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Research on the construction of village classification evaluation index system under the background of rural revitalization

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Abstract. *The Rural Revitalization Strategic Plan (2018-2022)* clearly divides the villages into agglomeration and upgrading villages, characteristic protection villages, evacuation and relocation villages and suburban fusion villages. However, the current classification of villages is subjective and lacks scientific and rational quantitative evaluation. This paper attempts to construct the villages classification evaluation index system from six aspects, namely transportation location, population scale, land resources, economic development status, infrastructure and historical context by using AHP. Through an empirical research of 12 villages in Mayangshan township, Longhui county, it was found that there were 2 agglomeration and upgrading villages, 4 characteristic protection villages and 6 evacuation and relocation villages in Matangshan township. In the background of rural revitalization, the construction of village classification evaluation index system to scientifically determine the type of village is a useful exploration for improving the theory and practice of rural planning, which can provide reference for village layout planning.

1. Introduction

At the party's 19th national congress, general secretary Xi Jinping proposed a strategy for rural revitalization. The strategic target is to achieve prosperous industry, ecological livability, rural civilization, effective governance, and affluent life, aiming at solving the issues of agriculture, countryside and farmers, improving the country's economic growth, and realizing the well-being of farmers [1]. After that, in order to realize rural revitalization, the central committee of the communist party of China issued *The Village Revitalization Strategic Plan (2018-2022)*, which clarified the classification and promoted rural development, and divided the village into a cluster of agglomeration and upgrading villages, characteristic protection villages, evacuation and relocation village and suburban fusion villages. After the promulgation of the document, the classification of villages was actively carried out during rural planning throughout the country. But when assessing the type of village, the judgment of designers and researchers alone is subjective and lacks objectivity. Therefore, this paper attempts to classify the villages by using the expert scoring method and AHP to build a rural evaluation index system, so as to make the village classification is more objective and reasonable.

At present, many domestic scholars mainly use AHP to make objective decisions or evaluate events. Wang Jianjun and others research on the optimization of transportation scheme based on Analytic Hierarchy Process has certain reference significance for the construction of village classification evaluation index system[2]; When studying the evaluation index system of rural tourism environmental

protection, Meng Qiuli first established the PSR model, and then combined the expert scoring method and AHP to evaluate the weight of each index in order to realize the sustainable development of rural tourism[3]; Liu Jizhi used AHP to study the evaluation index of beautiful rural areas in Tianjin, and constructed a three-layer evaluation index system to analyze the current situation of rural development [4]; When disscussing the evaluation index system of fairy tale countryside construction in Yunhe county, Liu Jianjun and others constructed a more detailed two-layer evaluation system in this paper by using analytic hierarchy process. They pointed out that the evaluation index system of fairy tale countryside construction in Yunhe county still needed to be improved and development level of villages and towns [5].

The village is a complex system, so the development of the village is not only related to the location of natural geography, but also closely related to the local economy, society, ecology and culture. Sometimes the development of a village is affected by the policy, too. It can be said that the factors influencing the development of the village are multi-faceted. Therefore, on the basis of field research on the village, a reasonable evaluation index system is needed to classify the village. Specifically, the significance of the construction of the rural evaluation index system has the following three points:

Firstly, we can determine the type of village by qualitative and quantitative methods, abandon the previous work idea of determining the type of village development subjectively, and avoid the error orientation of rural areas.

Secondly, there is no mature evaluation index system of rural classification in China. This research provides ideas for the construction of evaluation index system of rural classification and how to classify villages objectively.

Thirdly, it is conducive to deepening domestic research and planning scholars' comprehensive understanding of the current situation of village development, and speeding up the process of village planning and construction.

Nowadays, the countryside of our country is being planned and constructed. This paper holds that beautiful countryside is not only a beautiful picture in the mind of planners, but also a vision adapted to the current situation of rural development.

2. Research methods and steps

2.1. Research methods
On the basis of the current situation survey, combined the AHP and the expert scoring method, a variety of factors are selected to evaluate the village types and build the village evaluation index system.

