Red Study Greenway Route Selection at County Scale: A Case Study of Ji'an County, Jiangxi Province, China

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Abstract Using multi-source data like remote sensing images, resource point coordinates, road networks and land type, a suitability assessment system for red study greenway route selection is constructed with red study resource layer, traffic condition layer, ecological condition layer, and service radius layer as the selection elements. Analytic Hierarchy Process (AHP) and Delphi method aree used to determine the selection factors and weight allocation of each element, and the single factor evaluation and multi factor overlaying analysis are used to accurately identify suitable selection corridors. The potential position is determined based on the lowest cost path. Finally, the final red study greenway is obtained through manual optimization based on the current situation of the road network. The analysis results show that the areas with the highest suitability were those with the richest distribution of first, second, and third level red study resources. An effective connection of red resource points and various elements helps to enhance the competitiveness of red study tours in Ji'an County, providing a realistic path for selecting study greenways for cities rich in red resources.

Keywords Red study greenway, Route selection, Multi-source data, Suitability assessment, Indicator system

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The red study tour, an education tour on the history of revolution, is an important way to "inherit the red genes and continue the red bloodline". The red study tour greenway, which takes into account the ecological civilization attributes, is a scientific practice for the construction of a cultural power in the new era and has received widespread attention from all sectors of society. A scientific and reasonable plan of the study tour greenway route can ensure the smooth progress of study tour activities and the effective utilization of red resources, providing theoretical support for areas with abundant red resources but lagging behind in the construction of study tour greenways.

Located in the central northern part of Ji'an City, Jiangxi Province, Ji'an County is famous as a well-known tourist destination of "Luling Culture · Ecological Leisure" in Jiangxi Province, and is the backyard of leisure tourism in Ji'an City, Jiangxi Province, and even the Pearl River Delta. It is also an important service area for Jinggangshan tourism. Its regional characteristics and abundant resources provide important support for Ji'an City to achieve the simultaneous development of red study tourism, green ecological tourism, and ancient Luling culture tourism. Ji'an County has abundant red resources, including revolutionary historical relics, red cultural sites, and the former sites of revolutionary great figures, totaling 56 sites. However, these resources have not been fully utilized for a long time. In this study,

an evaluation model on red study resources is constructed to assess the suitability of red study greenways, and the route selection plan is determined for the red study greenway in Ji'an County, with the aim to help enhance the competitiveness of red study tours in Ji'an County.

1 Evaluation of red study resources

1.1 Determination of evaluation indicators for red study resources

In addition to discovering their own historical and cultural value, the evaluation on the quality of red study resources also needs to fully explore their regional characteristics, which means that while evaluating the attributes and influence of resources, it also needs to integrate with the evaluation indicators for regional added value[1]. Based on the classification and interrelationships of red study resources, the first level indicators for evaluating red study resources are selected with reference to the *National Red Tourism Development Plan Outline for 2004–2010 of China, Classification, Investigation and Evaluation of Tourism Resources* (GB/T 18972–2003), *Planning Specification for Scenic Spots* (GB 50298–1999) and other standards, and the selection of second level indicators is based on relevant literature on red culture and red resources in China, in accordance with the practical needs and regional characteristics of the development of the red

tourism industry[2-5].

1.2 Construction of the evaluation model for red study resources

Analytic Hierarchy Process (AHP) and Delphi method are used to construct the evaluation model. A judgment matrix is established and an AHP survey questionnaire is designed to conduct in-depth investigation and analysis of the opinions of experts in related fields such as historical and cultural heritage protection, tourism, transportation, and landscape architecture. Based on the scoring results, the weights of each level indicator are derived. To verify the reliability of the judgment matrix, the consistency ratio (CR) is used for evaluation[6].

$$CI=\lambda-n/n-1$$

$$CR=CI/RI$$

Where, CI is the consistency index; λ is the maximum eigenvalue of the judgment matrix; n is the number of factors; RI is the random consistency index.

1.3 Classification of red study resources

Vector coordinates and other relevant information of historical and cultural resource points are selected from the *Ji'an County Spatial Overall Planning* (2021–2035) database, from which the red study resource points are selected and evaluated. The indicators at each layer are scored on a percentage scale through on-site visits, questionnaire surveys, and expert scoring methods. Then, the score (C) and weight (W) of each indicator are inputted into the following red study resource evaluation model:

$$S=\sum_{i=1}^{n}W_iC_i$$

Where, S is the final score of the evaluation object; i is the count of evaluation indicators for red study resources; W_i is the weight value of the ith evaluation indicator ($0<W_i<1$), C_i is the score of the ith evaluation indicator ($0<C_i<100$); n is the number of evaluation indicators for red study resources[7].

