Research on the Strategies of Rural Revitalization and Development Aided by Urban-Rural Greenways under the Concept of Ecological Green Health and Wellness Using Ji'nan Dangjia District as a Case Study

Fei Wang*, Wenrui Wang, Daohu Zhong
Shandong Institute of Commerce and Technology, Jinan, Shandong, China
**Corresponding Author.*

Abstract: Returning to the countryside and establishing rural ecological health and wellness tourism routes is a new content in the current development of rural tourism. This article selects the Dangjia District of Ji'nan City for GIS analysis, establishes a landscape evaluation system, and constructs an attraction model. Based on the data, a scientific greenway planning and homestay development scheme is made.

Keywords: Ecological Health and Wellness; Urban-Rural Greenways; GIS Analysis; Gravitational Model; Greenway Planning

1. Introduction

On June 1, 2020, China's first national standard for ecological health and wellness, the "Ecological Health and Wellness Base Evaluation Standard", was implemented, providing a practical basis for rural ecological health and wellness tourism.[1] According to the psychological and physiological characteristics and needs of the elderly, middle-aged, and young people, returning to the countryside reduces the risk of respiratory and allergic diseases. The cost of living is low, and it satisfies the traditional concept of returning to one's roots. Through road protective green spaces, riverside green spaces, abandoned railway parks, etc., urban and rural areas are connected with large ecological patches such as villages and suburbs, establishing a greenway ecological network system throughout the city and even larger regions.

Based on the suburban advantages of Ji'nan Dangjia District, with convenient transportation, vast land, beautiful scenery, and a tranquil environment, we aim to create a "shared farm + health and elderly care + leisure vacation" homestay cluster and tourism planning to boost the revitalization and development of rural areas.[2]

2. Overview of the Dangjia District

The Dangjia District is located in the southwest of Ji'nan City and is the main entrance and exit for external transportation in the southwest direction of Ji'nan City. The area ranges from the second ring road south and the railway connection line to the north, Ma Wuzhai Mountain and Weizi Mountain to the east, Ma'anshan Mountain Ridge to the south, and the Beijing-Fuzhou Expressway to the west, covering a total area of 70.8 square kilometers (as shown in Figure 1).

Figure 1. Location Map of Dangjia District

Within the district, there is the Dangjia Village Train Station, with a private railway spur of 0.9 kilometers, making transportation very convenient. The southern part of the district consists of low hills, while the northern part is relatively flat, with a terrain that slopes from high in the south to low in the north. The district has two main rivers, the Yufu River and the Dougou River.

3. GIS Analysis Plan for Dangjia District

Greenway

In ArcGIS 9.3, using the Clip digital software, the research area within the Dangjia planning district was clipped out. The vector map data was imported into the database, and with reference to existing topographic maps, combined with field research, information about green spaces and roads in the district was extracted. A database categorizing the land usage in the district was established. Through data analysis, the final thematic map library required for planning and design was obtained.[3]

4. Landscape Assessment of Dangjia District Greenway and Construction of Gravitational Model

4.1 Establishment of the Evaluation System

The research focuses on four main functions of urban greenways: ecological function, leisure and recreation function, economic development function, and social, cultural, and aesthetic function. We selected factors to evaluate the comprehensive efficiency of the Dangjia District Greenway, established criteria for selecting urban greenways and evaluating landscape nodes, and invited experts in landscaping and urban planning for the first round of comprehensive evaluation, assigning weights to each factor.[4]

Based on field research and relevant data analysis, the Dangjia District identified 9 connecting paths, including 3 river paths, 6 urban road paths, and 12 landscape nodes (as shown in Table 1).

