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Exploring the interplay between traditional Bai dwelling conservation and cultural identity under urbanization in Dali, China

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Abstract

Traditional dwellings serve as important carriers of ethnic cultural identity, yet face increasing pressure from urbanization. This study investigates the bidirectional interaction mechanisms between traditional Bai dwelling conservation and cultural identity formation under urbanization pressures in Dali, China, addressing critical gaps in understanding how heritage preservation and cultural continuity mutually influence each other in rapidly changing ethnic minority communities. A mixed-methods research design was employed, integrating quantitative surveys of 480 Bai households across 12 traditional villages with qualitative interviews and spatial analysis, utilizing structural equation modeling, geographically weighted regression, and thematic analysis to examine conservation-identity relationships across varying urbanization contexts. Results demonstrate significant bidirectional causal relationships between conservation engagement and cultural identity ($\beta = 0.394$ and 0.312, both $p<0.001$), with community participation and intergenerational contact serving as key mediating mechanisms, while urbanization level negatively moderates these relationships ($\beta = -0.187$, $p<0.001$). Notably, intermediate urbanization areas achieve optimal conservation-identity synergy, with spatial clustering revealing geographic heterogeneity in heritage-identity dynamics. These findings suggest that traditional dwelling conservation and cultural identity serve as mutually reinforcing processes rather than independent phenomena, creating positive feedback loops that enhance both preservation outcomes and cultural continuity through embodied practice and community engagement. The study informs the development of community-centered conservation strategies that recognize the intimate connections between physical preservation and cultural vitality, suggesting that sustainable heritage conservation requires integrated approaches that nurture both architectural integrity and cultural identity processes for long-term preservation success.

Keywords: Traditional dwelling conservation; Cultural identity; Bai ethnic minority; Urbanization; Heritage preservation

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1. Introduction

Rapid urbanization in non-industrialized countries has significantly altered the interaction between established cultures and new ways of life, thereby posing unique challenges for the preservation of heritage and the perpetuation of cultural identities. Historic residential districts, as tangible representations of cultural memory and identity, storehouses of architectural knowledge, and community settings, face significant risks during this transition period. As socioeconomic conditions continue to evolve, tensions between conservation and renewal have intensified, particularly for ethnic minority communities that strive to sustain their diverse cultural traditions. In the wake of rapid global development and urbanization, the protection of traditional residential building settings has emerged as a pressing concern, with interrelated challenges that involve indigenous cultural identity, community resilience, and sustainable development policy.

The course of Chinese urbanization, characterized by record-breaking scope and speed, has provided an important framework for examining these processes, focusing on the country's commitment to economic development while preserving historical cultures. Based on the Chinese state government's increasing recognition of the paramount importance of traditional villages and building cultures, an investigation into overall spatial distribution has identified 777 national-level traditional villages, almost all of which are located in Yunnan province (X. Yuan *et al.*, 2024). Recent studies have shown significant spatial differences as well as diversified developmental pathways for these traditional villages (Zhang *et al.*, 2023), while studies emphasizing ethnic minority villages have shown marked spatial settings and ethnic disparities within the region (Gao *et al.*, 2024). Yunnan province, characterized by exceptional ethnic diversity with 25 minority groups, embodies these broader issues within a microcosmic setting where traditional building styles, conservation, and the complex dynamics of cultural identification, negotiation, and community adaptation coexist. In this context, the ethnic minority Bai of Dali has retained distinctive building methods characterized by complex spatial arrangements and significant cultural importance, thereby providing valuable experiences for an enhanced understanding of the dynamics of heritage protection.

The Bai ethnic group's architectural heritage is characterized by significant spatial arrangements, namely, the designs referred to as "three courtyards with one screen wall" and "four courtyards with five patios," which demonstrate complex construction traditions that have drawn significant interest in scholarly literature (Yan *et al.*, 2022). Recent research has focused on sustainable methods applicable to traditional residential areas, including various forms of evidence-based undertakings, in particular studies of Bai courtyard houses as models of sustainable architecture (Li *et al.*, 2022). Compositional assessments have chronicled the evolution of schools and Chinese residential compounds in Dali city in the Ming dynasty (1368–1644) and Qing dynasty (1644–1912) (Bai *et al.*, 2024), with recent research highlighting measures intended to promote the well-being of agrarian communities belonging to the Bai minority (Xian & Ek-Iem, 2023). The preservation of traditional crafts has been approached through cultural ecology theory, analyzing inheritance patterns for the sustainable development of traditional handicrafts (Yang *et al.*, 2022). In addition, the evolution of cultural symbols, such as Yunnan's tile cats, demonstrates the transformation from sacred rooftops to contemporary cultural and creative products (Nanxin & Chartniyom, 2024). However, despite these diverse research contributions, there remains a limited understanding of how conservation practices themselves influence and are influenced by the cultural identity processes that give these spaces meaning.

Cultural identity research within ethnic minority contexts has increasingly recognized the fluid and contextual nature of identity formation, particularly under conditions of rapid social change. Pioneering work on local traditional knowledge in urban contexts has specifically examined Bai ethnic minority communities, providing insights into knowledge adaptation processes (Ma & Cao, 2021). Digital conservation efforts have focused on Bai Benzhu culture, exploring art forms and digital preservation of intangible heritage (Y. Yuan & Yodmalee, 2023). The broader questions of heritage, homemaking, and identity formation have been examined through ethnographic studies of Yi migrants, revealing complex processes of identity negotiation (Liu, 2025). Contemporary research has also explored unconventional ecological farms and their role in bringing urban and rural communities together (Y. Zhao, 2023). Educational innovations in intangible cultural heritage tourism have demonstrated new approaches to cultural transmission (Wang & Xiao, 2021). Spatial analysis techniques have been applied to rural settlements in ethnic minority areas, providing revitalization strategies for places such as Shuanglang town (Sun *et al.*, 2024). These studies collectively demonstrate that cultural identity operates through dynamic processes of spatial practice, cultural transmission, and community engagement.

