

Research on the non-use value of rammed earth buildings in Shaxi Ancient Town based on CVM

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Abstract: Architectural cultural heritage not only enriches the cultural landscape but also drives economic activity, although its value is often underestimated by the market. This article uses the rammed earth buildings of Shaxi Ancient Town as a case study, quantifying their non-use value through the contingent valuation method, and explores factors influencing public willingness to pay using correlation analysis and binary logistic regression models. The results show that respondents have a high support rate (72.9%) and willingness to pay (26.23 RMB per person) for the conservation and development of rammed earth buildings. The total non-use value reached approximately 29.79 million RMB, demonstrating the significant economic potential of these structures as architectural heritage. This provides critical insights for the conservation and development of rammed earth architecture in China and calls for enhanced recognition and protection efforts from all sectors of society.

1. Introduction

Globally, architecture embodies rich historical and cultural value, along with economic potential. It gives places unique identities, preserves traditional culture, and promotes sustainable tourism. However, these values are often underestimated. Inadequate development and lack of protection threaten these precious resources.

Market systems often undervalue the social, cultural, and environmental contributions of architectural heritage due to market failures like externalities, unclear property rights, and information gaps. Non-market valuation methods can quantify the potential economic value of these buildings, providing policymakers with comprehensive data to promote rational use and protection. For instance, public willingness to pay extra to preserve vernacular buildings indicates recognition of their traditional value^[1]. Therefore, accurately assessing the economic value of architectural heritage is vital for sustainable development and cultural preservation.

2. Rammed Earth Buildings

For the protection of rammed earth architecture, there are significant cases worldwide. Approximately 17% of the World Cultural Heritage sites are earthen structures. China, one of the crucial origins of rammed earth architecture, boasts a plethora of historically significant earthen buildings. The Chinese government and various cultural heritage protection agencies have made numerous efforts to preserve these structures, such as the Fujian Tulou^[2] and the Ancient City of Pingyao in Shanxi^[3]. Internationally, the reconstruction of the Bam Citadel in Iran has not only

safeguarded the rammed earth construction techniques but also revitalized the spiritual and material cultural heritage of the city^[4]. In Africa, rammed earth architecture faces challenges from modernization^[5].

The protection of rammed earth architecture integrates community participation, policy support, and modern technology, though economic value studies are insufficient. These structures not only carry historical and cultural significance but also possess local economic potential. Conservation efforts promote the use of local resources, reduce environmental impact, and achieve sustainable development. Exploring their economic value will enhance practicality and provide economic benefits to communities.

3. Cultural Heritage Assessment

The market value of cultural heritage is reflected in various aspects such as tourism attraction, local economic development, and craft inheritance. Its uniqueness and irreplaceability make cultural heritage an economically valuable resource, irreplaceable by any man-made capital once lost. However, the social value of cultural resources is difficult to assess through traditional market transactions, making their protection complex due to market failure. Thus, revealing the economic value of cultural heritage from an economic perspective and formulating effective cultural policies for its protection is particularly important. Economic valuation methods, such as Contingent Valuation Method (CVM), are used to monetize the impact on social welfare by asking about willingness to pay (WTP). This objective evaluation of the value of non-market transactions facilitates decision-

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makers to devise effective protection strategies, ensuring the sustainable development of cultural heritage. Several studies have used CVM to assess cultural heritage, including Xu Hairong's^[6] evaluation of rooftop greening, Ning Chunjiao's^[7] landscape assessment of old residential areas, D.G. Kalfas's^[8] valuation of green spaces, and Ni Bin's non-use value assessment of Shanghai Yuyuan Garden^[9]. These studies reveal the public's willingness to pay for cultural heritage, emphasizing its cultural and economic value.

4. Research Methods and Data Sources

4.1. Overview of the Study Area

Shaxi Ancient Town, located in Jianchuan County, Dali, Yunnan, is a brilliant gem on the ancient Tea Horse Road and a living exemplar of rammed earth architecture in China^[10]. This ancient town is renowned for its efforts in preserving traditional architectural culture, and these buildings are not only the crystallization of the wisdom of the Bai and other ethnic minorities but also vivid representations of ecological sustainability. They embody rich history and culture, contributing to the development of local tourism and the economy. The rammed earth architecture of Shaxi Ancient Town exemplifies material construction and cultural creation, standing as a model for the inheritance and promotion of traditional culture^[11].

