Survey of urban greenway satisfaction based on a fuzzy comprehensive evaluation

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Abstract. Greenways are an important component of the ecological network of urban green spaces and contribute to ensuring a complete and continuous ecosystem. Once a city's greenways have been built, their future success relies heavily on visitors' intuitive feelings and satisfaction. Therefore, it is necessary to evaluate visitor satisfaction with greenways. Using Greenway No. 1 in Shanghai's Minhang District as an example, we in this article constructed an index system to evaluate visitor satisfaction with the greenway based on a fuzzy comprehensive evaluation method. The visitors' demographic and behavioral characteristics and their comprehensive reviews of Greenway No. 1 were analyzed. The results showed that the gender ratio among visitors to Greenway No. 1 was relatively balanced. Most visitors were retired and elderly, and most were from nearby areas. The visitors used the greenway frequently, and the travel time for most was less than ten minutes. The overall visitor satisfaction with the greenway reached the "satisfied" level, and most indices reached the basic level of satisfaction. However, certain basic service facilities were found to be inadequate. The results provide suggestions and references for the construction of greenways in Shanghai and surrounding provinces and cities.

1. Introduction

A greenway is a linear open space established along a natural (e.g., a river or stream valley) or artificial (e.g., a water canal or scenic road) corridor [1]. Greenways serve recreational functions and satisfy urban residents' need to interact with nature. With greater attention being focused on the development of an ecological environment and the increasing demand for a high quality of life among urban residents, the construction of greenways has become a public focus [2]. The planning theory, construction practice, and evaluation of urban greenways have become areas of interest in the fields of landscape ecology, urban planning, and landscaping [3-4].

Visitor satisfaction is a psychological state that arises when visitors compare their expectations of visiting a destination with their actual experience [5]. The analysis of visitor satisfaction with a greenway is an important method for the valuation of greenways. This information directly reflects visitors' intuitive feelings and needs and provides an effective way to gain experience for greenway construction and identify shortcomings. To date, research on visitor satisfaction in China and abroad has mainly focused on tourism development, theme parks, and urban open spaces [6-7]. There are few studies of visitor satisfaction with urban greenways. Lu et al. studied visitor satisfaction with the greenway around Purple Mountain, Nanjing, and proposed specific recommendations [8]. Liang et al. used the Guangzhou urban greenway as an example to study residents' perceptions and satisfaction [9]. Based on an importance-performance analysis (IPA), Yang et al. evaluated and discussed 18 projects influencing visitor satisfaction with Foshan greenways [10]. Zhao et al. analyzed the types of users of rural recreational greenways in Zengcheng and their behavioral characteristics and satisfaction [11]. The existing studies have concentrated on the natural, ecological, and scenic greenways in Guangdong, Jiangsu, and Zhejiang Provinces, and the visitors were mostly bikers and walkers. There are few studies of recreational greenways in the center of urban areas.

The present study used Minhang Greenway No. 1, in the center of Shanghai, as an example and analyzed the demographic and behavioral characteristics of greenway visitors. Based on the fuzzy comprehensive evaluation method, a visitor satisfaction index system was constructed to conduct the comprehensive analysis. The objective was to provide references for the construction and optimization of Shanghai's greenway system and advice and guidance for the design, construction, and management of similar greenways.

2. Methodology

2.1 Fuzzy comprehensive evaluation method

The fuzzy comprehensive evaluation method is based on fuzzy mathematics. Based on the membership theory of fuzzy mathematics, the method combines multiple indices into one index that can reflect the comprehensive situation and converts qualitative information into

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quantitative information [12]. This method produces clear results and is highly systematic. It is effective in resolving fuzzy problems that are difficult to quantify and suitable for solving various nondeterministic problems [13]. The greenway satisfaction survey is highly subjective; therefore, it is advantageous to study satisfaction using the fuzzy comprehensive evaluation method. The steps were as follows:

1. The evaluation object factor set U, the evaluation set V, and the measurement scale vector H were determined.

2. Expert advice was sought. The research team evaluated the relative importance and determined the weight W of each index and focused on each index to obtain the fuzzy set R.

