

Research on Urban Greenway Planning in the Old City of Jinan City Based on GIS Interpretation and Gravity Model Data

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ABSTRACT

Urban greenway planning is not only an important part of the construction of ecological cities and urban forest ecological network systems, but also a necessary means and an effective way to build urban ecological gardens and ecological green space systems. The link of the city plays a vital role in protecting the cultural and ecological civilization of the old city, and protecting the ecological environment, natural landscape, cultural relics and historical sites and local features along the line. This study selects the old urban area of Jinan City as the research area, uses GIS (geographic information system) remote sensing interpretation, conducts data analysis, conducts comprehensive performance evaluation of the area, selects the best connection paths and landscape nodes, and establishes the gravity model of urban greenways.

Keywords: Eco-environmental protection construction; expert evaluation method; gravity model; urban greenway planning

1. OVERVIEW OF JINAN OLD TOWN AREA

The old city area of Jinan is planned to take Lishan Road, Jingshi Road, Shunhe Elevated Road and Beiyuan Street as the planning scope, with an area of 10.28 square kilometers. The planning area mainly takes the ancient city as the core, infiltrates the surrounding area, and connects the main historical and cultural attractions and leisure landscapes outside the ancient city (see Figure 1).

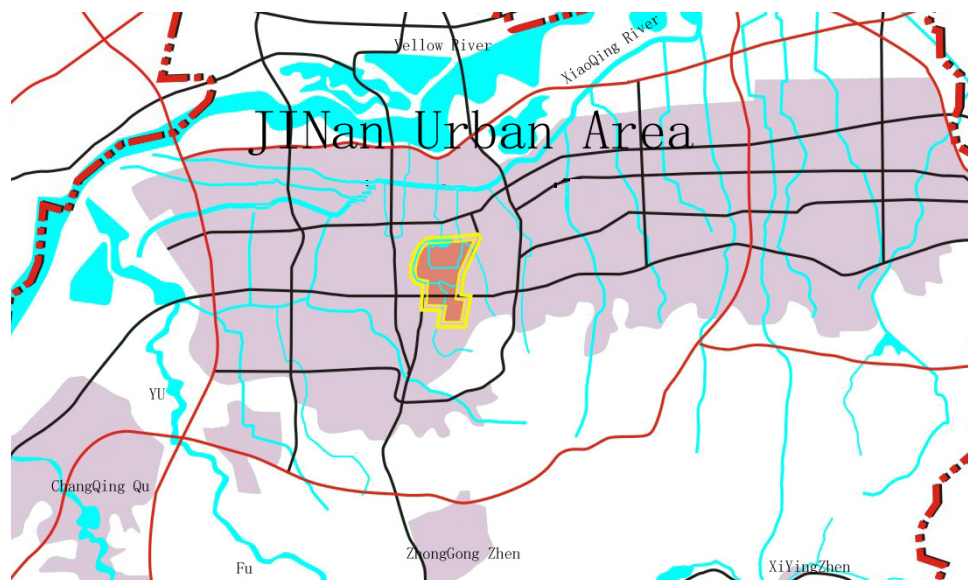


Figure 1. Location map of the old city

2. GIS REMOTE SENSING INTERPRETATION

2.1 Data Sources

The image formed by HRV (High Resolution Visible Light Scanner) has the excellent characteristics of high ground resolution, accurate positioning and better image resolution than TM and MSS images [1]. Therefore, this study selects the SPOT5 (see Figure 2) satellite remote sensing image of Jinan City as the source of interpretation information, and the red tick area in the image is the study area [2].



Figure 2. Color satellite image of the old city area

2.2 Classification of land use types based on the interpretation data, combined with the interrelationships between the topography

According to the spectral identification characteristics of the obtained remote sensing images and the distribution of land in the study area, combined with the national classification standard of the nature of urban land, the land division of the two areas was extracted [3].

2.3 Selection of evaluation factors for urban greenways

8 connection paths and 24 landscape nodes are determined in the old urban area as the object of this comprehensive evaluation [4].

3. EVALUATION OF GREENWAY PATHS AND LANDSCAPE ELEMENTS IN THE OLD CITY AREA

According to the established evaluation criteria, Delphi expert scoring method was used to evaluate and score the greenway paths and landscape elements in the old city area, and each landscape element was graded equally. Road planning provides data support and basis for route selection (see Table 1).

