Research on comprehensive benefit evaluation based on development and utilization of idle house site in rural area in Yunnan province

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Abstract. Along with the process of industrialization, urbanization and "counter urbanization" as well as the movement of population in rural and urban areas, it makes the increase of idle house site in rural area, as well as stimulating the development of the rural house site market. In order to further develop and utilize the idle house site in rural areas, the research takes Yunnan Province as the research target, and analytic hierarchy process is used to determine the index weight, the fuzzy comprehensive evaluation method is used to carry out research on the comprehensive benefit evaluation based on idle house site development and utilization from three aspects of economic benefits, social benefits and ecological benefits. According to the research results, the comprehensive benefit evaluation grade with respect to the development and utilization of idle house site in rural area Yunnan is desirable, but the social benefit is evaluated as general. Therefore, it puts forward some countermeasures and suggestions, such as giving full play to the unique advantages of local area to promote the reuse of idle house site, strengthening the layout and management of rural house site, promoting the construction of auxiliary facilities necessary for the reuse of idle house site etc.

1. Introduction

Rural house site plays several roles such as living security, business production and management, family property and economy and culture. The income from management and transfer of house site has become an integral part of farmers’ economy [1], but at the same time, house site is still deemed as the most important part which can guarantee the living conditions of farmers in rural area. In recent years, after China's "rural revitalization" strategy is put forward, the extensive attention has been gained from the academic circles to researches on rural house site. It is of great significance to improve the utilization efficiency of house site, realize rural revitalization, carry out overall planning of urban and rural development and the sustainable development of rural social economy [2].

As the urbanization rate increases quickly, the resident population in rural areas is continuously decreasing. According to statistics in 2015, the proportion of uninhabited houses all year around in rural areas accounts for 20%, but the newly area of house site added in rural area is continuously increasing. Due to the dual structure of urban and rural areas, farmers who move to cities cannot abandon their house sites as a result of difficulty in realizing the citizenization [3], thus aggravating the idleness of
house site. In order to improve the utilization rate of house site in rural area, the state has continuously issued various policies in recent years, aiming to encourage the development and utilization of idle house site in rural area, which has improved the idleness of house site to some certain extent. But some problems relating to the use of house site in rural area still exist, such as the problems relating to inadequate planning, poor management and excessive area.

The research on the utilization of rural house site in foreign countries mainly focuses on the phenomenon of counter urbanization. Cloke believes that the inflow of external population in rural area will lead to competition in rural residential space, thus causing the contradictions among rural residents [4].Keeble (1983) found based on investigation that the entry of immigrants will change the social environment in the rural area [5];In addition, many foreign scholars also carries out research from the perspective of land resources utilization, and they believe that the evaluation principle of land resources utilization should not only be measured according to the economic value, but also should be discussed according to the social value and ecological value (Blackie, 1993; Szczepanska, 1992) [6] [7].

Domestic scholars in China have conducted discussions and researches from different aspects. Peixin ZHU et. al. adopted the comparative analysis method to analyze the fairness and efficiency of the transfer of the right to use house site in rural area by taking the transfer of house site in rural area as the research object, and some problems such as problems relating to low utilization efficiency and loss of benefits in the use of rural house site are found [8];Ye WANG adopted the theory of behavior ability to evaluate and analyze the social benefits brought by the transfer of house site to the local area by means of constructing the evaluation index system applicable for the transfer of house site [9].Dan LIU et. al. adopted the economics theory to analyze and discuss the economic benefits from the house site replacement. [10] In addition, Yanhong LIU made a comparative research of different villages and towns by taking the renovation of rural residential areas as the research object, and obtained the benefit evaluation with respect to the renovation of residential areas [11].Jingli DOU, Junlian ZHANG et. al. adopted the theory of environmental economics to conduct the research on the ecological benefits brought by residential land consolidation in rural area as well as the research on composition of influencing factors [12].