The research method mainly adopts AHP proposed by T. L. Saaty, an American operational research scientist. AHP can decompose the elements related to decision-making into multiple objectives or criteria, and use the method of fuzzy quantification of qualitative indicators to calculate weights and total ranking.

2.2. Research steps

2.2.1. Selection of evaluation factors for village classification. After comprehensive analysis of villages, the research selects six evaluation factors which can represent the development status of villages to construct the evaluation index system of village classification. The evaluation factors are as follows:

① Population scale: Population concentration is the most basic condition for the development of villages. The change in population is the most direct indicator of the status quo of village development. Chen Xiaoli and others pointed out that when the urban-rural integration mechanism was innovated, they found that due to the one-way urbanization in China, the rural population outflow in China led to the phenomenon of hollow village, empty nest village and idle village [6]. Therefore, the evaluation of

population scale factor plays an important role in the classification of villages.

② Economic development status: The economy is one of the foundations of village development. The annual income of the village and the annual income of agriculture are selected as the evaluation criteria.

③ Transportation location: Whether a village is developing or shrinking, its transportation location is relatively important. According to experience, the more advantageous the transportation location of the village is, the more likely it is to become a developing village.When exploring the research on the revitalization of poor rural industries in Mongolia, Wei Dalei pointed out that there were problems in urban logistics, information flow and traffic in rural areas, and the inability to revitalize poor rural industries was mainly due to poor transportation[7].

④ Land resources: Land is the most important resource element in rural areas. The construction of villages and the development of agriculture must rely on land resources. Therefore, the richness and scarcity of land resources also promote or limit the development of the village. If the village has problems such as excessive slope and ecological environment, the space for production and living in the village will be compressed and even pose a certain threat to the production and life of the villagers.

⑤ Historical context: For some villages with historical and cultural resources, they can use their advantages in historical context resources to form village characteristics. These villages can be exploited on the basis of protecting historical and cultural resources to stimulate the vitality of the villages.

⑥ Infrastructure: The status quo of infrastructure construction is an important representative of a village's hardware facilities. To simplify the model, this paper selects the number of primary and secondary schools for corresponding scoring and assessment.

The selection of the above six evaluation factors takes the necessary hardware conditions and software conditions into account for the development conditions of the village, and the classification of the village is operable and practical.

2.2.2. Village classification. When the research methods and evaluation factors are determined, the evaluation index system model established by AHP can be used to classify villages.

First, establish a hierarchical structure model(see figure 1).The target layer: the optimal development type of the village; The criteria layer: population scale, economic development status, transportation location, land resources, historical context and infrastructure; The scheme layer: agglomeration and upgrading village, characteristic protection village, evacuation and relocation village and suburban fusion village.
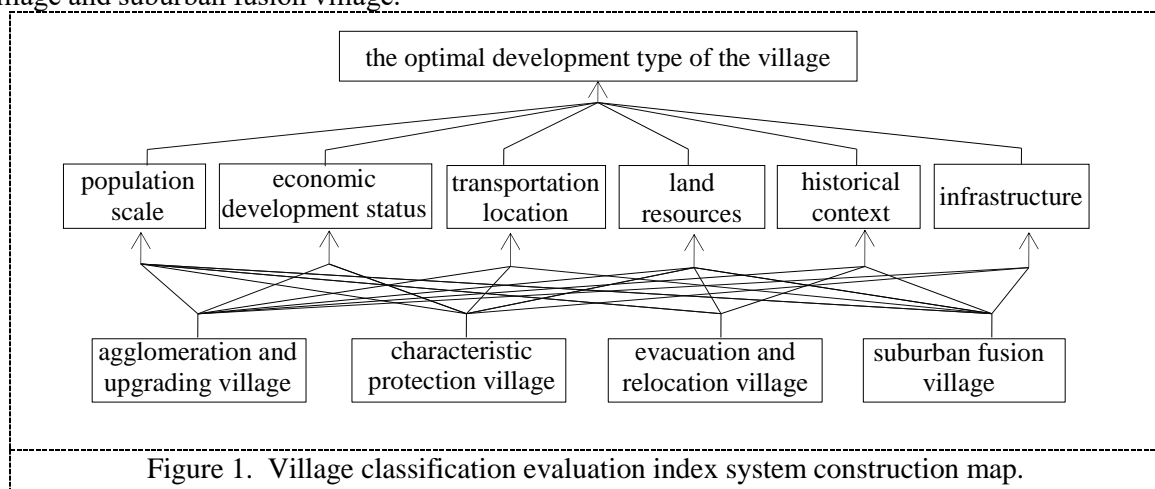

Figure 1. Village classification evaluation index system construction map.