In the process of selecting the route for the study greenway, the priority of connecting red study resources varies with their importance. On determining these priorities, relevant index grading methods[8] are comprehensively considered to ensure that the selected route reflects the importance and value of the resources. According to the final score (S), the evaluation level of red study resources is divided into 3 levels from high to low: those of 80−100 points are classified as first level red study resources, 60−79 points are second level, and below 60 points are third level.

2 Suitability assessment of the red study greenway route selection
2.1 Construction of suitability asse–ssment system

Taking into overall account of the functions of county-level red study greenways and the development of the red research industry, a total of 15 representative influencing factors are selected by integrating the research methods of relevant scholars at home and abroad in greenway route selection[9-10], namely, first level red study resources, second level red study resources, third level red study resources, national highways, provincial highways, county roads, township roads, elevation, slope, natural disasters, water systems, red tourism scenic spots, central urban areas, key towns, and general towns. The influencing factors are graded based on the importance of the relationship with red study greenway route selection, with scores of 9, 7, 5, 3, and 1. The scores are positively correlated with the evaluation.

2.2 Single factor suitability assessment

ArcGIS spatial analysis is used to grade the 15 route selection factors of first level red study resources, second level red study resources, third level red study resources, national highways, provincial highways, county roads, township roads, elevation, slope, natural disasters, water systems, red tourism scenic spots, central urban areas, key towns, and general towns, according to their corresponding levels, and the final score values are integrated into the corresponding spatial data, forming a grid layer for suitability assessment of 15 selection factors.

2.3 Multi factor overlaying analysis

Together with predetermined weight values, the weighted sum tool in ArcGIS is used to conduct a weighted overlay analysis on the 15 grid layers mentioned above to obtain the suitability assessment results of the red study greenway route selection in Ji'an County based on spatial analysis and multi factor comprehensive evaluation. The results show that the areas with the highest suitability are concentrated in the central and southern parts of the county, mainly located within the radiation range of the red tourism scenic spots defined in the *Ji'an County Tourism Development Overall Plan*, making them the areas with the richest red resource points. The areas with high suitability are mainly located in the eastern part of the county, as they are close to the central urban area with small terrain undulations and flat terrain, providing strong support for the feasibility of the construction of red study greenways. Areas with high suitability also include areas where roads and rivers pass through, which have relatively flat terrain and convenient transportation, making them suitable as extension routes or connection points for red study greenways.

3 Research on the selection of red study greenway routes in Ji'an County
3.1 Potential route generation

The identified red study resource points and comprehensive cost surface are used as data sources to get the lowest cost path between the corresponding connection points using "cost connectivity" tool with the red study resource points within the research area as important connection nodes for greenway route selection (Fig.1). By referring to the economic principles in the *Guide for Design of Greenway Planning*, the simulation results of the red study greenways are overlaid with the existing road network to obtain the potential route for the construction of the red study greenway in Ji'an County (Fig.2).

The results show that the generated red study greenways in Ji'an County connect various red study resource points, covering the entire county. The path selection mainly centers around high suitability areas, and the greenway routes
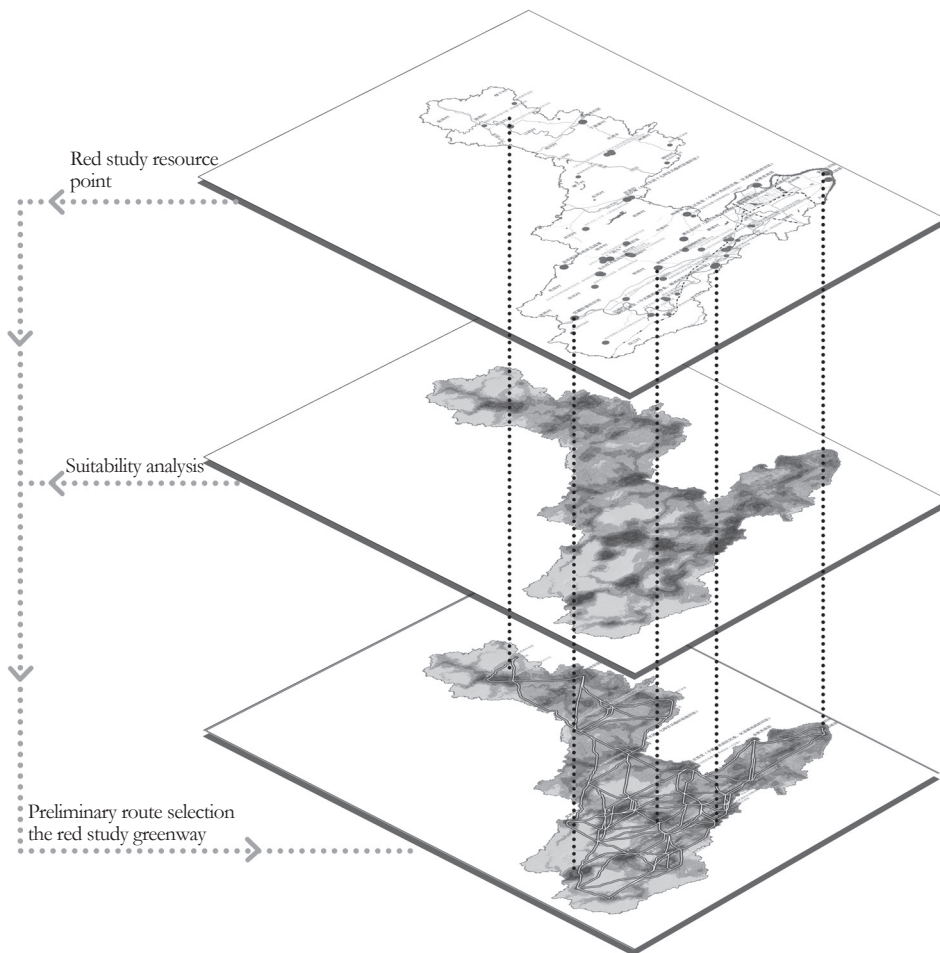