In conclusion, the research fields of the utilization benefits of house site in rural area in China are relatively concentrated, and such research is mainly conducted at the level of transfer [13], replacement [14] and consolidation [15] of house site in rural area. Although a wealth of experience in research method has been accumulated, there are still deficiencies in the research methods and achievements on the development and utilization of idle house site.

2. Research area and research method

2.1. Overview of the research area

Yunnan Province, which is located in southwest of China (21°8′–29°15′N, 97°31′–106°11′E), belongs to low latitude inland area. It is adjacent to Guizhou and Guangxi in the east, Sichuan in the north and Xizang in the northwest, with a total area of 394,100m2. Within the subtropical plateau monsoon zone, it has obvious three-dimensional climate characteristics, numerous climate types, small annual temperature difference, and large daily temperature difference and clear dry and wet seasons. Dominated by the mountainous and plateau topography, its mountainous area accounts for 94%.

Yunnan is the province with the largest population of minorities in China, accounting for 33.6% of the total population. As of 2019, the total population of Yunnan Province is 48.583 million, of which the population in urban area is about 23.762 million, the population in rural area is about 24.821 million, and migrant population is 5.517 million, with the urbanization rate up to 48.91%.

2.2. Determination of research indexes

The research on the land use benefits is mainly conducted by the academic circles from three aspects: economic benefits, social benefits and ecological benefits. As an important part of the land use system,
the research on comprehensive benefits from the rural house site utilization shall also be conducted from three aspects: economic benefits, social benefits and ecological benefits.

In this article, the AHP-fuzzy comprehensive evaluation method is adopted for research and analysis. AHP refers to analytic hierarchy process, which is a kind of decision-making method proposed by an American operations researcher T.L. saaty and is widely used in decision-making researches such as economy and planning, resource policy and resource allocation, project evaluation, etc. so as to decompose the elements related to decision-making problems into objective layer, criterion layer and scheme layer for the purpose of qualitative analysis and quantitative analysis. Fuzzy comprehensive evaluation method is a kind of method that uses fuzzy mathematics for research, which describes the fuzzy boundary based on membership degree. As most of the evaluation indexes are subjective ones, it shows nature of fuzziness to some extent. The fuzzy mathematics and AHP evaluation method can be used to determine the index weight, establish the index evaluation function and even evaluate the comprehensive benefits based on development and utilization of idle house site, which is conducive to obtaining the evaluation results in a more objective and reasonable manner.

2.3. Construction of comprehensive utilization benefit evaluation model of idle house site based on AHP

According to the principle of scientization, systematization and feasibility, by referring to literature [16], [17-19] and relevant statistical yearbooks, as well as considering the data acquisition method and limitation, this article selects the evaluation indexes based on the score by expert through questionnaire from the three aspects of economic benefits, social benefits and ecological benefits with respect to the development and utilization of idle house site, and finally determines 14 evaluation indexes that are suitable for comprehensive benefits evaluation with respect to development and utilization of house site in rural area in Yunnan Province. According to AHP hierarchical structure model, the comprehensive benefit evaluation system based on idle house site development and utilization in rural area of Yunnan Province is constructed, as shown in Table 1. The model is divided into three layers, the objective layer refers to comprehensive benefit A, the criterion layer refers to economic benefit B1, social benefit B2 and ecological benefit B3, and the index layer consists of 14 indexes (C1 - C14).

| Table 1. Comprehensive benefit evaluation system based on idle house site development and utilization in rural area of Yunnan Province. |
| --- | --- | --- |
| Objective layer | Criterion layer | Index layer |
| Comprehensive benefit evaluation based on idle house site development and utilization in rural area of Yunnan Province (A) | Economic benefits (B1) | Net income from production and management activities at house site (C1) |
| | | Per capita labor output value of household engaged in production and management activities at house site (C2) |
| | | Income from transfer of house site (C3) |
| | | Value of house site (C4) |
| | Social benefits (B2) | Per capita house site area (C5) |
| | | Family security ability of house site (C6) |
| | | Idleness rate of house site (C7) |
| | | Support local employment (C8) |
| | | Community safety (C9) |
| | | Community management (C10) |
| | | Utilization rate of house site (C11) |
| | Ecological benefits (B3) | Environmental protection property of residential fuels (C12) |
| | | Impact of sanitary environment (C13) |
| | | House renovation and alteration (C14) |
2.4. Evaluation method based on fuzzy comprehensive evaluation