The intersection of dwelling conservation and cultural identity presents theoretical and practical challenges that require interdisciplinary approaches. Recent advances in

traditional village research have emphasized sustainable characteristics based on the four-pillar theory of sustainable development (X. Zheng *et al.*, 2024), while policy studies have examined how traditional villages can achieve a unified identity through centralized contiguous protection and utilization strategies (X. Zhao *et al.*, 2024). Broader investigations into settlement spaces have explored the urban survival prospects of China's special communities (Wu & Wang, 2021). Emerging research has begun to address rural gentrification in developing economies (Zheng & Tuguldur). Contemporary applications of digital technology have enabled the construction of cultural landscape genomic maps for traditional communities, as demonstrated in Miao communities in Leigong Mountain (Gu *et al.*, 2025). This study addresses existing theoretical and empirical gaps by examining the bidirectional relationship between traditional Bai dwelling conservation and cultural identity formation in Dali, with a specific focus on how urbanization processes mediate this relationship. By investigating three core hypotheses—(i) conservation practices influence the intensity of cultural identity, (ii) cultural identity affects participation in conservation, and (iii) levels of urbanization moderate these relationships—this study aims to contribute both theoretical insights into heritage-identity dynamics and practical guidance for developing effective, community-centered conservation strategies that support both cultural continuity and adaptive change in rapidly urbanizing contexts.

2. Methods

2.1. Research design

This study employed a mixed-methods research design to investigate the interaction between traditional Bai dwelling conservation and cultural identity during urbanization in Dali, China, using interviews and questionnaires. Snapshots of information were taken over time to capture both stable dynamics and changes. This approach provided an opportunity to cross-check results across alternative sources, thereby making the findings on conservation and identity more robust and reliable. The design focused not only on place but also on conventional social science approaches, recognizing that place is a critical component in this respect for conservation activities and the creation of identities. It examined various villages with diverse levels of urbanization to illustrate how different modern circumstances influence the two-way dynamic between the preservation of homes and the construction of cultural identity in Bai societies.

Figure 1 illustrates the entire methodology, including the collection of numerical data and participants' personal narratives. The methodology started with a theoretical foundation, followed by data collection and analysis of the results. Such a methodology maintained high integrity and respected the cultural heritage of ethnic minorities in research.

2.2. Study area and sample selection

The study area encompassed the Bai autonomous prefecture in Dali, which is significant for preserving ethnic minority cultures amid urbanization. The study adhered to prescribed steps for studying traditional villages and a sampling strategy that divided the area into main and comparison areas based on varying levels of urbanization. Dali ancient city was the principal area, where extensive urban development and overt conflicts between development and preservation are evident. Shuanglang town and Xizhou town were selected as comparison areas due to their moderate levels of urbanization and varied approaches to preservation, as well as for their remote traditional villages that are under less pressure from modernization.

The selection of 12 villages from the 777 traditional villages in Yunnan province followed a purposive stratified sampling framework based on four criteria: (i) Bai population concentration exceeding 85 percent to ensure cultural homogeneity; (ii) preservation of traditional architectural patterns with at least 60 percent intact traditional dwellings; (iii) representation of different Bai sub-groups including Dali-Bai, Jianchuan-Bai, and Eryuan-Bai branches; and (iv) geographic diversity covering lakeside, mountain, and valley settlements. This sampling strategy ensures representation of the original Bai cultural context through capturing both cultural and environmental variations within Bai communities.

Table 1 presents the characteristics of the study areas, enabling us to examine the influence of various cities on conservation and identity across contrasting experiences of modernization. Twelve villages were selected from 777 traditional villages in Yunnan province to represent the original Bai cultural contexts. The sample comprised 480 Bai households, with 40 households from each village selected through stratified random sampling based on registration and length of residence.

2.3. Data collection methods

Data collection integrated multiple approaches to capture the multidimensional nature of conservation-identity interactions. Quantitative data collection centered on structured questionnaire surveys administered through face-to-face interviews, incorporating validated cultural identity scales and custom-developed conservation attitude measures. Surveys were conducted in both