Second, construct judgment matri*x*. The key to constructing a judgment matrix is what scale is used to represent the result of the pairwise comparison between elements. T. L. Saaty recommends using the 1 ~ 9 scale to characterize its importance. According to the model of village evaluation index

system, the 1~9 scale is used to compare the two arbitrary elements in the same layer to obtain the quantitative comparison result, which can get the judgment matrix between the indicators.

Finally, calculate weights and test consistency. After constructing the judgment matrix,the weight of each layer and eigenvector of the maximum eigenvalue of the judgment matrix are obtained. Then normalize eigenvector, and on this basis, the random consistency index of the matrix is tested. Generally speaking, if the random consistency index is less than 0.1, the judgment matrix is considered acceptable. At this time, the village type can be determined according to the weight of the scheme layer. Otherwise, the strategy needs to be readjusted to meet the requirements of consistency.

3. Village classification empirical research

3.1. General overview of the research area

This paper chooses Matangshan township (see figure 2) of Longhui county as the research object. Longhui county belongs to Shaoyang city, Hunan province. It is located in the upper reaches of the Zijiang River, slightly southwest of central Hunan province. It belongs to the subtropical humid monsoon climate. Its landform is high in the northwest and low in the southeast with dense rivers and abundant surface water resources. There are 966 administrative villages, 9670 villagers'groups and 40 community residents' committees in the county.
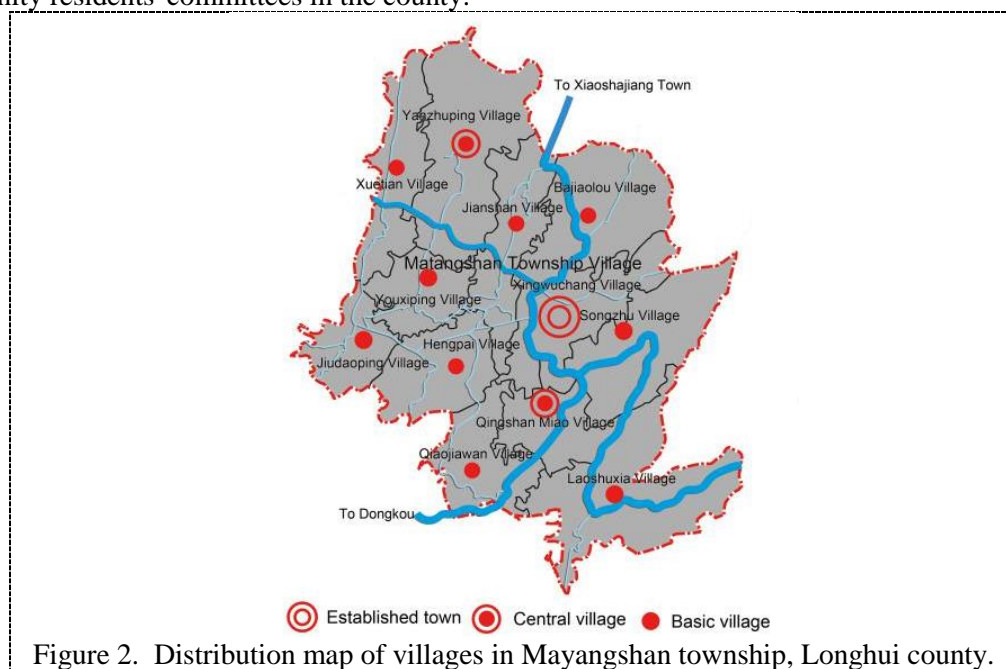

Figure 2. Distribution map of villages in Mayangshan township, Longhui county.