A total of 8 expert scoring sheets were distributed in this study, and 6 were returned. The experts included 3 professors of urban planning and landscape planning, 2 associate professors, and 2 senior planners of urban planning [5].

Table 1. Comprehensive evaluation of landscape factors in the old city

type		number	name	overall ratings
path	Water system	1	moat	2.3
	main road	1	Lishan Road	1.85
		2	Shunhe Street	1.65
		3	Minghu Lake Road	1.40
		4	Daming Lake Road	2.25
		5	Quancheng Road	2.15
		6	Luoyuan Street	1.85
		7	Jingshi Road	2.05
node	Natural and Human Resources	1	Baotu Spring Park	3.10
		2	Daming Lake Park	3.10
		3	Qianfoshan Park	3.10
		4	Spring City Square	2.95
		5	Huancheng Park Black Tiger Spring Section	3.00
			East Section of Huancheng Park	2.45
		6	Wulongtan Park	2.80
		7	Quancheng Park	2.35
		8	Pearl Spring Park	2.45
	historical and cultural district	1	Furong Street - Qushuiting Historical and Cultural District	2.80
		2	General Temple Historical and Cultural District	1.98
		3	Qilu University Historical and Cultural District	1.85
		4	Qilu Hospital Historical and Cultural District	1.65
	ancient artifacts	1	Liberation Pavilion	2.30
		2	Muslim South Temple	1.45
		3	Muslim North Temple	1.25
		4	Guangzhi Institute	1.30
		5	Wanzi Charity	1.45
	Cultural and sports facilities	1	National Fitness Center	2.10
		2	sports center	2.45
		3	Huangting Gymnasium	1.25
		4	Youth Palace	1.35
	commercial facility	1	Quancheng Road Commercial District	3.05
		2	Ginza Mall	1.95
		3	County West Lane Commercial Street	1.65

According to the comprehensive evaluation results, the greenway paths in the old city area are easily selected as the moat, Daminghu Road, Quancheng Road, and Jingshi Road; important nodes include Baotu Spring Park, Daming Lake Park, Qianfoshan Park, Quancheng Square, Huancheng Park, five Longtan Park, Quancheng Park, Rongjie-Qushuiting Historical and Cultural District, Sports Center, and Quancheng Road Commercial District [6].

4. CONSTRUCTION OF GRAVITY MODEL IN OLD CITY AREA

Gravity models can help identify effective green road networks. The most common evaluation method is the interaction between nodes, that is, the gravity model (Sklar and Conssar, 1991). The model calculates the interaction between node a and node b as follows:

$$Gab=(Na \times Nb)/(Dab)^2 \quad (1)$$

Based on the current situation of land use and vegetation in the planning and research area, combined with the conclusion of comprehensive evaluation of landscape factors, the old city area is summarized and screened. It shows that the greater the impact and importance of nodes on urban construction (see Table 2).

For the first-level node, the comprehensive evaluation index is greater than 2.5. Including Baotu Spring Park, Wulongtan Park, Quancheng Square, Quancheng Road Commercial Street, Huancheng Park (Black Tiger Spring Park), Daming Lake Park, and Qianfoshan Park;

Secondary node, comprehensive evaluation index 2.0-2.5. Including Furong Street-Qushuiting Historical and Cultural Block, Pearl Spring Park, National Fitness Center, Sports Center, Spring City Park, and the eastern section of Huancheng Park;

The third-level node, the comprehensive evaluation index is 1.0-2.0, including the Jiangjun Temple historical and cultural block, the Qilu University historical and cultural block, the Qilu Hospital historical and cultural block, the Ginza shopping mall, and the Xianxixiang commercial street.