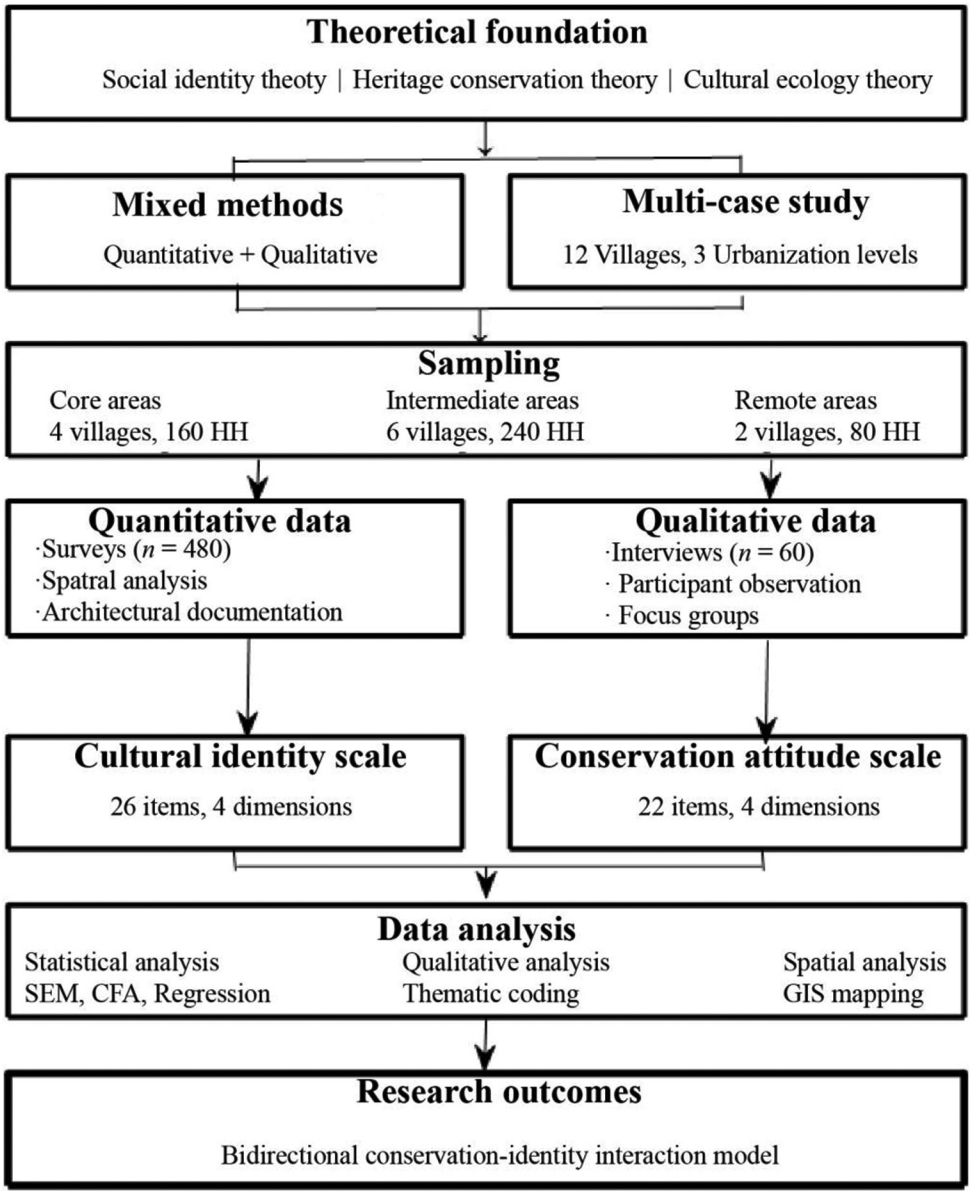

Figure 1. Research methodology framework
Source: Diagram by authors.
Abbreviations: CFA: Confirmatory factor analysis; GIS: Geographic information system; HH: Household; SEM: Structural equation modeling.

Table 1. Study area characteristics and sample distribution

Area category	Location	Urbanization level	Population density (persons/sqkm)	Sample villages	Households	Conservation status
Core area	Dali ancient city	High	2,850	4	160	Mixed (restored/original)
Intermediate	Shuanglang town	Medium-high	1,200	3	120	Good preservation
Intermediate	Xizhou town	Medium	800	3	120	Excellent preservation
Remote	Traditional villages	Low	250	2	80	Original condition
Total	-	-	Average: 1,025	12	480	-

Mandarin and the Bai language, utilizing trained bilingual enumerators to ensure accurate translation and cultural interpretation. Qualitative data collection employed semi-structured interviews with 60 key informants, using open-ended questions that allowed participants to share experiences within their own cultural frameworks. Interview protocols explored residents' perceptions of traditional dwelling values, conservation experiences, and differences in intergenerational cultural transmission. Participant observation documented cultural practices in daily contexts, modern usage patterns of traditional spaces, and actual conservation implementation, revealing gaps between stated attitudes and observed behaviors.

Spatial data collection incorporated the global positioning system and architectural surveying to precisely document building structures and conservation states. Drone aerial photography and three-dimensional modeling enable comprehensive documentation of architectural features and spatial relationships. Historical maps and archival imagery support longitudinal analysis of village transformation patterns and conservation impacts.

2.4. Measurement instruments

The study employed validated measurement instruments to assess cultural identity, conservation attitudes, and urbanization levels within the context of the Bai community. Cultural identity measurement drew on established frameworks while incorporating Bai-specific elements, assessing cultural knowledge cognition, practice participation, value identification, and transmission willingness. Conservation attitude measurement employed custom-developed scales evaluating policy support, behavioral participation, satisfaction with effectiveness, and tolerance of associated costs, specifically calibrated through extensive pilot testing.

The validation results in Table 2 demonstrate strong psychometric properties with Cronbach's alpha values ranging from 0.743 to 0.847, exceeding conventional thresholds. Factor loadings ranged from 0.634 to 0.879, indicating robust item-construct relationships. Urbanization indicators incorporated both objective measures from census data and subjective measures that captured residents' perceptions of the impacts of modernization.

2.5. Analytical methods

The analytical strategy encompassed quantitative, qualitative, and spatial approaches. Quantitative analysis began with descriptive statistics, followed by correlation and multiple regression analysis to identify significant relationships while controlling for confounding factors. Structural equation modeling (SEM) was used to test hypothesized causal pathways between conservation practices, cultural identity dimensions, and mediating variables, enabling the simultaneous examination of complex causal structures fundamental to understanding the bidirectional relationships between conservation and identity.

Table 2. Measurement instruments and validation results

Construct	Dimensions	Items	Cronbach's α	Factor loading range
Cultural identity	Knowledge cognition	8	0.847	0.658–0.821
	Practice participation	6	0.782	0.672–0.798
	Value identification	7	0.823	0.645–0.856
	Transmission willingness	5	0.769	0.689–0.824
Conservation attitude	Policy support	6	0.801	0.634–0.789
	Behavioral participation	7	0.845	0.671–0.842
	Effectiveness satisfaction	5	0.756	0.658–0.801
	Cost tolerance	4	0.743	0.692–0.798
Urbanization level	Population dynamics	3	0.812	0.724–0.856
	Infrastructure development	5	0.789	0.643–0.821
	Economic transformation	4	0.834	0.698–0.879

Geographically weighted regression (GWR) models were used to examine spatial heterogeneity in conservation-identity relationships. The mathematical formulation is shown in Equation (1):

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^{m} \beta_k(u_i, v_i) x_{ik} + \varepsilon_i \quad (1)$$

Where (u_i, v_i) represents the spatial coordinates of the location i; $\beta_0(u_i, v_i)$ denotes spatially varying parameters; and ε_i represents random error. This approach revealed how geographic context mediated conservation-identity relationships across urbanization gradients.