4.2. Survey Design and Implementation

Based on studies, we developed and administered a survey, collecting 303 valid responses (97% validity rate) from January to March 2024. This questionnaire, split into three sections with 21 questions, targeted tourists and non-tourists and utilized both online and offline methods in Shaxi Ancient Town. To reduce bias, we ensured confidentiality, clarified our intent, and set realistic scenarios, including reminders about income limits^[12] and that the conservation plan was one-off^[13]. Interviews were conducted politely with immediate clarification of doubts, maintaining an engaging questionnaire length to prevent respondent fatigue.

4.3. Survey Design and Implementation

4.3.1. Estimation of Non-Use Value of Rammed Earth Buildings Based on the Contingent Valuation Method (CVM)

We calculated both the relative and absolute frequencies of the willingness to pay (WTP) from the survey responses and obtained the cumulative frequency. Using linear interpolation, we determined the median as the average WTP value among respondents. We then expanded the sample size to represent the entire research area to estimate the non-use value. The specific calculation formula is provided below:

$$E(wtp)=WTP_q \times M \times P$$

$E(wtp)$ is the total non-use value (V) of buildings, WTP_q is the average payment willingness., M is the total number of Shaxi visitors, P is the percentage willing to pay.

4.3.2. Analysis of Factors Influencing Respondents' Willingness to Pay and Payment Values for the Conservation and Development of Rammed Earth Buildings

In assessing non-use value, WTP is influenced by various factors, including income, education level, environmental attitudes, social values and policy environment. These factors vary in importance across different fields. This study focuses on the rammed earth buildings in Shaxi Ancient Town, examining 21 variables related to personal background, knowledge of rammed earth architecture, and attitudes towards its preservation and development. Using SPSS software, we identified the key factors affecting WTP by excluding insignificant variables and employed a binary logistic regression model to further analyze the quantitative relationship between these factors and WTP.

4.3.3. Differential Analysis Between Tourists and Non-Tourists

We used the mean comparison method in SPSS software to analyze differences between tourists and non-tourists in several areas: their understanding of rammed earth architecture, overall impressions and feelings, views on the importance of its preservation, current preservation status, and attitudes towards preservation and development. This analysis aimed to identify if there were significant variances between these groups.

5. Results Analysis

5.1. Basic Characteristics of Respondents

In the survey, the majority of respondents were female (61.1%) and predominantly young adults aged 18-45 (60%). A significant portion held higher education degrees (39.6%), and a substantial majority (85%) reported stable incomes. The sample included a diverse range of occupations, with employees and students being the most represented. Monthly incomes were primarily concentrated between 3001 and 7000 RMB.

5.2. Current Distribution of Respondents

For most tourists, Shaxi Ancient Town is a new exploration site, with 73.5% of visitors experiencing their first visit, primarily for leisure and recreation. The main modes of transportation were self-driving (57%) and ride-hailing services (38%). Most tourists stayed for less than a week, with a significant number opting for day trips.

Shaxi is often chosen as a primary destination. Among non-tourists surveyed, nearly half (43%) had limited knowledge about Shaxi. Although they had no immediate plans to visit, the majority expressed interest in exploring the town in the future. Only a small fraction (12.8%) had no intention of visiting Shaxi.

5.3. Respondents' Willingness to Pay and WTP Values

The survey indicated (Fig. 1) that 72.9% of respondents are willing to pay for the preservation of Shaxi Ancient Town's rammed earth buildings, while 27.1% are not. The WTP ranged from 1 RMB to 500 RMB, with most respondents favoring lower amounts, and over 10% willing to pay 20 RMB or 10 RMB. Cumulative frequency analysis shows that more than 50% are willing to pay less than 50 RMB, with another peak at 100 RMB, but willingness declines beyond that. Generally, as the amount increases, the inclination to invest decreases.

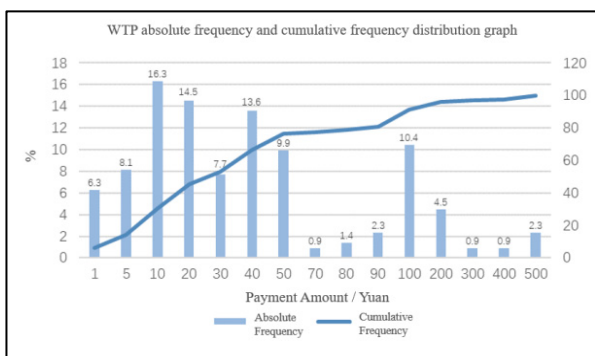


Fig. 1. Distribution of absolute frequency and cumulative frequency of willingness to pay (Photo source: self-drawn by the author)

The cumulative frequency analysis shows that the median WTP falls between 20 and 30 RMB, with an average WTP calculated at 26.23 RMB per person. Tourists tend to prefer lower payments (under 50 RMB), while non-tourists are more inclined to higher payments (over 100 RMB). This difference might stem from non-tourists, especially fans of "To the Windy Place" and travel enthusiasts, who value Shaxi's resources more deeply and are willing to pay more for their preservation.

