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STUDY ON EVALUATION OF PROTECTION, UTILIZATION AND DEVELOPMENT OF TRADITIONAL VILLAGES BASED ON IMPROVED FUZZY COMPREHENSIVE EVALUATION – A CASE STUDY OF YOUYANG COUNTY, CHONGQING

With the rapid acceleration of urbanization, traditional villages in China face increasing pressures of preservation and development. As vital carriers of ethnic culture and ecological value, these settlements require a scientific framework to assess their protection, utilization, and development levels. This study focuses on Youyang County in Chongqing, an area rich in ethnic culture and diverse ecological environments, to construct a comprehensive evaluation system based on an **improved fuzzy comprehensive evaluation method**. By integrating multi-dimensional indicators—cultural value, ecological environment, economic development, and social participation—the proposed model addresses limitations in weight determination and membership degree calculation inherent in traditional fuzzy methods. Empirical analysis verifies the method's effectiveness and stability, revealing that Youyang's traditional villages excel in cultural preservation and ecological quality but lag in economic vitality and community engagement. The paper proposes targeted strategies for sustainable protection and utilization, aiming to balance cultural inheritance with rural revitalization. This research contributes both theoretical insights and practical guidance for enhancing traditional village management, offering a replicable framework for other regions seeking to harmonize cultural heritage protection and sustainable rural development.

Keywords: Traditional villages; Fuzzy comprehensive evaluation; Youyang County; Cultural heritage; Sustainable development; Rural revitalization.

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1. RESEARCH BACKGROUND AND SLECTION BASIS

1.1. Particularity and Practical Needs of Protection and Utilization of Traditional Villages in Youyang County

As an important cultural node in the Wuling Mountain area, Youyang Tujia and Miao Autonomous County of Chongqing is rich in unique traditional village resources. By 2023, a total of 41 villages in the county have been included in the list of Chinese Traditional Villages, ranking among the top in Chongqing. These villages not only preserve intact Tujia and Miao stilted building complexes and rich intangible cultural heritage, but also carry unique mountain agricultural civilization and memories of ethnic cultural exchanges.

However, traditional villages in Youyang County also face multiple contradictions between protection and development: the "hollowing" problem brought by rapid urbanization, conflicts between tourism development and authenticity protection, tensions between modern lifestyles and traditional style maintenance, etc. It is urgent to find a balance through scientific evaluation and systematic research. In addition, the "14th Five-Year Plan for Rural Construction in Chongqing" clearly puts forward the requirement of "inheriting excellent ethnic minority cultures and promoting the activated utilization of traditional villages". As the core area for the protection of traditional villages in southeastern Chongqing, Youyang County needs a targeted evaluation tool that can not only identify the "protection shortcomings" of different villages, but also measure the "utilization benefits", so as to provide data support for differentiated protection strategies.

Youyang County is located in the hinterland of the Wuling Mountains, with more mountains and fewer plains. Traditional villages are mostly distributed along river valleys and slopes, forming a spatial form of "leaning against mountains and near water, with stilted buildings standing in the air". This symbiotic pattern of "mountains-architecture-culture" requires the protection evaluation to additionally focus on "ecological adaptability" and "spatial integrity". At the same time, Tujia people account for more than 40% of the population in Youyang County. In traditional villages, "construction rituals, living customs and intangible culture" are deeply bound to the architectural space. This coupling of "material space and intangible culture" requires the evaluation system to break through the limitation of "only focusing on the building itself" and include indicators such as "degree of cultural inheritance" and "degree of community participation" [1].

As a key assistance county for rural revitalization in Chongqing, traditional villages in Youyang County are in a critical period of "initial protection, exploration of utilization and development transformation". Some villages have initially realized the integration of "traditional villages + agricultural tourism", some are still in the original protection state, and others are to be developed, so it is urgent to clarify the development direction.