Red study resource point

Suitability analysis

Preliminary route selection the red study greenway

Fig.1 Red study greenway route selection and planning guidelines

are most dense in the areas with more red study resource points in the central and southern parts of the county.

3.2 Route selection correction and optimization

The results show that Yongyang Town, Antang Township, Guantian Township and Aocheng Town are the core areas which are most suitable for the construction of red study greenways in Ji'an County, embracing the most dense greenway routes. The main reason is that the selected areas has abundant first, second, and third level red study resources, including

the former residences of historical figures such as Peng Dehuai, General Zhou Guanwu, and General Liu Huachun, as well as the occurring places of important historical events such as the sites of the 49 Uprising and the Gongtang-Hengjiang Uprising Public Trial Conference, and the former stations founded during the Anti Japanese War, such as the Shide Hall of the Xiaos, the Office of Xiao Jingao, and Zhenglun Hall of the Lius. The concentrated distribution of these red study resources provides rich cultural resources and historical value for greenway route selection, and the convenient

transportation between different regions make it possible to achieve effective connection through the existing road network, which extends south to Taihe County, east to Jizhou District, and west to Yongxin County, forming a complete red study greenway route.

4 Conclusion and prospect

Based on the suitability assessment, a preliminary site selection plan for suitable red study greenways is selected and organized from the evaluation results of important red resources in Ji'an County through single factor evaluation and multi factor overlaying analysis with consideration given to the quality and weight of the selection factors for the red research resource layera. Yongyang Town, Antang Township, Guantian Township, and Aocheng Town are selected as the core areas, which are also the areas with the richest distribution of first, second, and third level red study resources. In addition, the effective connection of existing road networks and rivers forms a complete red study greenway route extending south to Taihe County, east to Jizhou District, and west to Yongxin County. This route selection plan aims to maximize the utilization of the rich red study resources in Ji'an County, together with the local excellent ecological resources, to enhance the depth and breadth of the red study experience, thereby improving the competitiveness of local red study tourism. The focus of this study is to explore and promote red culture, improve the selection mechanism of red study greenways with the goal of "red study + ecological civilization" development, and provide favorable support for the planning and implementation of future red study greenways.