Due to the problems such as complexity of evaluation factors, fuzziness in evaluation criteria, uncertainty of factors influencing the evaluation, difficulty in quantifying qualitative indexes etc., the fuzzy comprehensive evaluation can be adopted to combine qualitative and quantitative factors and expand information content, thus obtain the evaluation results in a more objective manner and in line with the actual situation.

The specific steps are as follows:

1) Establish the factors set. According to the 14 index factors mentioned in comprehensive benefit evaluation system based on idle house site development and utilization in rural area of Yunnan Province, a set of evaluation factors is established, \( U = \{u_1, u_2, u_3, ..., u_n\} \).

2) Determine the remarks set \( V = \{V_1, V_2, V_3, ..., V_m\} \). In this article, \( V = \) very good (V1), relatively good (V2), general (V3), not good (V4).

3) Establish fuzzy relation \( R \) for factors at each level. According to the already-established comprehensive evaluation index and by means of the scoring by the experts based on each evaluation factor, the evaluation matrix can be obtained by using the formula, with the calculation formula as follows:

\[
R_{ij} = \frac{x_{ij}}{\sum_{j=1}^{m} x_{ij}} \quad (i = 1, 2, ..., m)
\]

Set \( X_i = \{x_{ij} = 1, 2, ..., n; J = 1, 2, ..., m\} \), the factor \( i \) is the proportion of level \( j \).

4) The evaluation results for each layer of factors is calculated as follows:

\[
B_i = W_i \times R_i = (w_1, w_2, ..., w_n) \times \begin{bmatrix}
    r_{11} & r_{12} & ... & r_{1m} \\
    r_{21} & r_{22} & ... & r_{2m} \\
    ... & ... & ... & ... \\
    r_{n1} & r_{n2} & ... & r_{nm}
\end{bmatrix} = (b_1, b_2, ..., b_m)
\]

Among which, \( W_i \) is the index weight of each level, \( R_i \) is the judgment matrix of each level, and the \( R = \{R_n1, R_n2, R_n3, R_n4\} \), which is the result obtained based on the comprehensive evaluation of the index and indicates the membership degree of the index factor under \( V \).

3. Research and analysis

3.1. Determination of the index weight by using the AHP method

According to the above-mentioned comprehensive benefit evaluation index based on idle house site development and utilization in rural area of Yunnan Province, an analytic hierarchy process model is constructed. In this article, 9-scale method is adopted to assign values based on the importance of each index through comparison, and therefore obtain the index weight using the yaahp10.3 analysis software.

The maximum characteristic value and its characteristic vector \( \lambda_{max} \) are calculated by establishing a judgment matrix, and each target matrix is subject to consistency inspection. The scoring scale of the judgment matrix is shown in Table 2. The comprehensive consistency index \( CI \) is obtained through calculation

\[
CI = \frac{\lambda_{max} - n}{n - 1}
\]

The consistency test ratio \( CR \) is obtained through calculation

\[
CR = \frac{CI}{RI}
\]

and the consistency test index \( CR \) is used for consistency test at the same time. When \( CR < 0.1 \), the consistency of the judgment matrix is acceptable, so as to ensure the consistency of the judgment matrix. Finally, the importance priority between an element at each level and a certain element at the upper level is obtained, and the weight vector is hereby established, with the results as shown in Table 3-Table 6:

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**Table 2.** Scoring scale and meaning of analytic hierarchy process.

| Scoring scale | Meaning |
|---------------|---------|
| 1             | It indicates that in case of comparison of two factors, both of them are of equal importance. |
| 3             | It indicates that in case of comparison of two factors, one factor is slightly more important than the other factor |
5 It indicates that in case of comparison of two factors, one factor is obviously more important than the other factor.