The GWR model extends traditional regression by allowing regression coefficients to vary spatially, capturing how relationships between variables change across geographic space. The local coefficients $\beta(u_i, v_i)$ represent the strength of relationships at specific locations, with higher values indicating stronger conservation-identity connections. For example, a coefficient of 0.623 in remote villages means that a one-unit increase in conservation

engagement corresponds to a 0.623-unit increase in cultural identity at that location, compared to only 0.187 in urban cores. This spatial variation helps identify where conservation-identity relationships are strongest and where targeted interventions are most needed.

Qualitative analysis used thematic coding to examine interview transcripts. It integrated new concepts and theories into one framework. Narrative analysis examined how individuals construct narratives of their homes and identities. Discourse analysis assessed how society influences concepts of conservation and identity. Spatial analysis consisted of several approaches: space syntax analysis, which examined the physical arrangement of the village and its relationship to social activity; kernel density analysis, which determined clustering patterns; and spatial autocorrelation analysis, revealing how conservation and identity are geographically correlated.

2.6. Research ethics and quality control

Research ethics procedures ensure cultural sensitivity and methodological rigor for ethnic minority heritage research. The study obtained formal approval from the university Institutional Review Board and government authorities, including the Dali Prefecture Government and village committees. Individuals provided informed consent after receiving detailed information in either Mandarin Chinese or the Bai language, explaining the research objectives, methods, and participant rights, including the option to withdraw unconditionally. Cultural sensitivity protocols ensure respectful engagement with traditional knowledge while protecting intellectual property rights and preventing cultural appropriation.

Privacy protection encompasses comprehensive data anonymization, secure encrypted storage, and adherence to publication ethics, safeguarding individual and community identities while ensuring equitable community benefit-sharing. Quality control implemented multiple validation strategies, including cross-checking survey responses with observational data, inter-rater reliability assessments, and community feedback mechanisms. Field supervision ensured continuous adherence to ethical protocols through regular site visits and systematic documentation of any adaptations required during research.

3. Results

3.1. Descriptive statistics

The in-depth survey of 480 Bai families across 12 historical villages revealed great disparity among the people and their financial conditions. This reflects the influence of urban life on ethnic minority groups. The sample shows a balanced representation across age groups: 28.3 percent were aged 18–35 years old (young adults); 35.6 percent were aged 36–55 (middle-aged adults); and 36.1 percent were aged 56 and above (older adults), many of whom play a key role in maintaining cultural continuity. This balance across the three age groups enabled us to examine how culture is transferred from one generation to the next and how the stages of life shape their thoughts on preserving traditions and forming a sense of culture and identity.

Education levels varied remarkably between rural and city regions. Specifically, 22.7 percent completed primary school or less, 41.2 percent completed middle school, 28.9 percent completed high school, and 7.2 percent completed college or higher. This indicates that youths in traditional societies are getting increasing access to formal education. It can, however, also mean they may be less engaged with traditional knowledge practices and experiential learning processes gained through experience and narratives. The number of college graduates is low, indicating that most educated individuals prefer to stay in urban areas, leaving little for traditional villages. This makes it challenging to retain qualified personnel who can help transform the environment.

Occupational diversity within the sample reflected the economic transition occurring in traditional villages, with 34.6 percent engaged in traditional agriculture, 18.9 percent in tourism-related services, 15.7 percent in traditional crafts and construction, 12.4 percent in modern commercial activities, 10.3 percent in government or education positions, and 8.1 percent in other occupations. This occupational distribution demonstrated how traditional economic activities coexisted with emerging opportunities created by cultural tourism and modernization processes, while also revealing potential tensions between traditional livelihoods that supported cultural practices and modern economic activities that may prioritize efficiency over cultural authenticity.

As shown in Table 3, highly significant differences emerged across urbanization levels for all demographic variables (all $p<0.001$), confirming the validity of the stratified sampling approach and demonstrating how urbanization processes created distinct socioeconomic profiles across different community contexts. Core areas demonstrated younger age structures and higher income levels, reflecting the economic opportunities and lifestyle changes associated with tourism development and urban proximity. Intermediate areas showed balanced demographic profiles with moderate income levels, suggesting successful adaptation to modernization pressures while maintaining community stability. Remote areas exhibited older populations with lower levels of formal education and income, but these communities often

Table 3. Sample demographic characteristics by urbanization level

Characteristic	Core area (*n*=160) (%)	Intermediate areas (*n*=240) (%)	Remote areas (*n*=80) (%)	Total (*n*=480) (%)	χ^2/F	*p*-value
Age groups						
18–35 years	42 (26.3)	78 (32.5)	16 (20.0)	136 (28.3)	18.47	<0.001
36–55 years	61 (38.1)	89 (37.1)	21 (26.3)	171 (35.6)		
56+ years	57 (35.6)	73 (30.4)	43 (53.8)	173 (36.1)		
Education level						
Primary or less	28 (17.5)	46 (19.2)	35 (43.8)	109 (22.7)	24.12	<0.001
Middle school	62 (38.8)	108 (45.0)	28 (35.0)	198 (41.2)		
High school	55 (34.4)	72 (30.0)	12 (15.0)	139 (28.9)		
College or higher	15 (9.4)	14 (5.8)	5 (6.3)	34 (7.2)		
Monthly income (CNY)						
<2,000	18 (11.3)	32 (13.3)	28 (35.0)	78 (16.3)	42.86	<0.001
2,000–3,999	45 (28.1)	89 (37.1)	38 (47.5)	172 (35.8)		
4,000–5,999	67 (41.9)	84 (35.0)	12 (15.0)	163 (34.0)		
>6,000	30 (18.8)	35 (14.6)	2 (2.5)	67 (14.0)		

Note: Income categories refer to monthly household income in Chinese Yuan (CNY).

preserved stronger connections to traditional cultural practices and possessed deeper repositories of traditional architectural knowledge.