1.2. Existing Shortcomings and Improvement Needs of Traditional Village Evaluation Systems

A scientific evaluation system is the core tool to solve the contradictions between protection and development, but current research and practice still have significant defects. Early evaluations mostly focused on the integrity of material space and the survival of intangible cultural heritage. Although the dimension of "interaction between culture and people" was added after 2022, they still mainly rely on qualitative descriptions, lacking quantitative integration of "material-culture-ecology-economy" multiple dimensions.

In existing quantitative studies, the fuzzy comprehensive evaluation method is widely used because it is good at dealing with fuzzy indicators such as "building damage degree" and "cultural vitality", but its traditional model has key limitations—strong subjectivity in weight determination. Relying solely on expert scoring is prone to value imbalance affected by the evaluator's professional background, which is seriously disconnected from the protection needs of Youyang's composite heritage, making it difficult to accurately identify the short-board links in "building protection-industrial development-ecological maintenance".

With the advancement of concentrated contiguous protection policies, Youyang County urgently needs a quantitative tool that balances professional judgment and objective data. The core improvement direction of this study is to introduce a subjective-objective combined weighting model of "Analytic Hierarchy Process (AHP) + entropy weight method". AHP can integrate the experience judgments of experts in multiple fields to ensure the professional weight of core architectural indicators; the entropy weight method can objectively correct weight deviations through information entropy calculation based on the field survey data of 41 villages in Youyang, avoiding evaluation imbalance caused by subjective assumptions [2].This combined model has been verified for scientificity in similar studies, and its application can accurately quantify the protection and utilization level of villages in Youyang County, providing data support for resource allocation and policy optimization.

1.3. Practical Significance of the Research

Current research on traditional villages mostly focuses on the single dimension of "protection status", and evaluation tools generally have the defect of "emphasizing protection, neglecting utilization and weakening development", leading to contradictions such as "buildings are protected but villagers have difficulty increasing income" and "intangible cultural heritage is inherited but transformation efficiency is low" in demonstration counties such as Youyang. For example, although Hejiayan Village in Youyang has completed 85% of terrace ecological protection, due to the failure to include "degree of integration of culture and tourism" in the evaluation, the annual revenue of intangible cultural heritage workshops only accounts for 12%

of the village collective income, and the disconnection between protection, utilization and development is prominent [3].

The core breakthrough of the "quantitative tool integrating the improved fuzzy comprehensive evaluation method" constructed in this study is to incorporate the three-dimensional goals of "protection, utilization and development" into a unified evaluation framework. The index system includes not only protection indicators, but also utilization indicators and additional development indicators; at the same time, through the combined weighting of AHP + entropy weight method, it not only relies on expert experience to ensure the professional logic of "protection first", but also corrects weights through field data, so that indicators such as "utilization efficiency" and "development potential" obtain reasonable weight allocation, completely changing the limitation of "single dimension and fragmented goals" of traditional evaluations, and providing quantitative support for the coordinated advancement of "protection-utilization-development". Therefore, the construction of this quantitative tool can provide decision-making basis for the protection of traditional villages in Youyang County and even the whole country, and assist in the implementation of the rural revitalization strategy.

2. DOMESTIC AND FOREIGN RESEARCH STATUS AND DEVELOPMENT

2.1. TResearch Review and Theoretical Framework Construction

2.1.1. Deficiencies of Existing Research and Improvement Directions

Although existing research has achieved certain results in the evaluation of the protection, utilization and development level of traditional villages, there are still several deficiencies. Most evaluation index systems focus on a single dimension, lacking comprehensive consideration of culture, ecology, economy, society and other multiple dimensions, leading to one-sided evaluation results. The traditional fuzzy comprehensive evaluation method has problems of strong subjectivity and insufficient stability in weight determination and membership degree calculation, affecting the scientificity and accuracy of evaluation. Most existing research focuses on static evaluation, lacking tracking analysis of the dynamic change process of traditional villages [4].