Table 2. Gravity index of first-level nodes in the old city

	Baotu Spring Park	Wulongtan Park	Spring City Square	Quancheng Road Commercial Street	Black Tiger Spring garden	DaMing Lake	Qianfoshan Park
Baotu Spring Park	--	34.72	36.58	14.74	4.04	3.32	3.10
Wulongtan Park	34.72	--	9.85	9.38	3.28	5.10	1.10
Spring City Square	36.58	9.85	--	56.23	9.38	4.05	1.65
Quancheng Road Commercial Street	14.74	9.38	56.23	--	13.82	4.57	1.50
Black Tiger Spring garden Black Tiger Spring garden	4.04	3.28	9.38	13.82	--	3.55	1.49
DaMing Lake garden	3.32	5.10	4.05	6.57	3.55	--	1.20
Qianfoshan Park	3.10	1.10	1.65	1.50	1.49	1.20	--

In the old city, there are 9 corridors with a gravity index greater than 5.0, which are Baotu Spring Park-Wulongtan Park, Baotu Spring Park-Quancheng Square, Baotu Spring Park-Quancheng Road Commercial Street, Wulongtan Park-Quancheng Square, Wulongtan Park-Quancheng Road Commercial Street, Wulongtan Park-Daming Lake Park, Quancheng Square-Quancheng Road Commercial Street, Quancheng Square-Black Tiger Spring Park, Quancheng Road Commercial Street-Black Tiger Spring Park. There are 57 secondary corridors with a gravity index of 2.00-5.00.

Connect the first-level corridors to each other to obtain the gravity model of the old city (Figure 4).

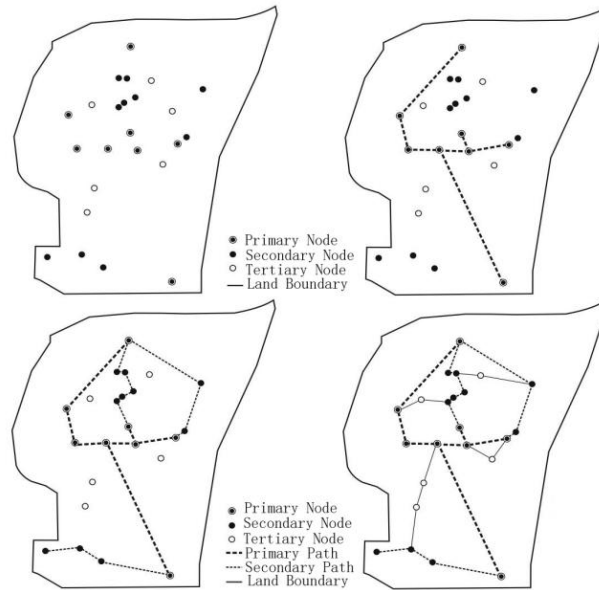


Figure 3. Construction of the gravity model in the old city area

5. URBAN GREENWAY PLANNING IN THE OLD TOWN OF JINAN CITY

Taking into account the special historical and cultural position of the old city in Jinan City, the future planning and functional positioning, the planning and formation of a "one main, one ring" urban greenway layout system [7].

5.1 Main axis greenway design

According to the "Jinan City Master Plan", the old city is the core area of the historical and cultural main line of the city's Shanquan Lake [8]. The planning combines the current landscape resources and landscape paths [9] to form a north-south area connecting Xiaoqinghebei Lake Park in the north and Qianfoshan Scenic Spot in the south. The greenway to the main city forms a new space carrier of Jinan's history and culture [10].

5.2 Greenway Design of Huancheng Park

The current situation of the old city ring park includes three sections of the east, south and west of the Huancheng River. The current moat is located inside the Daming Lake Park. Therefore, the old city is planned to rely on the existing moat section, and it is planned to increase the traffic and sightseeing urban green areas along Daming Lake Road. Roads are connected to form a ring-shaped urban greenway surrounding the core area of the old city.

6. CONCLUSION

A good ecological environment is the most equitable public product and the most inclusive people's well-being. China regards addressing climate change and energy conservation and emission reduction as an important part of building a beautiful China and a beautiful city. It accelerates the construction of climate-adaptive cities and increases urban greenways and parks. The selection of urban greenways in Jinan should rely on natural elements such as mountains, rivers, and valleys as much as possible, and connect cultural elements such as representative cultural relics and traditional blocks, fully reflect the style of the spring city, and build the integration of mountains, springs, lakes and cities. Based on the comprehensive evaluation of the main natural and human landscape elements in Jinan, the research will comprehensively optimize the construction plan of the urban greenway ecological network, and maximize the overall ecological benefits of the urban greenway network. Using GIS technology to analyze the old urban area and plan the greening layout accordingly can promote the ecological and scientific development of the old urban area and improve the happiness of residents' life.

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