7 It indicates that in case of comparison of two factors, one factor is highly more important than the other factor.

9 It indicates that in case of comparison of two factors, one factor is extremely more important than the other factor.

2, 4, 6, 8 It indicates the intermediate value of the above-mentioned adjacent judgment results.

Table 3. The index evaluation matrix of B to A and its weight variables: Consistency ratio 0.0088; Weight of "comprehensive benefit evaluation with respect to house site utilization": 1.0000; $\lambda_{max}$: 3.009.

| A  | B1 | B2 | B3 | WA  |
|----|----|----|----|-----|
| B1 | 1  | 4  | 1  | 0.4579 |
| B2 | 0.25 | 1  | 0.3333 | 0.126 |
| B3 | 1  | 3  | 1  | 0.4161 |

Table 4. Economic benefit B1 Consistency ratio: 0.0440; Weight of "comprehensive benefit evaluation with respect to house site utilization": 0.4579; $\lambda_{max}$: 4.1176.

| B1 | C1 | C2 | C3 | C4 | W1  |
|----|----|----|----|----|-----|
| C1 | 1  | 2  | 5  | 0.3333 | 0.2626 |
| C2 | 0.5 | 1  | 3  | 0.5  | 0.1789 |
| C3 | 0.2 | 0.3333 | 1  | 0.1429 | 0.0589 |
| C4 | 3  | 2  | 7  | 1    | 0.4996 |

Table 5. Social benefit B2 Consistency ratio: 0.0993; Weight of "comprehensive benefit evaluation with respect to house site utilization": 0.1260; $\lambda_{max}$: 7.8103.

| B2 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | W2  |
|----|----|----|----|----|----|-----|-----|-----|
| C5 | 1  | 9  | 4  | 3  | 3  | 1   | 0.5  | 0.2227 |
| C6 | 0.1111 | 1  | 0.25 | 0.25 | 0.1667 | 0.1429 | 0.1667 | 0.0233 |
| C7 | 0.25 | 4  | 1  | 5  | 3  | 0.3333 | 0.5  | 0.127  |
| C8 | 0.3333 | 4  | 0.2 | 1  | 0.3333 | 0.3333 | 0.3333 | 0.0563 |
| C9 | 0.3333 | 6  | 0.3333 | 3  | 1  | 0.1667 | 0.3333 | 0.0793 |
| C10 | 1  | 7  | 3  | 3  | 6  | 1   | 3    | 0.2941 |
| C11 | 2  | 6  | 2  | 3  | 3  | 0.3333 | 1    | 0.1973 |
Table 6. Ecological benefit B3 Consistency ratio: 0.0904; Weight of "comprehensive benefit evaluation with respect to house site utilization": 0.4161; $\lambda_{\text{max}}$: 3.0940.

| B3 | C12 | C13 | C14 | W3 |
|----|-----|-----|-----|----|
| C12 | 1   | 0.2 | 0.125 | 0.0643 |
| C13 | 5   | 1   | 0.25  | 0.237  |
| C14 | 8   | 4   | 1    | 0.6986 |

Through the above calculations, the weight of each index can be obtained, and beside, each judgment matrix is in line with the requirements of consistency test. The weight of each index is shown as follows:

$WA=(0.4579,0.126,0.4161)$

$W1=(0.2626,0.1789,0.0589,0.4996)$

$W2=(0.2227,0.0233,0.127,0.0563,0.0793,0.2941,0.1973)$

$W3=(0.0643,0.237,0.6986)$

3.2. Analysis of fuzzy comprehensive evaluation method

On the basis of scoring by expert, the membership degree of the corresponding index can be obtained, as shown in Table 7:

Table 7. Index membership degree of fuzzy comprehensive evaluation model.