Table 1. List of Main Evaluation Objects in Dangjia District

Category	Type	Serial Number	Name	Range	Area (ha)	Level	Landscape Quality
Connecting Paths	Water System	1	Yufu River	15 km long		Major City River	Better landscape south of G104
		2	Dougou River	10.6 km long			Average
		3	Da Jianguo River	Total length of 4.8 km			Poor
	Main Roads	1	Jinpu Railway	National Railway	35m wide		Good
		2	220 National Road	Major City Road	45m wide		Average
		3	104 National Road	Major City Road	40m wide		Average
		4	Heavy Vehicle Road	Main District Road	30m wide		Good
		5	Dang Ke Road	Main District Road	20m wide		Average
		6	Yin Family Road	Main District Road	15m wide		Average
Landscape Nodes	Suburban Green Land	1	Tiger Cave—San Wang Village—Da Wang Village	Southwest of the District, west of Yufu River	42.75		Good
		2	Double Mountain Point—Weizi Mountain	South of the District, east of Yufu River	19.07		Good
		3	Jue Mountain—Open Mountain—Ma An Zi Mountain	Southeast of the District, east of Yufu River	32.70		Good
	Historical Monuments	1	Tomb of Yin Ge Lao	North foot of Jiwei Road		City Preservation	Good
		2	Dangxi Mosque	Dangxi Village	0.167	District	Good

					4	Preservation	
		3	Dangdong Mosque	Dangdong Village	0.1841	City Preservation	Excellent
		4	Jiuding Mountain Qingfeng Cave	South of the Ring Road		District Preservation	Good
	Cultural and Sports Facilities	1	District Service Center	South side of Jiwei Road			Good
		2	Zhiyuan Bilingual School	East side of Dangyang Road	8.74		Average
		3	Dangjia Junior High School	Dangjia Village, Dangxi	3.8	Provincial	Excellent
		4	Women's Experimental Middle School	Southeast of Damiao Tun Village	7.18`	City	Excellent
		5	Ji'nan Third Middle School	South side of 104 National Road	12	Provincial Key	Average

4.2 Dangjia District Urban Greenway Evaluation Results

Based on the established evaluation criteria, the Delphi expert scoring method was used to evaluate and score the greenway paths and landscape elements of Dangjia and the old urban districts.[5] Each landscape element's grade and score were determined, and a weighted calculation was used to obtain a comprehensive score. This provides data support and selection basis for the greenway planning of the two districts (see Table 2).

For this study, 8 expert scoring sheets were distributed, 6 were collected in return. Experts included 3 professors in urban and landscape planning, 2 associate professors, and 2 senior urban planning specialists.

Table 2. Dangjia District Landscape Factors Comprehensive Evaluation

Type		Number	Name	Overall Score
Pathway	Water System	1	Yufu River	2.00
		2	Dougou River	1.55
		3	Dajiangou River	0.75
	Main Road	1	Jinpu Railway	1.45
		2	220 National Road	1.05
		3	104 National Road	2.05
		4	Heavy Vehicle Road	1.75
		5	Dangke Road	1.05
		6	Yinjia Road	0.85
Node	Rural Green Area	1	Tiger Cave	1.75
		2	Weizi Mountain	1.40
		3	Jue Mountain	1.25
	Historical Monument	1	Yinge Lao Tomb	0.85
		2	Dangxi Mosque	0.66
		3	Dangdong Mosque	1.85
		4	Jiuding Mountain Qingfeng Cave	0.55
	Cultural and Sports Facility	1	District Public Service Center	1.85
		2	Zhiyuan Bilingual School	0.55
		3	Dangjia Junior Middle School	0.65
		4	City Girls' Experimental School	0.70
		5	Jinan Third Middle School	1.65

Comprehensive evaluation results indicate the preferable greenway paths in Dangjia District to be Yufu River, Dougou River, 104 National Road, and Heavy Vehicle Road.