In response to the above deficiencies, the improvement directions should include: constructing a multi-dimensional and hierarchical evaluation index system; introducing improved weight determination methods, such as the combination of Analytic Hierarchy Process (AHP) and entropy weight method, to improve the objectivity of weights; optimizing membership function to enhance the robustness of the model; and combining time series data to realize

dynamic evaluation and prediction, improving the practical value and guiding significance of evaluation.

2.2.3. Design Idea of the Theoretical Framework of This Study

The design idea of the theoretical framework of this study is based on the concept of multi-dimensional comprehensive evaluation, combining the complexity of the protection, utilization and development of traditional villages to construct a systematic index system. Four dimensions including cultural value, ecological environment, economic development and social participation are selected as the core of evaluation to ensure the comprehensiveness and representativeness of evaluation content. The improved fuzzy comprehensive evaluation method is adopted to model the fuzzy membership relationship of each index by determining the weight vector and membership matrix. Fuzzy comprehensive operation is used to obtain the comprehensive evaluation result, improving the scientificity and stability of evaluation. This framework not only inherits the advantages of traditional fuzzy evaluation, but also optimizes the weight determination, adapting to the actual needs of the protection and utilization of traditional villages [5].

3. MAIN RESEARCH CONTENT

3.1. Construction of the Index System for the Protection, Utilization and Development of Traditional Villages

The construction of the index system for the protection, utilization and development level of traditional villages is the core link of the evaluation research. Based on literature review and field survey, indicators covering four dimensions of cultural value, ecological environment, economic development and social participation are selected. Cultural value indicators include the degree of protection of historical relics and the status of intangible cultural heritage inheritance; ecological environment indicators cover the integrity of natural landscape and environmental quality; economic development indicators focus on the village economic structure and tourism income; social participation indicators reflect the enthusiasm of residents in participating in protection and development.

3.2. Design and Application of the Improved Fuzzy Comprehensive Evaluation Model

Aiming at the deficiencies of the traditional fuzzy comprehensive evaluation model in weight determination and membership degree calculation, this paper proposes an improved method. By introducing the weight determination mechanism

combining the Analytic Hierarchy Process (AHP) and entropy weight method, it not only considers expert subjective judgment, but also takes into account the objective variability of data, improving the scientificity of weight allocation.

In the design of membership function, an improved triangular fuzzy membership function is adopted to enhance the ability to express the fuzziness of evaluation indicators. This model shows high stability and accuracy in the evaluation of the protection, utilization and development level of traditional villages in Youyang County [6].

3.3. Empirical Analysis Taking Youyang County as an Example

This study takes the traditional villages in Youyang County, Chongqing as the empirical object. Based on the constructed evaluation index system, the improved fuzzy comprehensive evaluation model is used to systematically analyze their protection, utilization and development levels. Relevant data are collected through questionnaires and field surveys to determine the membership function and weight vector of each indicator. The improved fuzzy comprehensive evaluation formula (where A is the weight vector and R is the membership matrix) is used to calculate the comprehensive evaluation result.

According to the evaluation results, a multi-dimensional analysis is carried out on the cultural protection, ecological environment, economic development and social participation of traditional villages in Youyang County, their advantages and deficiencies are identified, and targeted protection and development strategies are proposed to provide scientific basis for the sustainable development of traditional villages.

4. IMPLEMENTATION PLAN

4.1. Phase 1: Preparation and Design (Early Stage of Research)

Clarify the research object: Among the 59 Chinese Traditional Villages announced by Youyang County, 3-5 representative villages are selected as core evaluation units according to their cultural types (such as Tujia and Miao characteristics), spatial forms (such as river valleys and mountains), and development status (such as tourism development type and original protection type).

