Study on the Perception of Traditional Village Ecosystem Service Value Based on Structural Equation: A Case Study of Huayang Ancient Town in Yang County

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Abstract: Based on the perspective of human-environment interaction, the ecosystem service value of traditional villages in the Qinling Mountains was studied through a questionnaire and structural equation model. The results showed that: (1) Among the ecosystem service values of traditional villages, ecological value and physiological value had the most significant impact, followed by historical value, economic value, aesthetic value, and cultural value had the lowest impact. (2) The residents' value cognition and the ecosystem value factors have an interactive relationship. The improvement of human ecological consciousness promotes the coordinated development of people and the ecosystem. (3) Coordinating the ecological environment and socio-economic development, realizing the mutual growth and integration of people and nature in traditional villages, and providing a theoretical reference for the sustainable development of rural ecological patterns and rural revitalization.

Keywords: Traditional villages; Ecosystem services; Value; Structural equation model

1 Introduction

To promote the sustainable development of traditional settlements, it is emphasized to repair and maintain the semi-natural artificial ecosystem of the "ecological village"[1]. This paper puts the ecosystem service value of traditional villages in Qinling Mountains under the overall framework of nature, society, and people[2-4], and takes Huayang Ancient Town in Yangxian County as the object to identify, classify and evaluate the ecosystem service function of traditional villages in Qinling Mountains through information technology. It provides a reference for the protection of traditional villages and the construction of ecological civilization.

2 Overview of the Study Area

Huayang Ancient Town Village is located in the intermountain basin at the south foot of Qinling Mountains. The three mountains face each other, and the unique mountains, waters, lakes, grasses, forests, fields, streets, alleys, buildings, etc. have constructed a good ecological spatial pattern. The nature and human landscape are highly consistent, which is a typical case of the harmonious coexistence of nature and human beings.

3 Data Sources and Research

3.1 Data Sources

(1) Questionnaire

In August 2020 and September 2020, the research team conducted two questionnaires on local villagers. A total of 230 questionnaires were distributed, of which 209 were effectively recovered, with an effective rate of 90.87%.

(2) Historical events, folk customs, and other data information mainly come from the "Yang County Annals" and other documents provided by the county cultural museum. The economic data are mainly from the official website of the Shaanxi Provincial Bureau of Statistics, the Statistical Yearbook of Shaanxi Province, and the official website of the Yangxian County Government.

3.2 Research methods

(1) Structural equation model

Structural Equation Modeling is a composite model composed of a measurement model and a structural model. Its specific form is as follows:

Measurement model:

$$X = \Lambda_x \xi + \delta \tag{1}$$

$$Y = \Lambda_y \eta + \varepsilon \tag{2}$$

Structural model:

$$\eta = B\eta + \Gamma\xi + \zeta \tag{3}$$

In these formulas, ξ and η are exogenous and endogenous latent variables respectively, Λx and Λy are the load value matrixes of the observed variables X and Y of and respectively, and δ and ε are the measurement errors; B and Γ are the load value matrixes of η and ξ respectively, and ζ is residual error terms.

