthen understanding of the model's generalizability and clarify how environmental context shapes identity formation and cultural transmission.

The temporal structure of the study also presents a limitation, as data were collected at a single point in 2025. Rural tourism and cultural revitalization are dynamic processes influenced by policy changes, migration patterns, and economic cycles. Longitudinal research would enable the examination of how identity, participation, and tourism evolve over time, and could capture processes such as the gradual erosion or strengthening of cultural attachment, the emergence of new heritage practices, or shifts in community involvement as tourism intensifies. In terms of measurement, although the quantitative scales were adapted from established literature, they may not fully encompass locally embedded interpretations of concepts such as identity, belonging, transmission, and participation. These constructs often contain tacit, emotional, and symbolic layers that are difficult to quantify through Likert scales.

Future studies could therefore incorporate participatory visual methods, cultural mapping, in-depth ethnographic observation, or narrative-based interviews to capture the nuance of local meanings and lived experiences. Another limitation concerns the conceptualization of policy support, which was treated as a broad, unified construct. In practice, policy support encompasses multiple dimensions, including financial assistance, regulatory protection, educational training, administrative facilitation, and heritage legislation. Disaggregating these components would allow researchers to identify which specific policy instruments exert the strongest influence on cultural sustainability.

Building on these limitations, several directions for future research emerge. Scholars may explore digital heritage mediation, such as augmented or virtual reality storytelling, interactive archives, and digitally enhanced interpretive trails as new avenues for transmitting cultural knowledge to both residents and visitors. Further investigation is also needed into gendered and generational patterns of participation, as younger residents, elders, men, and women may engage differently with landscape identity, tourism, and heritage practices. Finally, modelling cross-regional networks linking geoparks, cultural corridors, and inter-village alliances would offer new perspectives on macro-level pathways of cultural transmission, highlighting how ideas, narratives, and practices circulate across broader spatial systems beyond individual villages.

Concluding Remarks

This study demonstrates that rural cultural landscapes serve as powerful foundations for sustainable cultural transmission when supported by strong local identity, active community engagement, and geosite-oriented tourism under enabling governance conditions. Using traditional villages in Central Shandong as empirical cases, the research shows that cultural landscape identity motivates residents to participate in heritage and tourism activities, and that this participation translates into both educational and economic pathways through geosite tourism development. Policy support further strengthens these community-driven processes, ensuring that cultural knowledge, practices, and landscape stewardship are maintained across generations. The integrated model, validated by quantitative SEM results and corroborated by qualitative narratives, reveals that sustainable cultural transmission is not a singular outcome but a multi-layered process linking people, place, and institutional context. The geological formations, vernacular architecture, ritual spaces, and ecological knowledge of the study villages form living cultural landscapes where identity, participation, and tourism interact continuously.

These findings extend Cultural Landscape Theory by operationalizing identity as a measurable construct, advance geotourism scholarship by illustrating its role as a medium of intangible heritage continuity, and enrich governance studies by highlighting the moderating influence of policy frameworks. Beyond Shandong, the insights emphasize that rural revitalization depends on cultivating local pride, empowering communities, designing interpretive geotourism that integrates natural and cultural heritage, and institutionalizing multiscale policy support. Ultimately, the study affirms that sustainable cultural transmission arises not from external preservation mandates but from the synergy of attachment, participation, learning, and governance embedded within rural cultural landscapes.

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