Fig.2 Potential route generation results

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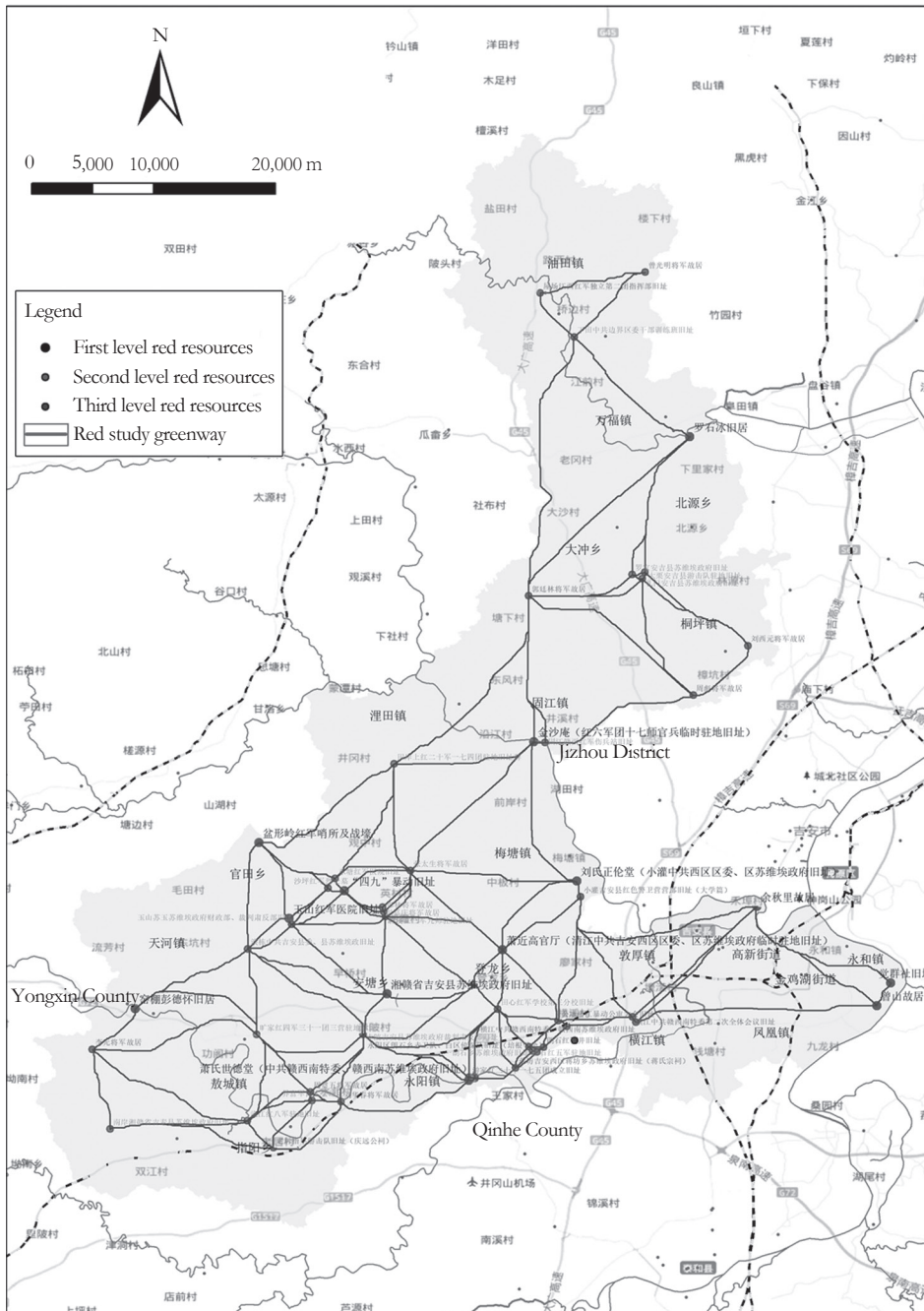[4] Wang, X. (2024). Multidimensional value and implementation path of red cultural resources

possesses distinct advantages that should be strategically leveraged to position the pagoda as a focal point of cultural tourism. Pagoda cultural tourism not only fosters the diversification of cultural and creative products but also facilitates the introduction of pagoda-related merchandise, including keychains, block models, and mugs. These products serve to integrate the rich history and culture of the pagoda into everyday life, thereby enhancing public awareness and emotional connection to this cultural heritage.

3.6 Strengthening residents' participation

To ensure the continued vitality of the Jingzhou pagoda, it is essential to prioritize the engagement and contributions of its residents. By participating in a range of cultural events, craft bazaars, musical performances, and other activities in the vicinity of the pagoda, residents can enhance their respect for and sense of belonging to this significant landmark. Residents are afforded the opportunity to apply for volunteer positions in the daily maintenance, environmental cleaning, and patrolling activities associated with the pagoda, as well as in the pagoda conservation program. These roles involve engaging in straightforward, less specialized tasks, such as conducting daily observations and monitoring the structural safety of the pagoda. Additionally, residents may serve as tour guides or cultural interpreters, offering visitors a comprehensive introduction to the historical context and distinctive features of the pagoda, thereby enriching the overall visitor experience.

4 Conclusions

The advancement of modernization has raised an urgent question regarding the optimal integration of the pagoda, a valuable architectural cultural heritage, into contemporary urban culture. This integration aims to enhance the soft power of the local Jingchu culture and increase the appeal of cultural tourism. In the context of urban planning and social development, it is essential to prioritize the preservation and transmission of architectural cultural heritage. This approach not only enhances the distinctive characteristics of such heritage within contemporary urban environments but also offers citizens and tourists an opportunity to engage with historical and cultural narratives. In conclusion, by implementing scientifically informed and suitable conservation and transmission strategies, it is feasible to ensure that the Longevity Pagoda will persist in showcasing its unique historical, cultural, and social significance in the future.

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