Key nodes include the intersection of Yufu River and 104 National Road, Tiger Cave—San Wang Village—Da Wang Village, Dangdong Mosque, and the District Public Service Center

4.3 Establishment of the Urban Greenway Gravity Model for the Dangjia District

The most common evaluation method involves the interaction between nodes, known as the gravity model [5]. Na and Nb represent the weight values of node a and node b respectively. The level function between nodes can be used to represent the importance of the green link. Dab represents the distance between the centroids of node a and node b, while Gab, the gravity index, denotes the interaction level between node a and node b. Generally, the greater the importance and the closer the distance, the smaller the "friction," resulting in a larger interaction.[6]

The formula for calculating the mutual influence between node a and node b is as follows:

$$G_{ab} = (N_a \times N_b)/(D_{ab})^2 \quad (1)$$

Based on the current status of land use and vegetation in the planning research area and combined with the conclusions of the comprehensive evaluation of landscape factors, the study summarized and filtered the Dangjia and Old City areas respectively. According to the different nodes affecting urban landscape and the intensity of citizen participation, they were divided into 3 levels. The higher the level, the greater the influence and importance of the node to the construction of the urban greenway.

First-level nodes include the Yufu River 104 National Road node, Tiger Cave—Sanwangzhai—Dawangzhai, Jinan Third Middle School, Dangdong Mosque, and the District Public Service Center.

Second-level nodes include the City Girls' Experimental School, Dangxi Village, Mountains and Rivers Group, and Tiger Cave.

Third-level nodes include Yinge Lao Tomb, Shaoxi Village, Phoenix Mountain, and Dougou Village.(in Table 3)

Table 3. Gravity Index of Primary Nodes in Dangjia District

	Yufu River 104 National Road Node	Tiger Cave—Sanwangzhai—Dawangzhai	District Public Center	Jinan Third Middle School	Dangdong Mosque
Yufu River 104 National Road Node	——	2.61	5.54	0.51	2.43
Tiger Cave	2.61	——	0.85	1.15	5.88
Combined Medical University	5.54	0.85	——	7.10	1.10
Jinan Third Middle School	0.51	1.15	7.10	——	1.05
Dangdong Mosque	2.43	5.88	1.10	1.05	——

In the Dangjia district, corridors with a gravitational index greater than 5.00 are considered first-level corridors, of which there are 3: Yufu River—District Public Center, District Public Center—Jinan Third Middle School, and Dangdong Mosque—Tiger Cave. Corridors with a gravitational index between 2.00-5.00 are considered second-level corridors, totaling 31. Connecting the first-level corridors derives the gravitational model of the Dangjia district (as shown in Figure2).

5. Urban Greenway Layout Planning in Dangjia District

Taking into account the current construction conditions of the district, the requirements of higher-level planning, and based on the comprehensive efficiency evaluation of the influencing factors of the urban greenway in the Dangjia district, the district forms a “one vertical, one ring, one branch” urban greenway system (as shown in Figure 3).