3. The fuzzy comprehensive evaluation set B was obtained through the comprehensive evaluation matrix R as follows:

$$B=W\times R \qquad (1)$$

4. The comprehensive evaluation score E of the evaluation object was calculated based on the measurement scales H and B as follows:

$$E=B\times H=\sum_{i=1}^{n} r_i \times i \qquad (2)$$

5. The evaluation object results were comprehensively analyzed according to the value of the fuzzy scores.

2.2 Construction of a system to evaluate visitor satisfaction with a greenway

2.2.1 Selection and determination of evaluation system indices

The evaluation system indices were determined based on the satisfaction evaluation. Following the relevant literature and the principles of objectivity, representativeness, and practicability of evaluation indices, a satisfaction evaluation system for Greenway No. 1 was established. The evaluation system had three levels. The first was the goal level, which was the overall satisfaction of the greenway visitors. The second was the constraint level. The indices were determined primarily by referring to the function and design principles for urban greenways in the Construction Guidelines of Shanghai Greenways (Trial) [14]. The principle of conservation and ecological priority states that greenway construction should fully consider the surrounding environment and link important cultural and natural resources. Based on this principle, the ecological and cultural landscape was included as one of the second-level indices. The principle of landscape recreational function, comfort, and convenience states that a greenway should expand green space and ensure convenient transportation. From this perspective, two second-level indices—accessibility (traffic conditions) and infrastructure—were devised. The principle of resource utilization and low-carbon emission states that greenway construction should make use of, improve, and enhance important landscapes and human resources. Greenways should promote the development of tourism and the service industry based on local conditions. Therefore, service facilities were included as an important second-level index. Additionally, after further reference to the literature and consultation with experts, comprehensive impression was included as a second-level index. Ultimately, the following five second-level indices were included: accessibility (traffic conditions), ecological and cultural landscape, infrastructure, service facilities, and comprehensive impression. The third-level indices were detailed breakdowns of the second-level indices. With further reference to the regulations concerning greenway construction in the Shanghai and Minhang Districts, 20 indices were identified, including transportation convenience along the greenway, route arrangement, signage system, scenery and environment, overall experience, and recommendation intention. See Table 1 for details.

2.2.2 Determination of the weights of the indices at all levels

Based on the evaluation indices for visitor satisfaction with the greenway, a table containing the experts' evaluation of the indices' importance was produced to assign weights to the influencing factors. The table emphasized the contribution of each index to the corresponding index at the higher level and ensured that the sum of the weights of all dimensional indices was 1. The research team evaluated the relative importance of each index based on the consulting experts' opinions. The results were calculated through the weighted geometric mean. The weight coefficients of each index and the final total order of the weights were obtained (Table 1).

Table 1. Minhang Greenway No. 1 visitor satisfaction evaluation index system

Goal level	Constraint level	Weight	Index level	Weight	Total weight order
Visitors' level of satisfaction	Accessibility (traffic conditions)	0.214	Level of transportation convenience along the route	0.379	0.0758
			Route arrangement	0.343	0.0686
			Signage system	0.279	0.0558
	Ecological and natural landscape	0.179	Scenery and environment	0.307	0.0614
			Plant landscape	0.257	0.0514
			Regional cultural characteristics	0.229	0.0458
			Principles of harmony	0.207	0.0414

Infrastructure	0.264	Road length and width	0.179	0.0358
		Rest facilities	0.221	0.0442
		Location and quantity of trash cans	0.171	0.0342
		Bike parking locations	0.121	0.0242
		Play facilities	0.129	0.0258
		Richness and entertainment	0.179	0.0358
Service facilities	0.193	Service facilities	0.200	0.0400
		Police services	0.193	0.0386
		Diversity of activities along the route	0.193	0.0386
		Environmental cleanliness	0.214	0.0428
		Lighting and safety facilities	0.200	0.0400
Comprehensive impression	0.150	Overall experience	0.607	0.1214
		Willingness to recommend	0.393	0.0786

2.3 Measurement of greenway visitor satisfaction

2.3.1 Overview of the study area

The Minhang District has the longest and largest greenways in Shanghai. Since 2015, a greenway network designed to cover the entire district has been in development. Sixty kilometers of greenway have been built to date. With the acceleration of the construction of greenways and the greenway network in the whole district, the corresponding facilities have also been gradually improved. The greenways combine multiple functions, such as road passage, a slow traffic system, sports and recreation, and disaster prevention and shelters. The improvement of the landscape and the discovery of cultural points of interest along the greenways have also been emphasized. The Minhang greenways have become a comprehensive landscape integrating recreation, tourism, sports, and fitness.