(2) Structural equation model

In this paper, six factors including ecological value, physiological value, economic value, historical value, cultural value, and aesthetic value are set as potential variables (A-F), and 22 cognitive factors are set as observation variables (A1-H22). Endogenous and extrinsic cognitive values are outcome variables.The theoretical model of cognitive evaluation of the ecosystem service value of traditional villages is constructed, as shown in Fig1.
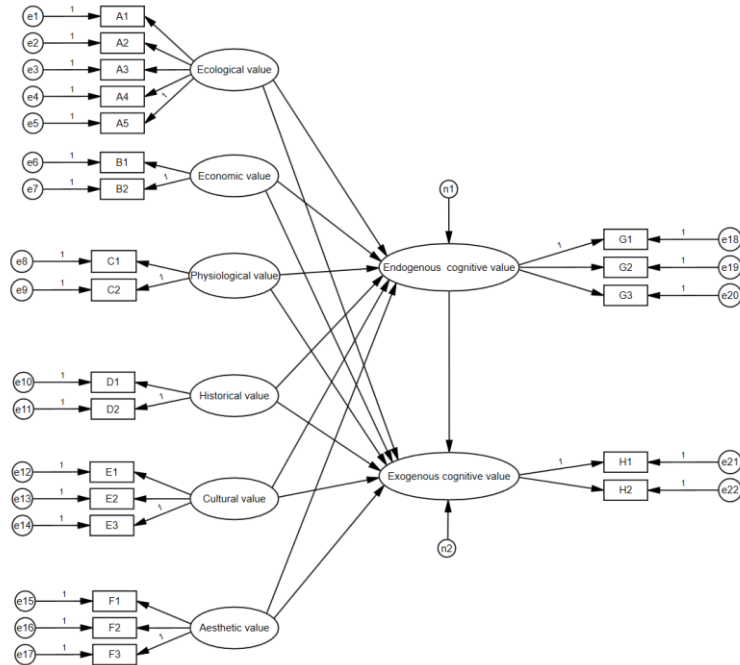
Fig. 1 Theoretical model of traditional village ecosystem service value

(3) Factor analysis

Through exploratory factor analysis to test the reliability and validity of the scale, 209 valid questionnaires were tested for reliability and validity. It is considered that Cronbach's Alpha coefficients of the seven latent variables are greater than 0.7, and KMO test values are greater than 0.5. Bartlett's sphericity test meets the requirement of significance, and the statistical table has good consistency.

Table 1. Testing of latent variable reliability and validity

Latent variable	Cronbach's Alpha coefficient	KMO Inspection value	Bartlett Ball shape inspection
Ecological value	0. 837		
Physiological value	0. 791		
Economic value	0. 814		
Historical value	0. 861		
Cultural value	0. 767	0. 769	0. 000
Aesthetic value	0. 894		
Endogenous Cognitive value	0. 759		
External cognitive Value	0.724		
Standard value	>0. 7	>0. 5	<0. 001

3.3 Construction of traditional village ecosystem evaluation indicator system

This study draws on the ecological service value cognitive evaluation index system proposed by domestic and foreign scholars and adds endogenous cognitive value and extrinsic cognitive value as the result of the structural equation model variable indicators[1,5]. The traditional village ecosystem service value is divided into ecological value, physiological value, economic value, historical value, cultural value, aesthetic value, endogenous cognitive value, and external cognitive value, and 22 secondary indicators are constructed for evaluation (as shown in Table 2).

Table 2. Evaluation factor system of traditional village ecosystem service value

Evaluation factor	Assessment element	describe
Ecological value (A)-	Water conservation (A1) Climate regulation (A2) Purified air (A3) Material production (A4) Bio-diversity (A5)	Mountain, water, forest, field, lake, grass, sky, birds, animals, fish and insects, and other natural element resources provided by the ecosystem.
Physiological value (B)-	Fitness value (B1) Future value (B3)	The space and the surrounding environment
Economic value (C)-	ecotourism (C1) ecological resources (C2)	Ecotourism and other activities drive the development of the village economy.
Historical value (D)-	Events and Traditions (D1) Local Customs (D2)	Local dialects, clan genealogy, (entertainment, trade) customs, and belief objects.
Cultural value (E)-	Abundance of cultural activities (E1) Educational value (E3) Opportunities to guide learning (E4)	Cultural activities, cultural landscapes, natural knowledge, etc. can provide Opportunities for public education and spread knowledge.
Aesthetic value (F)-	Environment cleanliness (F1) Building and landscape (F2) Spatial forms (F3)	Change of natural landscape, characteristics of layout form, architectural characteristics, and degree of architectural perfection.
Endogenous cognitive value (G)-	Abundant experience (G1) Social confidence experience (G2) sense of security and belonging (G3)	The services of the traditional village ecosystem. Traditional village ecological space. Identifying with the space environment.
The cognitive value of denotation (H)-	Improve perception (H1) Personal ecological awareness (H2)	Realistic experience Actively protect the ecological environment

To judge the fitting degree between the statistical data and the model, the traditional village ecosystem service value evaluation model was built and fitted in Amos 22.0.