There are some reasons for selecting the Matangshan township in Longhui county for research.

Firstly, Matangshan Township of Longhui village is located in the mountainous area of northwest Longhui county. It is the slowest economic development area, and the limited land resources restrict the development of the village. In recent years, Longhui county is a region with shrinking trend of economy and population development. How to rationally classify 12 villages in Mayangshan township is a difficult problem to be faced in village planning.

Secondly, in China, most villages are facing similar development dilemmas to those in Matangshan village. For example, the lack of obvious location advantages, the inconvenience of transportation and the difficulty of external economic links lead to the developmnt of villages in a bottleneck stage or even gradually shrinking.

Thirdly, the current situation survey shows that 5 of the 12 villages in Matangshan township are at risk of geological disasters, so classifying these villages can provide reference for the classification of other villages suffering from geological disasters in China.

3.2. Classification of villages in Matangshan township

3.2.1. Village selection. This paper first selects Xingwuchang village for specific explanation. Xingwuchang village is located in the middle of Matangshan township and is in the center of the township administrative area. Compared with other villages, it has better infrastructure and better transportation.

3.2.2. AHP solution. First, establish a hierarchical structure. The target layer is the optimum village; The criteria layer is the six evaluation factors mentioned. The scheme layer is agglomeration and upgrading village, characteristic protected village, evacuation and relocated village and suburban fusion village.

Second, construct judgment matrix. Judgment matrix is used to express the relative importance of each layer relative to the upper elements. In order to reflect the scientific nature of decision-making, this paper consulted 10 experts, scored the relative importance of indicators in Xingwuchang village according to the experience of experts, and obtained pairwise comparison matrices of target layer and scheme layer respectively. By recording the matrix under the optimum village type in Xingwuchang village indicator as V. If the matrix under the index of the optimal type of rural development is

recorded as V, then
$$V=\begin{bmatrix} 1 & 5 & 1/2 & 1 & 2 & 4 \\ 1/5 & 1 & 1/2 & 1/3 & 1/3 & 1 \\ 2 & 2 & 1 & 3 & 3 & 5 \\ 1 & 3 & 1/3 & 1 & 1/2 & 2 \\ 1/2 & 3 & 1/3 & 2 & 1 & 1 \\ 1/4 & 1 & 1/5 & 1/2 & 1 & 1 \end{bmatrix}.$$

Similarly, population scale, economic development status, transportation location, land resources, historical context and infrastructure indicators are record as V1, V2, V3, V4, V5, V6, then the following matrix can be obtained:

$$V_1=\begin{bmatrix} 1 & 1/2 & 1/3 & 3 \\ 2 & 1 & 1/3 & 4 \\ 3 & 3 & 1 & 4 \\ 1/3 & 1/4 & 1/4 & 1 \end{bmatrix}, V_2=\begin{bmatrix} 1 & 2 & 4 & 2 \\ 1/2 & 1 & 2 & 2 \\ 1/4 & 1/2 & 1 & 1/4 \\ 1/2 & 1/2 & 4 & 1 \end{bmatrix}, V_3=\begin{bmatrix} 1 & 3 & 2 & 3 \\ 1/3 & 1 & 3 & 2 \\ 1/2 & 1/3 & 1 & 2 \\ 1/3 & 1/2 & 1/2 & 1 \end{bmatrix}, V_4=\begin{bmatrix} 1 & 2 & 2 & 5 \\ 1/2 & 1 & 2 & 5 \\ 1/2 & 1/2 & 1 & 6 \\ 1/5 & 1/5 & 1/6 & 1 \end{bmatrix},$$

$$V_5=\begin{bmatrix} 1 & 1/5 & 1/4 & 1/2 \\ 5 & 1 & 3 & 4 \\ 4 & 1/3 & 1 & 3 \\ 2 & 1/4 & 1/3 & 1 \end{bmatrix}, V_6=\begin{bmatrix} 1 & 5 & 5 & 3 \\ 1/5 & 1 & 3 & 1/3 \\ 1/5 & 1/3 & 1 & 1/3 \\ 1/3 & 3 & 3 & 1 \end{bmatrix}.$$