2.3.2 Research site determination

Greenway No. 1 is the first urban greenway built in Minhang. It starts at the Huangpu River in the south and reaches the Suzhou River in the north. The greenway vertically passes through the central area of the Minhang District with a total planned length of 37 km. The currently completed greenway section extends from Shuying Road to the Huangpu River, with a total length of 20 km. The main reasons for choosing Greenway No. 1 as the research site were as follows. (1) The surrounding areas were mostly residential and heavily populated. The utilization rate of the greenway was high, which was convenient for data collection. (2) The greenway was long and had a large surrounding area and comprehensive service functions, making it possible to better analyze the visitors' satisfaction level. (3) The greenway was one of the first built and was a good example.

2.3.3 Research method

For a comparative perspective, three representative sections of the existing greenway were selected to conduct the research. Section 1 is in the northern part of the greenway (Hengjinggang Greenway). This segment is approximately 700 m long and is surrounded by residential and commercial areas. The visitors are mainly nearby residents with a small number of workers. Section 2 is in the middle part of the greenway (Yinqiaohuayuan Greenway). The length of this study section is approximately 600 m, and it is close to residential areas. The visitors are mainly nearby residents. Section 3 is in the southern part of the greenway (Huanlu Greenway), with a length of 800 m. It is in a technology park, and the visitors are mainly workers from the area.

The survey was conducted between April 1 and June 31, 2018. Different time periods were selected, including weekdays and weekends (one weekday and one weekend day were selected within a week). A random nonrepeated sampling method was used. The questionnaires were completed and returned on site. The surveys were administered between 6 a.m. and 10 p.m. For the convenience of the survey takers, the questionnaire used checkboxes. The questionnaire contained two parts: (1) basic information about the visitor, including gender, age, and occupation and (2) options to indicate the visitor's satisfaction level with respect to the indices. A total of 350 questionnaires were distributed; 321 were valid, for a validity rate of 92%.

2.4 Analysis of basic visitor information

2.4.1 Visitors' demographic characteristics

The demographic characteristics mainly included the visitors' genders, ages, occupations, and sources. As shown in Table 2, 51.7% of the greenway visitors were men and 48.3% were women, but the difference was not significant. Most of the visitors were middle-aged or elderly. The largest age group was the group aged 61 and older, accounting for 39.6% of all visitors, followed by the age group between 41 and 60 (28.3%). The percentage of youths was only 5.9%, indicating that the elderly choose nearby greenways for exercise and recreation because of their declined physical condition. Regarding occupation, respondents who were retired accounted for the largest proportion at 50.5%. The greenway visitors were mostly nearby residents, accounting for 83.8% of all visitors.

Table 2. Visitors' demographic characteristics

	Variable	Frequency	Percentage	Cumulative percentage
Gender	Male	166	51.7	51.7
	Female	155	48.3	100
Age	Under 17	3	0.9	0.9
	17-22	16	5.0	5.9
	23-40	84	26.2	32.1
	41-60	91	28.3	60.4
	61 and above	127	39.6	100
Occupation	Student	20	6.2	6.2
	Employed	105	32.7	38.9
	Unemployed	18	5.6	44.5
	Retired	162	50.5	95.0
	Other	16	5.0	100
Source area	Areas surrounding the greenway	269	83.3	83.3
	Minhang District but far from the greenway	28	8.7	92.5
	Other areas of Shanghai	22	6.9	99.4
	Outside Shanghai	2	0.6	100