| Criterion layer | W   | Index layer | Wi   | Evaluation level |
|-----------------|-----|-------------|------|------------------|
|                 |     |             | V1   | V2   | V3   | V4   |
| Economic benefit (B1) | 0.4579 | C1           | 0.2626 | 0.5 | 0.4 | 0.1 | 0.0 |
|                  |     | C2           | 0.1789 | 0.0 | 0.6 | 0.4 | 0.0 |
|                  |     | C3           | 0.0589 | 0.6 | 0.4 | 0.0 | 0.0 |
|                  |     | C4           | 0.4966 | 0.3 | 0.6 | 0.1 | 0.0 |
| Social benefit (B2) | 0.126 | C5           | 0.2227 | 0.0 | 0.4 | 0.5 | 0.1 |
|                  |     | C6           | 0.0233 | 0.0 | 0.3 | 0.5 | 0.2 |
|                  |     | C7           | 0.127  | 0.0 | 0.2 | 0.4 | 0.4 |
|                  |     | C8           | 0.0563 | 0.0 | 0.7 | 0.3 | 0.0 |
|                  |     | C9           | 0.0793 | 0.0 | 0.0 | 0.3 | 0.7 |
|                  |     | C10          | 0.2941 | 0.0 | 0.3 | 0.6 | 0.1 |
|                  |     | C11          | 0.1973 | 0.0 | 0.5 | 0.3 | 0.2 |
| Ecological Benefit (B3) | 0.4162 | C12          | 0.0643 | 0.0 | 0.5 | 0.5 | 0.0 |
|                  |     | C13          | 0.237  | 0.0 | 0.4 | 0.6 | 0.0 |
|                  |     | C14          | 0.6986 | 0.5 | 0.5 | 0.0 | 0.0 |

Based on the AHP calculation results and by means of using the weight vector and rating matrix corresponding to the index, the comprehensive evaluation vector for each target is calculated, and therefore sub-target evaluation matrix is formed. Finally, the total target evaluation vector is obtained, and the membership grade of the objective layer can be determined.

Firstly, the fuzzy comprehensive evaluation vector at the criterion layer is calculated according to the weight vector and evaluation matrix corresponding to the index. The calculation formula is $E_n=W_nU_n$, through which, the comprehensive membership degrees of economic benefits B1, social
benefits B2 and ecological benefits B3 in the criterion layer can be calculated. The results are shown as follows: x

Table 8. Summary of comprehensive benefit evaluation of idle house site in rural area of Yunnan province.

| Factors set               | W      | V1    | V2    | V3    | V4    |
|---------------------------|--------|-------|-------|-------|-------|
| Economic benefit (B1)     | 0.4579 | 0.32  | 0.54  | 0.15  | 0.00  |
| Social benefit (B2)       | 0.1260 | 0.00  | 0.35  | 0.45  | 0.20  |
| Ecological Benefit (B3)   | 0.4162 | 0.35  | 0.48  | 0.17  | 0.00  |

Secondly, the fuzzy comprehensive evaluation matrix at the objective layer is established, aiming to realize normalization of the fuzzy comprehensive evaluation vector at the criterion layer and finally obtain the comprehensive utilization evaluation results of idle house site in rural area in Yunnan Province.

\[ B = W \times R = (0.46,0.13,0.41) \times \begin{bmatrix} 0.32 & 0.54 & 0.15 & 0.00 \\ 0.00 & 0.35 & 0.45 & 0.20 \\ 0.35 & 0.48 & 0.17 & 0.00 \end{bmatrix} = (0.29,0.49,0.19,0.03) \]

4. Research conclusions

By adhering to the principle of maximum membership degree, the comprehensive utilization benefit grade of idle house site in rural area in Yunnan Province is "relatively good", which means, the overall development trend in terms of comprehensive utilization benefit of idle house site in rural area in Yunnan Province is under good condition, and there is still room for development in the future. The specific conclusions are shown as follows:

(1) The evaluation result of "economic benefits" are "relatively good", with the membership degree of 0.54. Due to the rapid development of leisure tourism in rural area in Yunnan Province in recent years, the income from transfer of house site and the asset value of house site in the process of development and utilization can be well reflected. Although the evaluation result of "per capita labor output value of household Engaged in production and management activities at house site " is "good", the membership degree for "general" level is quite high, which means that the economy-facilitated effect in the process of development and utilization of house site is not yet strong.