In 2021, Shaxi Ancient Town received 1.31656 million visitors^[14]. By 2023, the daily average exceeded 5,000 visitors, totaling 1.8 million annually^[15], with an average yearly attendance of approximately 1.5583 million. The survey revealed that 72.9% of visitors were willing to pay for the preservation and maintenance of the town's rammed earth buildings. Using the formula, the total non-use value of these buildings was calculated to be 29.7969 million RMB. This figure underscores the significant economic value of Shaxi's rammed earth architecture as cultural heritage and highlights its substantial potential for future development and economic benefit.

The survey also indicated that 82 respondents, making up 27.1% of the total, declined to pay. The main reasons for refusal, summarized in Fig. 2, include: lack of current financial capability (17.5%), distrust in relevant

management authorities (13%), belief that preservation and development should be government-funded (11.5%), preference for visiting other places (10%), and a lack of interest in the preservation of rammed earth buildings (3.2%).

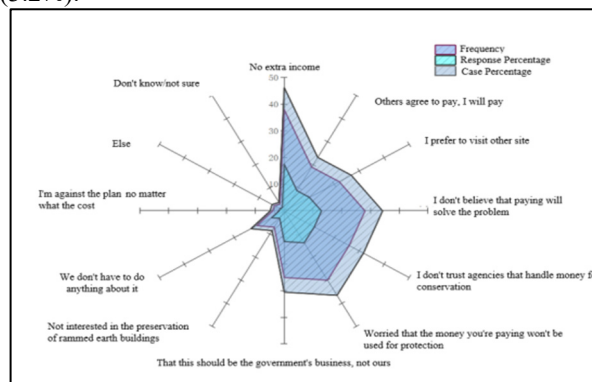


Fig. 2. Statistics of reasons for refusal to pay (Photo source: self-drawn by the author)

Analyzing these data provides insights into the public's payment decisions, revealing a complex interplay of socio-economic factors, trust levels, and environmental awareness. This information is valuable for formulating more effective policies, enhancing public participation, and improving management efficiency.

5.4. Analysis of Main Factors Influencing Respondents' Willingness to Pay and Payment Amounts"

To explore how respondents' characteristics influence their willingness to pay (WTP) and the amount they are willing to pay for the preservation and development of rammed earth architecture in Shaxi Ancient Town, this study identified a set of key variables. These variables include being a tourist, gender, age, occupation, education level, income, understanding of rammed earth architecture, overall impressions, views on the importance of preservation, current preservation status, and attitudes towards preservation and development. Using SPSS software, we conducted a correlation analysis of these independent variables against WTP and payment amount. The results, summarized in Table 1, highlight the main factors affecting both WTP and the payment amount.

The analysis indicates that the identity and occupation of tourists, knowledge of rammed earth architecture, overall impressions and feelings, as well as attitudes towards conservation and development, significantly influence their willingness to pay and the amount paid. Specifically, education level has a minor impact on willingness to pay, while the importance of conservation and the current state of preservation have a positive but weak influence.

In detail, knowledge of rammed earth architecture and overall impressions display a strong correlation, highlighting the crucial role of historical architecture awareness in influencing both the willingness to pay and the amount paid. Among basic demographic data, occupation and tourist status are closely linked to attitudes towards conservation and development, with some

professional groups more inclined to fund preservation efforts. However, although tourist status affects

willingness to pay, it does not significantly influence the payment amount.

Table 1. Correlation analysis of variables affecting willingness to pay and the value of willingness to pay

symbol	variable	Willingness to pay		Willingness to pay value	
		Correlation	significance	Correlation	significance
Q1	Tourist or not	0.370**	0.000	0.040	0.490
Q9	Understanding degree	0.694**	0.000	0.272**	0.000
Q10	Overall impression and feel	0.717**	0.000	0.484**	0.000
Q11	Importance of Preservation	0.169**	0.003	0.262**	0.000
Q12	Existing conservation status	0.113*	0.049	0.202**	0.000
Q14	Conservation and development attitude	0.280**	0.000	0.268**	0.000
Q19	occupation	0.400**	0.000	0.238**	0.000
Q20	Educational level	0.019	0.739	0.384**	0.000

Therefore, enhancing cultural awareness of rammed earth architecture, deepening understanding of its historical value, and optimizing the tourist experience are key to increasing willingness to pay. A positive attitude towards conservation and development is also essential.