2.4.2 Visitors' behavioral characteristics

As shown in Table 3, 63.2% of all visitors used greenways 13 times or more per month, indicating a high frequency of use. Most visitors came alone or with families, accounting for 39.9% and 35.8%, respectively. Among all visitors, 51.4% traveled less than 10 minutes to the greenway, and 28.7% traveled between 10 and 20 minutes. Up to 89.1% of visitors reached the greenway by foot, indicating the convenient location and high accessibility of the greenway. Among the visitors, 40.2% used the greenway for 0.5 to 1 hour, and 30.8% used the greenway for 1 to 2 hours. This finding indicated the attractiveness of the greenway. Up to 63.6% of the visitors came to the greenway when they had time, indicating that the greenway was convenient to use and that the service facilities met the needs of most visitors. Most visitors used the greenway for exercise and recreation. The vast majority of visitors learned about the greenway unaided, indicating that the greenway was constructed near the visitors' living and working areas. It was easy for nearby visitors to find and use it. However, the responses also revealed shortcomings in the promotion of the greenway. The construction achievements of the greenway were not sufficiently advertised through modern information technology.

Table 3. Visitors' behavioral characteristics

	Variable	Frequency	Percentage	Cumulative percentage
Monthly use frequency	4 times or fewer	48	15.0	15.0
	5-8 times	39	12.1	27.1
	9-12 times	31	9.7	36.8
	More than 13 times	203	63.2	100
Tour Group	Alone	128	39.9	39.9
	With family	115	35.8	75.7
	Relatives and friends	53	16.5	92.2
	Coworkers	18	5.6	97.8
	Other	7	2.2	100
Travel time	Within 10 minutes	165	51.4	51.4
	10-20 minutes	92	28.7	80.1
	20-30 minutes	28	8.7	88.8
	More than 30 minutes	36	11.2	100
Length of use	0.5 hour or less	59	18.4	18.4
	0.5-1 hour	129	40.2	58.6
	1-2 hours	99	30.8	89.4
	More than 2 hours	34	10.6	100
Time of use	Weekdays	51	15.9	15.9
	Weekends	47	14.6	30.5
	During long holidays	0	0	30.5
	Whenever available	204	63.6	94.1
	Other	19	5.9	100
Purpose of use	Exercise	138	43.0	43.0

	Recreation	86	26.8	69.8
	Tourism and sightseeing	3	0.9	70.7
	Afternoon walk	44	13.7	84.4
	Commuting needs	30	9.3	93.8
	Other	20	6.2	100
Traffic	Private car	3	0.9	0.9
	Public transportation	10	3.1	4.0
	Bicycle	16	5.0	9.0
	Walk	286	89.1	98.1
	Other	6	1.9	100
Information source	TV	0	0.0	0.0
	Internet	5	1.6	1.6
	Newspapers and magazines	1	0.3	1.9
	Friends and relatives	56	17.4	19.3
	Self	259	80.7	100

3 Results and analysis

3.1 Evaluation of visitor satisfaction

3.1.1 Data summarization and reliability analysis

A five-point Likert scale was used to measure the level of satisfaction. Very satisfied, satisfied, average, dissatisfied, and very dissatisfied were assigned values of 5, 4, 3, 2, and 1 points, respectively. The data were summarized, and the results were used to construct Table 4.

Table 4. Summary of visitor satisfaction survey data

Index level	Very satisfied	Satisfied	Average	Dissatisfied	Very dissatisfied
Level of transportation convenience along the route	120	148	38	4	11
Route arrangement	104	184	26	3	4
Signage system	68	174	62	9	8
Scenery and environment	105	178	24	11	3
Plant landscape	116	169	26	8	2
Regional cultural characteristics	40	159	93	25	4
Principles of harmony	81	173	56	5	6
Road length and width	74	196	29	5	17
Rest facilities	57	124	94	18	28
Location and quantity of trash cans	45	166	82	14	14
Bike parking locations	13	95	83	88	42
Play facilities	39	124	120	30	8
Richness and entertainment	42	131	116	19	13
Service facilities	28	188	83	10	12
Police services	44	164	86	20	17
Diversity of activities along the route	34	106	129	31	21
Environmental cleanliness	47	165	66	28	15
Lighting and safety facilities	45	153	83	34	6
Overall experience	81	213	23	1	3
Willingness to recommend	101	167	39	9	5

To ensure that the questionnaire data were scientific and reliable, we carried out Cronbach's alpha analysis with SPSS 17.0 software. A reliability coefficient of $\alpha>0.9$ is generally considered to indicate good reliability [15]. Based on the data analysis, the coefficient of reliability of the survey data was 0.914, indicating high reliability of the questionnaire.