(2) The evaluation result of "social benefits" is "general", with the membership degree of 0.45, and the membership degree is higher for level of "general" and below. Among which, the evaluation results of "support local employment" and "community management" are "not good", which reflects the fact that economic development in rural area in Yunnan Province is unbalanced, there is still space for developing and using idle house site to support local employment, the management and service level of rural communities needs to be improved, and the market mechanism of house site in rural area is imperfect.

(3) The evaluation result of "ecological benefits" is "relatively good" with the membership degree at 0.48, which indicates that farmers have better ecological awareness in the development and utilization of idle house site. Among which, the evaluation result of "house renovation and alteration" is "very good" with a membership of 0.5, but the evaluation results of "environmental protection property of residential fuels" and "impact of sanitary environment" are "general", with the membership degrees of 0.5 and 0.6 respectively. Therefore, further improvements need to be made in terms of residential fuels and sanitary environment.

5. Countermeasures and suggestions

5.1. Give full play to the local advantages and promote the reuse of idle house site
According to the requirements of the Ministry of Agriculture and Rural Affairs on the reuse of idle house site in rural area, the house site shall be developed and utilized by adhering to the principle of "adjusting measures to local conditions" and by adopting the development mode that conforms to local conditions. Yunnan has superior natural conditions and diversified ethnic cultural characteristics, so as for the development and utilization of house site in different rural regions, it is not suggested to simply copy the successful experiences of other regions. The government should strengthen the planning and design at the macro level, implement more policies in the development and utilization management of house site in rural area, vigorously develop the rural economy, accelerate the integration of primary, secondary and tertiary industries, as well as utilizing the radiation effect of urban area to stimulate the development of idle house site in rural area, so as to avoid homogeneous development and improve the comprehensive benefits on the whole.

5.2. Strengthen the planning and management of house site in rural area
House site in rural area has the attribute of resources and assets, so it is deemed as a welfare and guarantee for farmers. In the process of development and utilization of idle house site in Yunnan Province, most of the works are carried out by farmers spontaneously, so the social driving effect is not obvious. Only by strengthening the training of farmers’ skills and improving the social security systems such as rural medical care and endowment insurance can more farmers be guided and encouraged to start new businesses and take up an occupation in local. It shall improve the primary level management ability in the rural area, make innovation in the management mode in the process of house site development and utilization and adopt the mode of "cooperatives + companies + farmers", i.e. under such mode, it shall set up idle house site cooperatives, introduce companies to uniformly renovate and build farmers’ houses and carry out operations, and the farmers are able to participate in the specific reception & management, and obtain share income and salary income according to proportion. In addition, by continuously improving the level of rural public services and improving the management ability of rural communities, it is conducive to continuously improving the social benefits with respect to the development and utilization of idle house site.

5.3. Strengthen the construction of the supporting facilities necessary for the reuse of idle house site
In the process of development and utilization of house site, attention should be paid to the combining of the environmental protection and resource development, strengthening the overall management and planning of house site in rural area, developing new industries such as rural leisure, fitness tourism etc., and fully utilizing the "tourism" and "ecology" modes to promote the deep integration of the whole industrial chain in Yunnan's rural areas. In terms of the layout and structure with respect to management and renovation of house site in rural area, especially for the villages with ancient trees, ancient buildings and ethnic traditional characteristics, reasonable planning and management should be carried out in combination with local conditions, so as to minimize the destructive effect of rural house site utilization on the ecological environment. In addition, as a kind of land utilization method, the sustainable development and utilization of house site in rural area shall also be focused. In combination with village renovation works, the supporting facilities for water conservancy, fuel, garbage disposal etc. at house site shall be constructed and improved, which will not only improve the living environment of local farmers, but also further enhance the ecological benefits in the development and utilization process of house site.

Acknowledgement
Supported by School-level Youth Social Science Fund of Yunnan Agricultural University (2018SK11).

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