Table 3. Fitting index analysis of measurement models

Parsimony index		Absolute fitting index			Relative index	
NFI	AGFI	CMIN/DF	RMSEA	GFI	CFI	IFI
0. 757	0. 865	1. 496	0. 025	0. 895	0. 972	0. 912
>0. 8	>0. 5	1<X<3	<0. 1	>0. 80	>0. 90	>0. 80

The measurement results of the fitting degree analysis showed a high fitting degree. This demonstrated that the equation model was generally ideal, and finally, the evaluation model of the ecological service value of traditional villages was obtained as shown in Fig2.
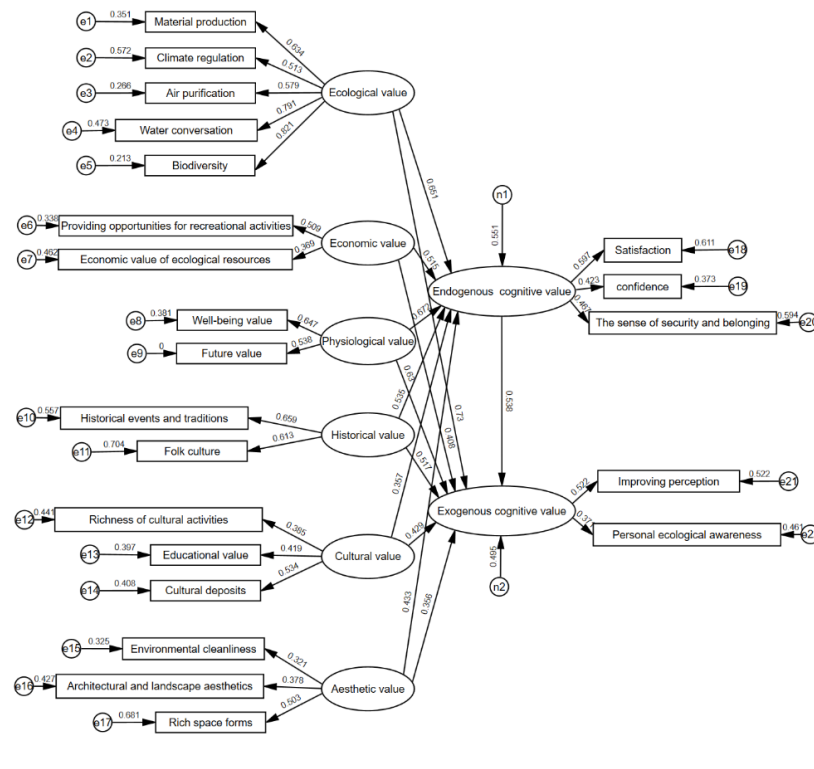

Fig. 2 Evaluation model of traditional village ecosystem service value

3.4 Confirmatory analysis

The survey data of residents' satisfaction with traditional village ecosystem services were substituted into the evaluation model to analyze the evaluation results of traditional village ecosystem service value satisfaction quantitatively. Using Amos 22. 0 data analysis software, taking six evaluation factors as latent variables, to output the standardized path coefficient among the variables in the cognitive evaluation model, and the influence degree of each evaluation factor on the service function value of the traditional village ecosystem.

Table 4. Estimate of path coefficient

	Normalized path coefficient	Significance	Result
Endogenous cognitive value-economic value	.515	***	Remarkable
Endogenous cognitive value-historical value	.603	***	Remarkable