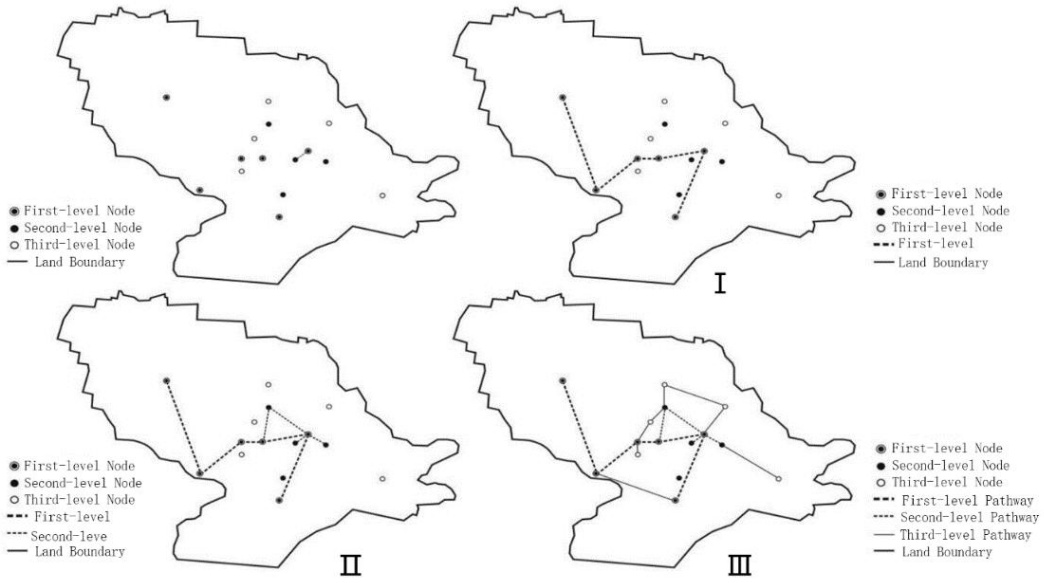

Figure 2. Construction diagram of the Gravitational Model in the Dangjia District