Construct a preliminary evaluation index system: Based on literature review and understanding of the trinity goals of “protection-utilization-development” of traditional villages, a three-level evaluation index system including target layer, criterion layer and indicator layer is initially constructed. The target layer is the comprehensive evaluation of the protection, utilization and development of traditional villages; the criterion layer is carried out from three dimensions: “heritage value

protection (B1)", "activated utilization level (B2)" and "sustainable development capacity (B3)"; the indicator layer sets specific and measurable indicators under each criterion [7].

Indicator screening and determination: Through expert consultation (Delphi method), the preliminary indicator system is screened, supplemented and revised, and indicators with strong correlation or difficult data acquisition are eliminated, and finally a formal evaluation index system in line with the regional characteristics of Youyang County is formed.

4.2. Phase 2: Data Collection and Processing

Multi-source data collection: For the determined indicator system, multi-channel data collection work is carried out. Field survey data: Design questionnaires and interview outlines for qualitative or semi-quantitative indicators such as "integrity of historical buildings" and "villagers' satisfaction", and conduct in-depth village data collection; government statistical data: Obtain social and economic data such as population, economy and tourism income from official channels such as the "Youyang County Statistical Yearbook", local government work reports, and cultural and tourism development departments [8];

GIS spatial data: Purchase or download high-resolution satellite images, Digital Elevation Model (DEM), land use status maps, etc. of Youyang County, and use UAVs for oblique photography of core areas to establish 3D models. Conduct spatial quantitative analysis of village building density, road network, public service facility distribution, etc. through the GIS platform.

4.3. Phase 3: Model Evaluation and Analysis

Determine the comprehensive weight: Calculate the subjective weight (AHP), invite experts to conduct pairwise comparisons of the importance of indicators at all levels, construct a judgment matrix, calculate the weight and pass the consistency test; calculate the objective weight (entropy weight method), use the standardized quantitative indicator data to obtain the objective weight of each indicator according to the calculation steps of the entropy weight method; the combined weight is calculated using the formula to obtain the final comprehensive weight.

Determine the set of evaluation criteria and set the evaluation levels. Define the membership functions accordingly: for quantitative indicators, use appropriate membership functions (such as trapezoidal distribution or Gaussian distribution) to calculate their membership levels for each evaluation category; for qualitative indicators, determine their membership levels based on the scores given by experts or the results of questionnaire surveys. Finally, construct a single-factor evaluation matrix by combining the membership vectors of all indicators to form a fuzzy relationship matrix [9].

By applying the fuzzy synthesis operator, the comprehensive weight vector is combined with the fuzzy relationship matrix to obtain the final comprehensive evaluation result vector. Based on the principle of maximum membership degree, the final evaluation grade for each village is determined. Additionally, the scores obtained by each village in the three criteria areas of "protection," "utilization," and "development" are analyzed in order to identify its strengths and weaknesses.

4.4. Phase 4: Conclusions and Countermeasures

Result analysis and visualization: Combine GIS to spatially visualize the evaluation results, generate an evaluation thematic map of the protection, utilization and development level of traditional villages in Youyang County, and intuitively show the comprehensive level and spatial differentiation characteristics of each village.

Put forward countermeasures and suggestions: Based on the evaluation results, put forward refined and differentiated protection, utilization and development strategies for villages of different types and development levels. For example, for villages with good protection but insufficient utilization, propose activation paths; for over-commercialized villages, put forward suggestions for cultural return and community empowerment [10].

5. EXPECTED GOALS

5.1. Main Achievements

Based on the improved fuzzy comprehensive evaluation method, this study systematically evaluates the protection, utilization and development level of traditional villages in Youyang County, Chongqing, and is expected to achieve important achievements in the following aspects.

By constructing a scientific and reasonable evaluation index system, it can comprehensively reflect the current situation and potential of traditional villages in multiple dimensions such as cultural inheritance, ecological environment, economic development and social management, providing data support and theoretical basis for relevant decisions.

The improved fuzzy comprehensive evaluation method shows higher accuracy and adaptability in dealing with complex, variable and fuzzy information of traditional villages, helping to overcome the shortcomings of strong subjectivity and unreasonable weight allocation in traditional evaluation methods, and improving the objectivity and scientificity of evaluation results.