Cultural identity assessment revealed nuanced patterns across the four measured dimensions, as shown in Figure 2, with overall composite scores averaging 3.68 on a five-point scale (standard deviation [SD] = 0.74), indicating moderate to strong cultural identification among Bai respondents. Cultural knowledge cognition demonstrated the highest mean score (mean = 3.89, SD = 0.82), suggesting that architectural terminology, construction principles, and symbolic meanings remained relatively well-preserved across the sample population, despite urbanization pressures. Practice participation showed moderate levels (mean = 3.52, SD = 0.91), indicating that while residents maintained certain engagement with traditional cultural activities, participation may be declining or becoming selective. Value identification recorded strong scores (mean = 3.78, SD = 0.79), indicating a continued emotional and symbolic attachment to traditional culture, even when behavioral participation may be limited. Cultural transmission willingness showed the lowest score (mean = 3.45, SD = 0.95), revealing potential concerns about intergenerational cultural continuity that warrant further investigation through qualitative analysis.

3.2. Traditional dwelling conservation status analysis

The comprehensive assessment of traditional dwelling conservation status across the 480 surveyed households revealed complex patterns of preservation conditions, restoration quality, and conservation intervention effectiveness that vary significantly across different urbanization contexts and community characteristics. The survey of the houses revealed that 34.2 percent were in good condition, with little damage and remaining original-looking; 28.9 percent were in good condition but required only minor repairs; 23.1 percent required more assistance and would require major repairs; and 13.8 percent were in poor condition and required immediate and full restoration. This leaves 63 percent of the traditional houses in good condition, a good foundation for their preservation, but over a third need urgent repairs to prevent further deterioration.

The spatial distribution of conservation status correlated strongly with urbanization levels and tourism development intensity, creating distinct conservation challenges and opportunities across different community contexts. Core areas displayed mixed preservation patterns, reflecting both substantial restoration investments driven by tourism development and degradation pressures from intensive use and inappropriate modifications. Many dwellings in these areas underwent commercial renovations that prioritized tourist appeal over authentic traditional features, sometimes resulting in superficial authenticity that maintained visual elements while compromising structural integrity or traditional spatial functions. Intermediate areas demonstrated consistent preservation outcomes, often benefiting from government conservation programs and community preservation initiatives while

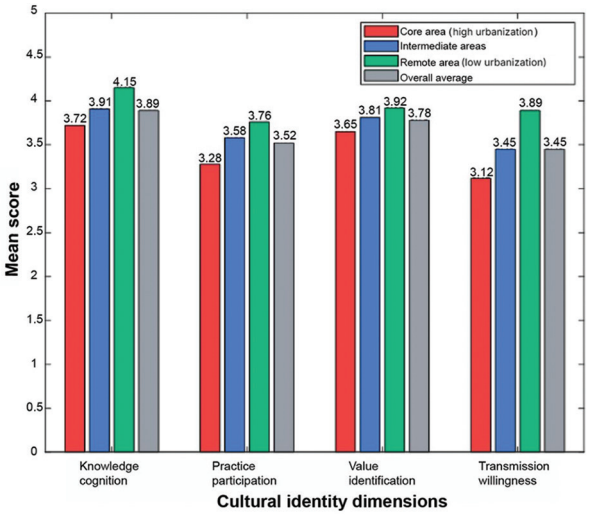

Figure 2. Cultural identity dimensions by urbanization level
Source: Diagram by authors.

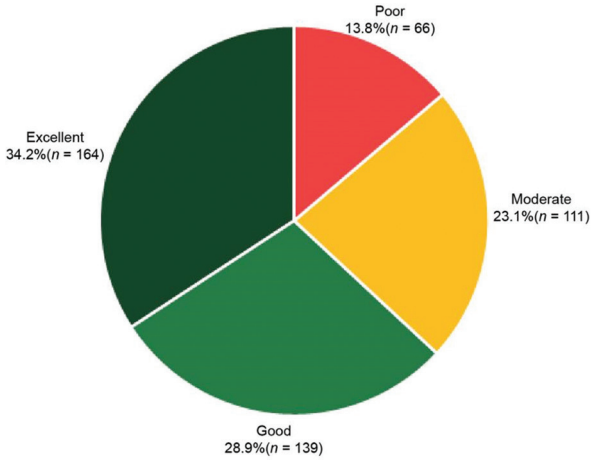

Figure 3. Traditional dwelling conservation status distribution
Source: Diagram by authors.

experiencing manageable development pressures that provided resources without overwhelming traditional architectural systems.

In 67.3 percent of the houses surveyed, traditional Bai courtyards remained unchanged; 78.6 percent of the surveyed households retained the conventional pattern of "three courtyards with one screen wall" (*sanfangyizhaobi*); 64.2 percent of larger houses have the layout of "four courtyards with five patios" (*sihewutianjing*). These figures indicate the continued use of traditional patterns and that fundamental concepts of building design had not changed, although a few elements of the building had been modified. However, detailed analysis revealed concerning trends in specific architectural components: Traditional wooden structural elements showed 71.2 percent preservation rates; stone masonry work maintained 84.6 percent integrity; traditional roofing materials were preserved in only 58.9 percent of structures; and decorative carved elements were intact in 69.4 percent of dwellings.

Traditional craft inheritance conditions presented particularly concerning trends that threaten the long-term sustainability of authentic conservation approaches. Only 42.1 percent of households reported active transmission of traditional construction techniques within family networks, while 28.7 percent indicated the availability of skilled traditional craftspeople in their communities. This decline in traditional building skills created practical challenges for maintaining authentic construction methods and threatened the intergenerational transmission of embodied technical knowledge that enabled appropriate restoration and maintenance practices. As shown in Figure 3, the shortage of traditional craftspeople also increased dependence on modern construction techniques that may be incompatible with traditional materials and structural systems, potentially undermining long-term building integrity and cultural authenticity.

3.3. Cultural identity influencing factors analysis

The systematic analysis of factors influencing cultural identity revealed intricate patterns of association among individual characteristics, household dynamics, community contexts, and the formation of cultural identity, illuminating the complex mechanisms through which cultural continuity was maintained or threatened in rapidly changing social environments. Individual-level factors demonstrated significant but differentiated relationships with cultural identity intensity, with age emerging as the strongest predictor (r = 0.387, p<0.001), indicating that older residents maintained substantially stronger cultural identification across all measured dimensions. This age effect manifested most dramatically in cultural knowledge cognition, where respondents aged 56 and above demonstrated significantly higher scores (mean = 4.15, SD = 0.68) compared to younger cohorts aged 18–35 (mean = 3.42, SD = 0.89, t(307) = 7.84, p<0.001), suggesting that traditional knowledge acquisition relies heavily on experiential learning processes that require extended community residence and participation in traditional practices.