In Table 2, a binary logistic regression analysis was conducted on variables that showed strong correlations and significance in the previous correlation analysis. The results further elucidate the relationship between various factors and WTP. It was found that the level of understanding of rammed earth architecture, overall impression, and attitudes towards preservation and development significantly impact WTP. These findings are consistent with previous analysis results. Clearly, a deeper understanding of the functionality of rammed earth buildings, a clearer perception of their overall impression and importance of preservation, and a more defined attitude towards their preservation and development significantly increase residents' WTP.

Table 2. Results of binary logistics regression analysis

Symbolic	variable	B	Standard Error	Wald χ^2	P	EXP(B)
Q1	Tourist or not	0.752	0.573	1.726	0.189	0.471
Q9	Understanding degree	1.857	0.322	33.185	<0.001	6.406
Q10	Overall impression and feel	2.086	0.405	26.568	<0.001	8.054
Q14	Conservation and development attitude	-0.856	0.250	11.694	<0.001	0.425
Q19	occupation	0.248	0.081	9.416	0.002	1.281
	constant	-7.18	1.09	43.367	<0.001	0.001

5.5. Differential Analysis Between Tourists and Non-Tourists

The mean comparison analysis (Table 3) reveals significant differences between tourists and non-tourists regarding their understanding, overall impression, and attitudes towards the conservation and development of rammed earth architecture. Specifically, tourists exhibit a greater interest and knowledge about the historical,

cultural, and architectural features of rammed earth buildings, likely due to prior preparation or guided tours. With a mindset of leisure and exploration, tourists have a more favorable overall impression of these structures. They also show stronger support for preserving the original appearance and historical value, reflecting a greater appreciation for cultural heritage.

Table 3. Mean comparison and analysis results

variable	Differences	Sum of Squares	Mean Square	F	p
Understanding degree	BG	66.313	66.313	46.14	<0.001
	WG	432.585	1.437		
	Total	498.898			
Overall impression and feel	BG	37.066	37.066	71.57	<0.001
	WG	155.872	0.518		
	Total	192.937			
The importance of conservation	BG	5.641	5.641	5.46	0.020
	WG	310.663	1.032		
	Total	316.304			
Status of existing protection	BG	2.708	2.708	3.02	0.083
	WG	269.655	0.896		
	Total	272.363			
Conservation and development attitude	BG	9.669	9.669	9.12	0.003
	WG	318.932	1.060		
	Total	328.601			

Despite differences in attitudes and knowledge between tourists and non-tourists, there was no significant difference in their evaluation of the existing preservation measures. Both groups believe that current preservation efforts have not been fully effective and recognize the challenges faced in the preservation and development of rammed earth buildings.

6. Conclusion

This study examines the preservation and development of rammed earth architecture in Shaxi Ancient Town. Using the Contingent Valuation Method (CVM), we assessed public willingness to pay (WTP) and analyzed its influencing factors. The findings highlight the balance between heritage preservation and economic development.

6.1. Findings

Willingness to Pay and Economic Value: 72.9% of respondents are willing to pay for preserving rammed earth buildings, showing strong public support for heritage conservation. The average WTP is 26.23 RMB per person, with a total non-use value of 29.79 million RMB, indicating significant economic potential.

Influencing Factors: Visitor status, occupation, knowledge about rammed earth buildings, and attitudes towards preservation significantly impact WTP. Greater knowledge and clear attitudes towards development correlate with higher WTP. Educational level does not significantly affect WTP, suggesting that the desire to preserve is driven by cultural appreciation rather than academic background.

Tourists vs. Non-Tourists: Tourists and non-tourists differ in their understanding and attitudes. Tourists prefer balanced preservation and development strategies, while non-tourists focus more on cultural preservation.

6.2. Recommendations

Sample Representativeness: Future research can ensure a more representative sample by using multistage sampling, increasing sample size, surveying diverse regions, and regularly updating data to capture changing opinions.

Methodological Expansion: Combining the Contingent Valuation Method (CVM) with other non-market valuation methods, such as the Travel Cost Method (TCM), Choice Experiment (CE), and Benefit Transfer (BT), can enhance the robustness of valuation results by providing multifaceted data support.

Economic Impact Analysis: Preserving rammed earth buildings in Shaxi Ancient Town can boost tourism by attracting more visitors, create jobs in restoration and management, stimulate related industries like hospitality and crafts, and enhance the local economy by increasing overall economic activities.

Policy Recommendations: To effectively protect and promote rammed earth heritage, the study suggests enacting protection laws, providing financial support for restoration, enhancing public education on cultural value, encouraging community involvement in preservation efforts, and supporting academic research on practices.

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