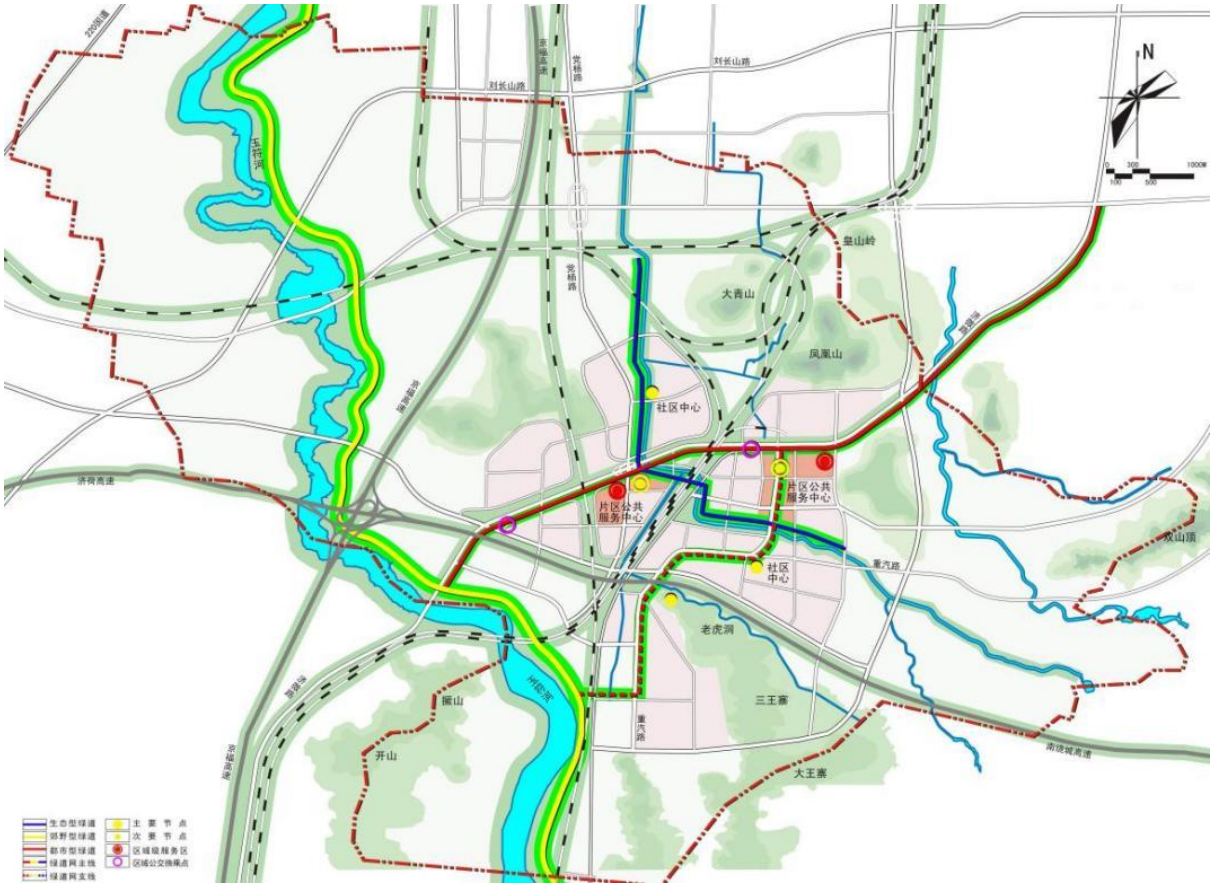

Figure 3. Layout Planning Diagram of the Greenway System in Dangjia District

5.1 One Vertical

Along the Yufu River ecological greenway. The Yufu River is the third largest river in Jinan. The city's master plan dictates that both sides should maintain 3-5 kilometers of ecological forest land, forming the main green ecological barrier and green buffer zone in the eastern part of Jinan.[7]

Greenway Nature: Suburban urban greenway, one of the main greenways connecting the western part of Jinan to the southern mountainous area.

Greenway Route: Along the Yufu River, north to the Jixi National Wetland and south to one of the sources, the Wo Hu Mountain Reservoir.

Greenway Length: The length within the district is 13 kilometers.

5.2 One Ring

Urban Greenway Nature: Urban green slow-walking path, connecting various groups within the district.

Urban Greenway Route: The planned circular path is formed by connecting two slow-walking paths along the 104 National Road and the Zhongqi Road with the urban greenway along the Yufu River.

Among them, the greenway along the 104 National Road combines the construction of auxiliary urban roads and green belts on both sides, with a length of 6.5 kilometers within the district; the greenway along the Zhongqi Road is 5.2 kilometers long, connecting the center of the group on the south side of the Jinpu Railway.

Urban Greenway Nodes: Along the 104 National Road greenway, it connects the planned district public service center, central group community center, city third middle school, and the combined university of traditional Chinese and Western medicine;

Along the Zhongqi Road greenway, it connects the Zhongqi Group, the main natural landscape nodes of Tiger Cave—Sanwangzhai—Dawangzhai Mountain green suburban park, the main historical building Dangdong Mosque, the southern group community center, and the district public service center.

5.3 One Belt

Urban Greenway Nature: The Dougou River in the central part of the district is the main spatial carrier of the public green space in the master plan. The urban greenway is planned to be constructed along the river as a recreational urban greenway for city residents.[8]

Greenway Length: Planned length is 5.5 kilometers.

Urban Greenway Nodes: Connecting Dangjia Middle School, Jinan Girls' Experimental School, and the district's three major residential groups.

6. Construction of Shared Farms + Health & Elderly Care Homestays and Farm Planning Design along the Dangjia District Greenway

6.1 Dangjia District Shared Farm Landscape Planning Design

The shared farm in the Dangjia district is designed as a green, eco-friendly landscape, emphasizing the integration of nature and culture. A vast amount of locally suitable green plants are preserved or planted, creating a pleasant environment and enhancing the feel of greenery and natural elements. Within the Dangjia district shared farm, facilities such as elderly care homes, rehabilitation centers, and gyms are constructed, all staffed with professional medical personnel to cater to the wellness needs of the elderly.

A certain proportion of land in the Dangjia district is allocated for farmland, where organic vegetables, fruits, and other crops are cultivated. These crops can provide fresh and healthy ingredients for residents, used in health and dining activities. Flowerbeds, lawns, and other areas can also be developed, creating farm landscapes for residents to stroll or rest.

6.2 Dangjia District Health & Elderly Care Homestay Planning Design

The planning design for the health and elderly care homestays in the Dangjia district focuses on comfort and convenience. Room arrangements prioritize a comfortable living environment, taking into account the special needs of the elderly, such as setting up barrier-free passages, bathroom handrails, etc., to ensure residents' safety and convenience.