Education level exhibited a fascinating curvilinear relationship with cultural identity, challenging simple assumptions about the impact of formal education on traditional culture preservation. Respondents with middle school education demonstrated the highest cultural identity composite scores (mean = 3.78, SD = 0.71), followed closely by high school graduates (mean = 3.72,

SD = 0.75), while those with primary education or less scored lower (mean = 3.51, SD = 0.82) and college graduates showed intermediate levels (mean = 3.64, SD = 0.69). This pattern suggests that basic literacy and numeracy skills enhance engagement with cultural preservation activities and policy processes by enabling participation in formal conservation programs and documentation efforts, while extensive formal education may create competing cultural frameworks or lifestyle aspirations that distance individuals from traditional community practices.

Residence duration exhibited an exceptionally strong positive association with cultural identity (r = 0.329, p<0.001), confirming theoretical propositions about the embodied nature of cultural identity development through accumulated place-based experiences. Long-term residents (>20 years) consistently scored higher across all cultural identity dimensions compared to newer residents (< 5 years), with particularly large differences observed in cultural practice participation (4.12 vs. 2.89, Cohen's d = 1.34) and value identification (4.05 vs. 3.21, Cohen's d = 1.18). These effect sizes indicate that residence duration was among the most powerful predictors of cultural identity strength, supporting arguments for place-based identity-formation theories and highlighting challenges faced by communities experiencing high population mobility.

Economic factors revealed complex relationships that reflected the intersection of material security and cultural engagement opportunities. Household income demonstrated a curvilinear pattern where moderate income levels (2,000–3,999 Chinese Yuan [CNY] monthly) were associated with stronger cultural identification (mean = 3.79, SD = 0.72) than either very low income categories (< 2,000 CNY, mean = 3.48, SD = 0.89) or very high income levels (> 6,000 CNY, mean = 3.51, SD = 0.78). This pattern suggests that basic economic security provided the material foundation for cultural participation, while extreme poverty created survival pressures that limit cultural engagement, and very high incomes may be associated with lifestyle changes or social networks that distance individuals from traditional community practices and cultural obligations.

Community-level factors proved equally important in shaping cultural identity outcomes, with community organization participation showing strong positive associations with all cultural identity dimensions (r = 0.412, p<0.001). Active engagement in village committees, cultural associations, and conservation groups significantly predicted higher cultural identity scores, indicating that collective decision-making processes and collaborative cultural activities strengthened individual identification through shared responsibility and mutual reinforcement of cultural values. Traditional activity frequency demonstrated particularly robust relationships with practice participation (r = 0.548, p < 0.001) and transmission willingness (r = 0.467, p<0.001), confirming that regular cultural practice served as both outcome and reinforcement mechanism for cultural identity maintenance.

3.4. Conservation-identity interaction mechanism verification

The empirical verification of conservation-identity interaction mechanisms through advanced statistical modeling provided robust evidence for the hypothesized bidirectional relationships between traditional dwelling conservation and cultural identity formation. Correlation analysis revealed consistently significant positive associations between conservation attitudes and cultural identity across all measured dimensions, with correlation coefficients ranging from 0.298 to 0.467 (all p<0.001), indicating moderate to strong relationships that supported theoretical propositions about the mutually reinforcing nature of conservation engagement and cultural identification processes.

Regression analysis demonstrated that cultural identity was a powerful predictor of conservation participation, with the overall cultural identity composite score explaining 32.4 percent of variance in conservation behavioral participation (R^2 = 0.324, F = 76.82, p<0.001). Individual cultural identity dimensions showed differential predictive effects, with cultural value identification emerging as the strongest predictor (β = 0.289, p<0.001), followed by practice participation (β = 0.246, p<0.001) and transmission willingness (β = 0.198, p<0.001). These findings suggest that emotional attachment to traditional culture provides the primary motivation for conservation engagement, while active cultural practice and commitment to intergenerational transmission create additional pathways linking identity to conservation behavior.

During SEM model specification, initial testing revealed a high correlation between "cultural knowledge cognition" and "practice participation" (r = 0.712). To address potential multicollinearity, these were combined into a single latent construct. In addition, household income was excluded from the final model due to low factor loadings (<0.4) and non-significant paths (p>0.05), suggesting that economic factors operate indirectly through community participation rather than directly influencing conservation-identity relationships.

The SEM results in Table 4 confirm bidirectional causal relationships between conservation and identity. As shown in Figure 4, the model has an excellent fit (root mean

Table 4. Structural equation model results for conservation-identity interactions

Path	Standardized coefficient (β)	Standard error	*t*-value	*p*-value	95% CI
Direct effects					
Cultural identity → conservation behavior	0.394	0.048	8.21	<0.001	0.300–0.488
Conservation behavior → cultural Identity	0.312	0.052	6.00	<0.001	0.210–0.414
Urbanization → conservation-identity link	−0.187	0.041	−4.56	<0.001	−0.267–−0.107
Indirect effects					
Community participation (mediator)	0.156	0.036	4.33	<0.001	0.086–0.226
Intergenerational contact (mediator)	0.124	0.032	3.88	<0.001	0.062–0.186

Notes: Model fit indices: χ^2 (df=124): 198.47, p<0.001; root mean square error of approximation: 0.036; comparative fit index: 0.958; Tucker-Lewis index: 0.951; standardized root mean square residual: 0.042.
Abbreviation: CI: Confidence interval.