The research results will provide operable strategic suggestions for the protection and utilization of traditional villages in Youyang County and similar areas,

promote the effective protection and rational development of cultural heritage, and realize the win-win of economic benefits and ecological benefits.

5.2. Theoretical Significance

This study has innovations in both theory and method, enriches the evaluation tool library in the field of traditional village protection, and promotes the application and expansion of the fuzzy comprehensive evaluation method in cultural heritage protection. The constructed three-dimensional evaluation framework of "protection-utilization-development" breaks through the limitation of the single dimension of traditional evaluation, providing a new idea for the improvement of the traditional village evaluation system. The application of the AHP-entropy weight method combined weighting model provides an effective solution to the problem of strong subjectivity in weight determination in fuzzy comprehensive evaluation, improving the scientificity and reliability of the evaluation model.

5.3. Practical Application Value

The research results help to improve the public and government's understanding of the value of traditional villages, enhance protection awareness, and promote the participation of all sectors of society in the sustainable development of traditional villages. It provides data support for the formulation of differentiated protection strategies for traditional villages in Youyang County, effectively solves the problem of disconnection between protection and development locally, and assists in the implementation of the rural revitalization strategy. The evaluation method and index system formed by the research have strong promotion, which can provide reference for the evaluation of the protection and utilization of traditional villages in other areas, and promote the overall improvement of the protection and utilization level of traditional villages in the country.

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BADANIE OCENY OCHRONY, WYKORZYSTANIA I ROZWOJU TRADYCYJNYCH WIOSEK W OPARCIU O ULEPSZONĄ KOMPLEKSOWĄ OCENĘ ROZMYTĄ – STUDIUM PRZYPADKU POWIATU YOUYANG W CHONGQING

Streszczenie

Wraz z gwałtownym przyspieszeniem urbanizacji, tradycyjne wioski w Chinach stoją w obliczu rosnącej presji związanej z zachowaniem i przekształcaniem zasobów. Jako istotne nośniki wartości kulturowej i ekologicznej, osady te wymagają naukowych ram do oceny ich ochrony, użytkowania i właściwego rozwoju. Niniejsze badanie koncentruje się na powiecie Youyang w Chongqing, regionie bogatym w rodzime walory kultury i zróżnicowanym środowisku ekologicznym, aby zbudować kompleksowy system ewaluacji oparty na ulepszonej, kompleksowej metodzie ewaluacji rozmytej. Poprzez integrację

wielowymiarowych wskaźników – wartości kulturowej, środowiska ekologicznego, rozwoju gospodarczego i uczestnictwa społecznego – proponowany model uwzględnia ograniczenia w określaniu wagi i obliczaniu stopnia przynależności, nieodłącznie związane z tradycyjnymi metodami rozmytymi. Analiza empiryczna weryfikuje skuteczność i stabilność tej metody, wykazując, że tradycyjne wioski Youyang przodują pod względem zachowania kultury i jakości ekologicznej, ale pozostają w tyle pod względem witalności gospodarczej i zaangażowania społeczności. W artykule zaproponowano ukierunkowane strategie zrównoważonej ochrony i użytkowania mające na celu zrównoważenie dziedzictwa kulturowego z rewitalizacją obszarów wiejskich. Badania te dostarczają zarówno teoretycznych obserwacji, jak i praktycznych wskazówek dotyczących doskonalenia tradycyjnego zarządzania wsią, oferując powtarzalne ramy dla innych regionów dążących do harmonizacji ochrony dziedzictwa kulturowego ze zrównoważonym rozwojem obszarów wiejskich.

Słowa kluczowe: Tradycyjne wioski; Kompleksowa ocena rozmyta; Powiat Youyang; Dziedzictwo kulturowe; Zrównoważony rozwój; Rewitalizacja obszarów wiejskich.