Within these homestays, shared facilities like recreational areas, fitness zones, libraries, and activity rooms can be set up. These facilities offer places for the elderly to relax, entertain,

and socialize, promoting interactions among them. Utilizing natural light, optimizing views, and providing outdoor relaxation areas, gardens, or balconies allow the elderly to relax in natural settings. A health management system is established, offering regular health check-ups, health education, and rehabilitation care services. Medical care areas are set up, staffed with professional medical personnel, providing timely medical services.[9,10]

7. Conclusion

Urban greenways inherently possess strong natural attributes, and their composition and form are intricate. Different types of urban greenways emphasize different functions and roles. Urban greenways extend beyond just green urban corridors and slow transit systems. The construction of urban greenways should accentuate their multifunctionality, incorporating more history, culture, sports, education, and tourism, ensuring that they reflect city-specific traits while embodying urban character and culture. The selection of urban greenways in Jinan should ideally rely on natural elements like mountains, rivers, and valleys, and connect with representative cultural relics and traditional blocks, fully reflecting the character of the "Spring City". The aim is to build an integrated urban greenway ecological network of mountains, springs, lakes, and the city. Research selects the Dangjia district in Jinan as the study area, using RS and GIS as technical support, with SPOT satellite remote sensing images as the primary data source. Remote sensing interpretation is conducted to establish a geographic information database and determine greenway types and functions. The Delphi expert evaluation method is used for a comprehensive efficacy evaluation of the area, selecting the best connection routes and landscape nodes. The establishment of a suburban greenway gravity model is proposed, along with greenway planning suggestions.

References

[1] Liu Hang. A Study on the Spatial Characteristics and Evolution of China's Inter provincial Recurrent Network: A Modified Gravity Model and Social Network Analysis. Sichuan: Chongqing University of Technology and Industry, 2023:19-25

[2] Jin Li A Study on the Multidimensional Development Model of Rural Health Tourism. Journal of Shenyang Normal University (Social Sciences Edition), 2023, (5): 63-65

[3] Wang Pin, Yuan Jingcheng, Xiong Shanshan Preliminary Study on the Selection of Tourist Greenway Route in Jinzhu Town, Jilin City Based on GIS Analysis. Information, Model, and Creation - Proceedings of the 2016 National Architectural Digital Technology Teaching Seminar (57). Beijing: China Construction Industry Press: 318-323

[4] Li Hua, Sun Wence, Wei Yiting, Liu Xufang, Gu Xiangyang, Shen Shuang, Xiang Yaxin, Li Pinghao Sharing+Agriculture__ Shared farms lead the agricultural sharing economy. Vegetable, 2021, (5): 2-3

[5] Zhu Nanyan, Wang Yahua, Lan Siren, Zhu Xinkai. Research on the Development Model Design of Shared Farms in China. Green Technology, 2018, (2): 1-2

[6] Shen Mingshu. A Study on the Aging Adaptability Design of Homestays under the Background of "Migratory Bird Style" Rural Elderly Care: Taking Zhongyuan Township, Jiangxi Province as an Example. Jiangxi: Nanchang University, August 11, 2020

[7] Bo Xiaoguang. Strategies and Methods for Homestay Design from the Perspective of Health and Elderly Care. Journal of Hubei Correspondence University, 2017, (24): 108-109

[8] Fabos Julius. Greenway planning in the United States: its origins and recent case studies Landscape and Urban Planning, 2004, 68: 321-342.

[9] Lu'is Ribeiro, Teresa Bar"ao, Greenways for recreation and maintenance of landscape quality:five case studies in Portugal. Landscape and Urban Planning 2006, 76: 79-97.

[10] Yokokhari Makoto, Amemiya Mamoru; Amati Marco. The history and future directions of greenways in Japanese New Towns. Landscape and Urban Planning, 2004, 5:1-13.