Third, calculating weights and testing consistency. For example, the optimum type of matrix for rural development is V. The column vectors of matrix V are normalized, and then the sum of rows is normalized. The corresponding weights from left to right can be obtained and recorded as W0, multiplying V by W_0. The result is [4.16, 4.18, 4.23, 4.16, 4.11, 4.20]. The maximum characteristic root is λ_{max}=6.47.

Similarly, the matrix of the remaining six indicators can be obtained by comparing them. The weight of population scale, economic development status, transportation location, land resources, historical context and infrastructure indicators can be recorded as W_1, W_2, W_3, W_4, W_5 and W_6. The corresponding maximum eigenvalues are λ_{1max}=4.16, λ_{2max}=4.18, λ_{3max}=4.23, λ_{4max}=4.16, $\lambda_5$max=4.11, λ_{6max}=4.20.

Finally, conduct consistency testing. The formulas for calculating consistency index and random consistency index are as follows:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{1}$$

$$CR = \frac{CI}{RI} \tag{2}$$

Among them, *RI* has the following relationship with *n* (see table 1):

TABLE 1. RELATIONSHIP BETWEEN *RI* AND *N*.

N	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

n is the number of criterion layers, where n is 6. For matrix V, *CI*=0.094, *CR*=0.075<0.1, indic inconsistency of the matrix V is within the allowable range. Similarly, the other six matrices pass consistency test. The scheme layer weight can be obtained by multiplying the target layer and the criterion layer weight, that is, W=(W$_1$, W$_2$, W$_3$, W$_4$, W$_5$, W$_6$)W$_0$=[0.33, 0.30, 0.12, 0.25].

3.2.3. Classification results of villages. The weights of each index obtained by Xingwuchang village after establishing the evaluation index system (see Figure 3). Through the scale of the weights, we can know that the optimal development type of Xinwuchang village is the agglomeration and upgrading type of village. According to the weight, the optimal development type of Xingwuchang village is the agglomeration and upgrading village. Because the current villages under the jurisdiction of Matangshan township have weak communication links with the external contact, most of the villages are not only restricted by the terrain, but also have a certain degree of closure. The Xingwuchang Village is located in the center of the township and the transportation location is more advantageous than other villages. Therefore, strengthening the connection between Xingwuchang village and the external transportation can create a situation of point-driven development.
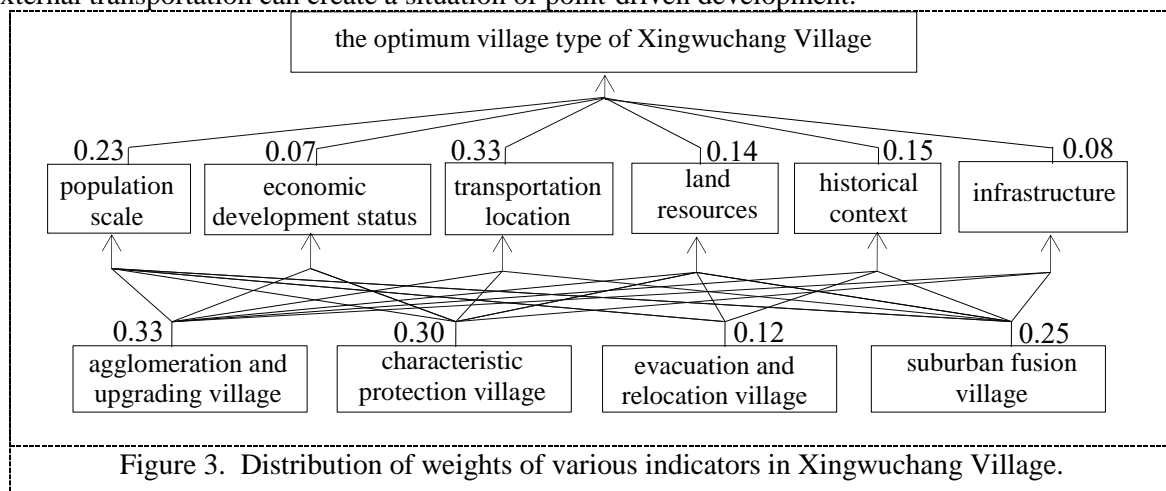

Figure 3. Distribution of weights of various indicators in Xingwuchang Village.