Endogenous cognitive value-ecological lvalue	.651	***	Remarkable
Endogenous cognitive value-cultural value	.357	***	Remarkable
Endogenous cognitive value-aesthetic value	.429	***	Remarkable
The cognitive value of denotation-ecological value	.730	***	Remarkable
The cognitive value of denotation-historical value	.517	***	Remarkable
The cognitive value of denotation-cultural value	.433	***	Remarkable
The cognitive value of denotation-aesthetic value	.356	***	Remarkable
Endogenous cognitive value-Physiological value	.672	***	Remarkable
The cognitive value of denotation-Physiological value	.535	***	Remarkable
The cognitive value of denotation-Endogenous cognitive value	.538	***	Remarkable
The cognitive value of denotation-economic value	.408	***	Remarkable
Fitness value-physiological value	.647	***	Remarkable
Future value -physiological value	.538	***	Remarkable
Abundant experience -Endogenous cognitive value	.597	***	Remarkable
Social confidence experience -Endogenous cognitive value	.423	***	Remarkable
Sense of security and belonging-Endogenous cognitive value	.467	***	Remarkable
Economic value of ecological resources-economic value	.396	***	Remarkable
Provide opportunities for recreational Activities-economic value	.509	***	Remarkable
Local Customs-historical value	.613	***	Remarkable
Historical events and traditions-historical value	.659	***	Remarkable
Aesthetics of architecture and landscape-aesthetic value	.378	***	Remarkable
Environment cleanliness-aesthetic value	.321	***	Remarkable
Rich spatial forms-aesthetic value	.503	***	Remarkable
Abundance of cultural activities-cultural value	.385	***	Remarkable
Educational value-cultural value	.419	***	Remarkable
Cultural details-cultural value	.534	***	Remarkable
Improve perception-Cognitive value of denotation	.522	***	Remarkable
Personal ecological awareness-Cognitive value of denotation	.371	***	Remarkable
Material production -ecological value	.634	***	Remarkable
Climate regulation-ecological value	.513	***	Remarkable
Purified air -ecological value	.579	***	Remarkable
Water conservation-ecological value	.791	***	Remarkable
Bio-diversity-ecological value	.812	***	Remarkable

a. *** means significant at 0.01 level.

4 Analysis of Results

(1) Ecological value had a highly significant positive impact on the endogenous cognitive value and external cognitive value (the path coefficient was 0. 651, 0. 730). It showed that the natural ecological subsystem composed of mountains, rivers, forests, and other habitats as well as fauna and flora in the ancient town was less disturbed. The natural environment and human beings coordinated with each other, which provided strong support for the traditional ecosystem.

(2) Physiological value had a highly significant positive effect on the endogenous cognitive value and exogenous cognitive value (the path coefficients were 0.672 and 0.535, respectively). It showed that the good combination of ecological resources and human resources in space made the traditional village ecosystem form a healthy and livable ecological space, which could provide sustainable services for future generations.

(3) Historical value had a positive and moderate significant impact on endogenous and external cognitive values (the path coefficients were 0.603 and 0.517, respectively). It showed that the characteristic historical customs formed by the cultural collision were the deep representation of ecosystem service function.

(4)Economic value positively impacted the endogenous cognitive value and external cognitive value (the path coefficients are 0. 515 and 0. 408, respectively). It showed that the development of ecological health in the Qinling Mountains is good, but there are few opportunities to provide other recreational activities.

(5) Cultural value had a low significant positive effect on endogenous and external cognitive values (the path coefficients were 0.357 and 0.433, respectively). The cultural value effect was low.

(6) Aesthetic value had a low significant positive effect on the endogenous cognitive value and external cognitive value (the path coefficients were 0.429 and 0.356, respectively). It showed that the aesthetic value was more prominent, but the effect coefficient was relatively small.

(7) Endogenous cognitive value had a significant positive effect on explicit cognitive value (the path coefficient was 0.538). It showed that the recognition of the internal factors of the ecosystem could improve the environmental perception and ecological awareness of residents, and play an important role in improving human well-being.

5 Conclusion

In the ecosystem service value of traditional villages, ecological value and physiological value had the most significant effect. Following were historical value, economic value, and aesthetic value. And cultural value had the lowest effect. On the one hand, the perception of residents' value changed with the significant degree of the influence of value factors within the ecosystem. On the other hand, it was affected by the internal coupling relation between value factors and value perception factors. Therefore, in the village ecological pattern of harmonious coexistence between man and nature, on the one hand, selective restraint of human behavior and rational use of resources can promote a virtuous circle within the traditional village ecosystem. On the other

hand, it can improve people's ecological awareness and establish ecological values of respecting nature.

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