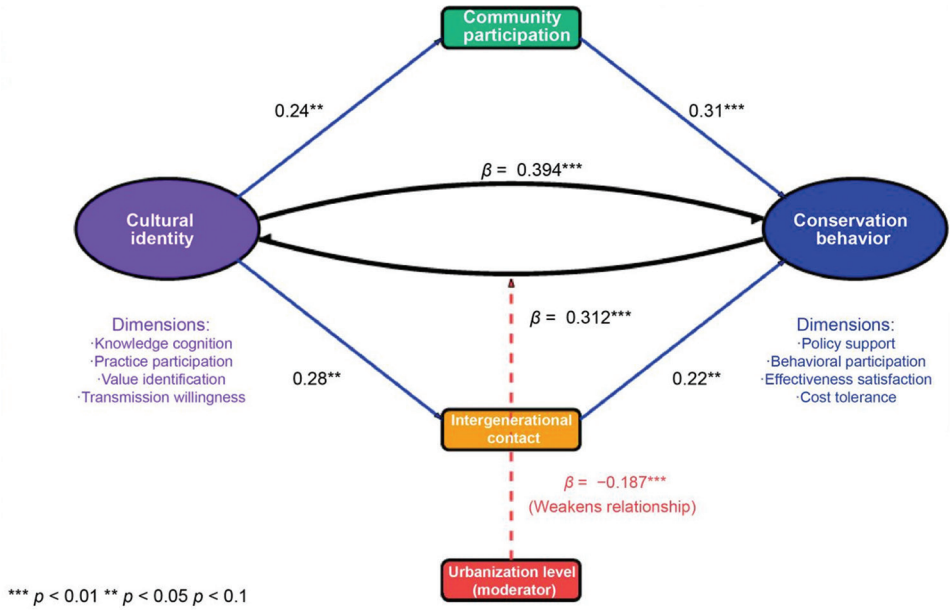

Figure 4. Structural equation model path diagram. Statistical significance determined at *p<0.1, **p<0.05, and ***p<0.01.
Source: Diagram by authors.

square error of approximation = 0.036, comparative fit index = 0.958). The urbanization level showed significant negative moderation (β = −0.187, p<0.001), indicating that higher urbanization levels weakened conservation-identity interactions. Community participation and intergenerational contact served as significant mediating variables.

3.5. Spatial difference analysis

The spatial analysis revealed pronounced geographic heterogeneity in conservation-identity relationships across the study area, demonstrating that place-based factors significantly influence the strength and character of interactions between heritage preservation and cultural identity formation. Geographic distribution analysis showed clear clustering patterns, with conservation effectiveness exhibiting high spatial autocorrelation (Moran's I = 0.342, p<0.001), indicating that villages with strong conservation outcomes tended to be geographically proximate to other high-performing villages. This spatial clustering suggested the importance of regional policy environments, shared cultural networks, spillover effects from successful conservation experiences, and diffusion of innovative conservation practices across neighboring communities through social learning and professional networks.

Cultural identity patterns also demonstrated significant spatial dependence (Moran's I = 0.298, p<0.001), with areas of high cultural identity intensity forming recognizable geographic clusters, particularly in

intermediate urbanization zones around Xizhou town and portions of Shuanglang town, where traditional cultural practices remain vibrant while benefiting from moderate economic development and tourism opportunities. These spatial patterns suggest that cultural identity maintenance benefits from regional cultural networks that provide mutual reinforcement and shared identity validation across proximate communities, and that successful cultural preservation in one village can inspire and support similar efforts in neighboring areas.

Geographically weighted regression analysis revealed substantial spatial variation in the factors influencing conservation-identity relationships, with local regression coefficients ranging from 0.187 in highly urbanized core areas to 0.623 in remote traditional villages, demonstrating that the strength of conservation-identity connections varies dramatically with geographic context and local conditions. Figure 5 illustrates that cities with certain urban growth have satisfactory conditions for sustaining conservation and identity in harmony. Locally, the mean value was 0.542, indicating that effective development management and sufficient financing were favorable for sustaining conservation and identity initiatives.

3.6. Qualitative research findings

Qualitative analysis reported that residents had a deep emotional attachment to their old houses. Courtyard houses were often referred to as "living ancestors," symbolizing family history and culture. Experiences of community preservation policies highlighted differences between the administrative approaches and residents' needs. While residents valued their houses, they expressed frustration with conventional restoration methods that prioritized outward appearance over functional use. Traditional practitioners emphasized the importance of preserving old techniques, concerned that machine-based restoration might erode critical cultural skills even if it enhanced the houses' appearances. Intergenerational differences were also evident: younger participants appreciated traditional aesthetics but lacked practical construction knowledge, while older participants expressed anxiety about the potential loss of these skills. Observations revealed significant gaps between formal conservation policies and community practices, with residents often modifying officially restored spaces to better serve cultural and practical needs.

4. Discussion

The empirical findings provide robust evidence for bidirectional causal relationships between traditional dwelling conservation and the formation of cultural identity among Bai communities. Cultural identity significantly predicted participation in conservation behavioral activities ($\beta = 0.394$, $p<0.001$), while conservation behavior