In the same way, according to the above method, the layout of the remaining 11 villages in Matangshan Township is obtained in turn (see table 2).

TABLE 2. MATANGSHAN TOWNSHIP VILLAGE CLASSIFICATION TABLE.

TYPE	Agglomeration and upgrading village	Characteristic protection village	Evacuation and relocation village	Suburban fusion village
VILLAGE	Xingwuchang village, Youxiping village	Jianshan village, Bajiaolou village, Hengpai village, Qiaojiawan village	Songzhu village, Laoshuxia village, Jiudaoping village, Yanzhuping village, Xuetian village, Qingshanmiao village	zero

4. Conclusion

The strategy of rural revitalization provides ideas for rural development in China, and puts forward new requirements for the classification of villages in the new era. In the context of rural revitalization, the construction of a scientific and reasonable evaluation index system to classify villages is the basis for determining the direction of village development and the breakthrough point for solving village problems. By investigating and analyzing villages, this paper effectively selects the most representative six evaluation factors of population scale, economic development status, transportation location, land resources, historical context and infrastructure to construct the evaluation index system of village classification, and then uses expert scoring and qualitative and AHP to analyze the results of village classification. Based on this, it is very important to construct a scientific and reasonable index system for village classification. It not only avoids the subjectivity of the designers and researchers in the classification of villages, but also avoids the blind development of villages under uncertain types.

This paper makes an empirical study on the village classification of Matangshan village in Longhui county, and classifies 12 villages of Matangshan township by AHP. As one of the slower developing townships in Longhui county of Hunan province In the context of rural revitalization, the construction of a scientific and reasonable evaluation index system to classify villages is not only the basis for determining the direction of village development but also the breakthrough point for solving village problems. By investigating and synthetically analyzing villages, this paper effectively selects the most representative six evaluation factors,namely population scale, economic development status, transportation location, land resources, historical context and infrastructure to construct the evaluation index system of village classification, and then uses AHP as well as expert scoring method to determine the results of village classification. Furthermore, it is important to construct a scientific and reasonable index system for village classification, which not only avoids the subjectivity of the designers and researchers when comes into the classification of villages, but avoids the blind development of villages.

References

[1]   Chen Yanbing 2017 Implementing the strategy of rural revitalization promoting the development of urban and rural integration--also on the experience of learning the report of the 19th national congress of the communist party of China *China Economic and Trade Guide* 3452-5.

[2]   Wang Jianjun, Zhao Huili and Dou Huijuan 2004 Research on optimization of transportation scheme based on AHP J*ournal of Shijiazhuang Railway Institute (Natural Science Edition)* **17** 245-48.

[3]   Meng Qiuli 2017 Research on Rural Tourism Environmental Protection Based on PSR Model of Evaluation Index System *Ecological Economy: Chinese Edition* **33** 4121-126.

[4]   Liu Jizhi 2018 Research on the Rural Tourism Environmental Protection beautiful rural areas in Tianjin based on AHP *South China Agriculture* V **12** 1707-109.

[5]   Liu Jianjun 2012 Discussion on the Evaluation Index System of Fairy Tales in Yunhe County *Modern Business Trade Industry* **24** 369-70.

[6]   Chen Xiaoli, Wu Haiyan 2018 Innovative urban-rural integration mechanism: the concept and path of rural revitalization *Journal of the Party School of Fujian Provincial Committee of the Communist Party of China* 121-7.

[7]   Wei Dalei 2018 Exploratory research on the revitalization of poor rural industries in inner Mongolia *Inner Mongolia Science Technology & Economy* 2417-18.