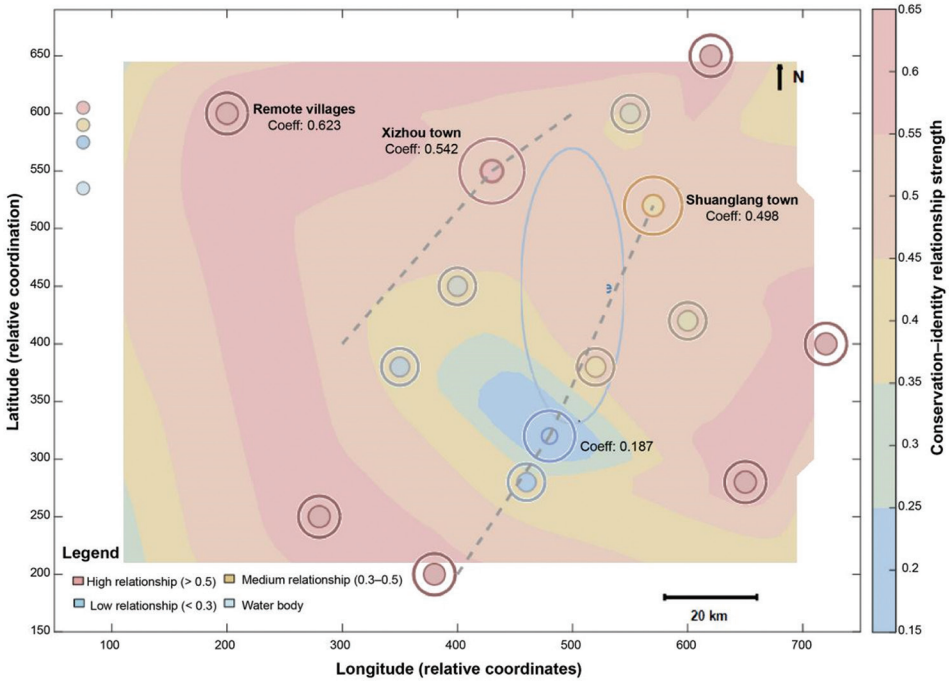

Figure 5. Spatial distribution of conservation-identity relationship strength.
Source: Diagram by authors.

reciprocally strengthened cultural identity (β = 0.312, $p<0.001$). This mutually reinforcing relationship operated through community participation (β = 0.156, $p<0.001$) and intergenerational contact (β = 0.124, $p<0.001$) as key mediating mechanisms, creating positive feedback loops that enhanced both preservation outcomes and cultural continuity.

The negative moderation effect of urbanization (β = −0.187, $p<0.001$) revealed how modernization disrupts conservation-identity relationships. These connections were strongest in remote villages (local coefficient = 0.623) and weakest in urban cores (0.187), with intermediate areas achieving optimal synergy (0.542). This pattern suggests that moderate development provides sufficient resources for conservation while maintaining social structures supporting culturally meaningful engagement.

Intergenerational knowledge transmission emerged as a critical but vulnerable pathway. Traditional construction knowledge was transferred through apprenticeship-based skill acquisition (42.1% of households) and family-based informal learning. However, declining availability of craftspeople (28.7% of communities) created transmission bottlenecks, threatening both conservation quality and continuity of identity, requiring formal apprenticeship programs integrated with school curricula.

Among cultural identity dimensions, value identification most strongly predicted conservation behavior, suggesting emotional attachment provides fundamental motivation that transcends practical concerns. The concerning finding that transmission willingness showed the lowest scores highlights vulnerabilities in long-term sustainability, revealing critical gaps between current engagement and future continuity.

These findings have significant implications for conservation policy. The bidirectional relationship suggests that policies must consider the impacts of cultural identity in conjunction with physical preservation. Differentiated strategies are necessary across various urbanization contexts. High-urbanization areas require heritage interpretation centers and community benefit-sharing mechanisms, while intermediate zones need conservation cooperatives that link craftspeople with homeowners. In contrast, remote villages require urgent stabilization subsidies and youth apprenticeship programs.

Several limitations warrant consideration. The cross-sectional design limits causal inference, despite the use of SEM analysis. The focus on Bai communities may limit generalizability to other ethnic minorities. Self-reported measures may introduce social desirability bias, though they can be triangulated with observational data. The study may underestimate informal conservation practices that occur outside of official programs. Future research should employ longitudinal designs across diverse ethnic communities with objective conservation measures.

This study demonstrates that traditional dwelling conservation and cultural identity function as mutually reinforcing processes rather than independent phenomena. Sustainable heritage conservation requires integrated approaches that nurture both architectural integrity and cultural identity, recognizing that preserving buildings without preserving culture cannot ensure long-term success. The findings provide theoretical insights into heritage-identity dynamics and practical guidance for community-centered conservation strategies, supporting both cultural continuity and adaptive change in rapidly urbanizing contexts.

5. Conclusion

This study demonstrated a link between the preservation of traditional Bai houses and the construction of cultural identity, showing that these two processes are mutually reinforcing rather than mutually independent. The research included 480 households across 12 traditional villages in Dali prefecture. Findings indicate that the construction of cultural identity has a significant influence on residents' participation in conservation, while such participation, in turn, reinforces cultural identity. These processes form a feedback loop, simultaneously preserving heritage and sustaining cultural activity. The study identified participation in conservation and intergenerational contact as key mechanisms for strengthening the relationship between conservation and cultural identity. Excessive development weakens such connections, while moderate development enhances them. Spatial analysis identified variations in the relationships between conservation and identity in various regions. Moderately urbanized regions exhibited the most balanced mix, providing sufficient resources while maintaining orderly structures and preserving meaningful cultural relationships. Qualitative findings indicated that residents have a strong attachment to traditional building forms, viewing courtyard houses as "living ancestors" that convey family history and culture and influence identity in daily life. These results provide new insights into the nexus between heritage and identity and propose practical strategies for designing community-centered conservation projects. Such strategies require an understanding of the intimate relationship between preserving structures and sustaining culture, emphasizing that effective heritage conservation must support both the physical buildings and the construction of cultural identity through community involvement and the intergenerational transfer of traditions.

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Conflict of interest

The authors declare they have no competing interests.

Author contributions

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Ethics approval and consent to participate

This study was approved by the Research Ethics Committees of Kunming University of Science and Technology (approval no. KUST-IRB-2025-017). Written informed consent was obtained from all 480 household representatives before their participation in the study.

Consent for publication

Written informed consent for publication of anonymized data and dwelling photographs was obtained from all participants. All identifying information has been removed from the manuscript.

Availability of data

Primary data collection (original survey data):

The dataset comprises responses from 480 Bai households across 12 traditional villages in Dali Bai Autonomous Prefecture, Yunnan Province, China. Due to participant privacy, the primary survey data are not publicly available; however, they can be obtained from the corresponding author on reasonable request.

Secondary data sources:

- Village boundaries and geographic coordinates: Available from the Dali Prefecture Bureau of Natural Resources (https://www.dali.gov.cn/).
- Census data: Population and urbanization statistics are available from the Yunnan Provincial Bureau of Statistics (http://stats.yn.gov.cn/).
- Heritage documentation: Traditional village designation records are available through the Ministry of Housing and Urban-Rural Development of China (https://www.mohurd.gov.cn/).

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