3.1.2 Satisfaction rating

Greenway No. 1's visitor satisfaction rating index set U contained five indices, i.e., $U=(U_i)(i=1, 2, 3, 4, 5)$, where Ui was composed of second-level indices Uij The evaluation set was $V=(v_1, v_2, v_3, v_4, v_5)$=(very satisfied, satisfied, average, unsatisfied, very unsatisfied). Through the questionnaire, the results of evaluation set V for the index Uij were obtained [16].

Using a fuzzy comprehensive evaluation model, we obtained the evaluation matrices of visitor satisfaction at the constraint level, including accessibility (traffic conditions), ecological and cultural landscape, infrastructure, service facilities, and comprehensive impression.

According to Equation (1) and the weight of each index, the evaluation set of each index in the constraint level was calculated as follows:

$B_1 = W_1 \times R_1 = (0.312, 0.522, 0.126, 0.016, 0.024)$
$B_2 = W_2 \times R_2 = (0.274, 0.531, 0.146, 0.038, 0.011)$
$B_3 = W_3 \times R_3 = (0.148, 0.442, 0.269, 0.079, 0.063)$
$B_4 = W_4 \times R_4 = (0.123, 0.482, 0.275, 0.076, 0.044)$

$B_5 = W_5 \times R_5 = (0.277, 0.607, 0.091, 0.013, 0.012)$

According to Equation (2), defuzzification operations were performed on each evaluation set at the constraint level to obtain the visitors' satisfaction evaluation levels.

$E_1 = 5b_{11} + 4b_{12} + 3b_{13} + 2b_{14} + b_{15} = 4.081$
$E_2 = 5b_{21} + 4b_{22} + 3b_{23} + 2b_{24} + b_{25} = 4.018$
$E_3 = 5b_{31} + 4b_{32} + 3b_{33} + 2b_{34} + b_{35} = 3.535$
$E_4 = 5b_{41} + 4b_{42} + 3b_{43} + 2b_{44} + b_{45} = 3.564$
$E_5 = 5b_{51} + 4b_{52} + 3b_{53} + 2b_{54} + b_{55} = 4.124$

Using a fuzzy comprehensive evaluation method, we obtained the final visitors' satisfaction evaluation set as follows:

$A = W \times B = (0.220, 0.507, 0.191, 0.048, 0.034)$

Defuzzification operations were performed on the final evaluation set to obtain a comprehensive evaluation of visitor satisfaction.

$E=5\times0.220+4\times0.507+3\times0.191+2\times0.048+0.034=3.832$

Table 5. Fuzzy comprehensive evaluation results of the Greenway visitors' satisfaction

Visitors' satisfaction evaluation index	Fuzzy set					Satisfaction value after defuzzification
	Very satisfied	Satisfied	General	Dissatisfied	Very dissatisfied	
Accessibility (traffic conditions)	0.312	0.522	0.126	0.016	0.024	4.081
Ecological and natural landscape	0.274	0.531	0.146	0.038	0.011	4.018
Infrastructure	0.150	0.453	0.269	0.079	0.049	3.535
Service facilities	0.123	0.482	0.275	0.076	0.044	3.564
Comprehensive impression	0.277	0.607	0.091	0.013	0.012	4.124
Overall level of satisfaction	0.221	0.510	0.191	0.048	0.030	3.832

3.2 Analysis based on satisfaction

3.2.1 Analysis of the satisfaction evaluation results

As shown in Table 5, the comprehensive evaluation result of visitor satisfaction with Greenway No. 1 was 3.832 after defuzzification. Based on the assigned values of the five-point Likert scale, this value fell between "satisfied" and "average." According to the maximum membership principle, the highest satisfaction score was 4.124, which is higher than the "satisfied" rating. In summary, the visitors were generally satisfied with Greenway No. 1.

The highest value of visitors' comprehensive impression of Greenway No. 1 was 4.124. The overall experience and willingness to recommend both reached the level of "satisfied," with values of 4.146 and 4.090, respectively. This finding showed that the visitors were positive about the development of the greenway.

The visitors' satisfaction value for accessibility (traffic conditions) was 4.081, which was higher than the overall visitor satisfaction value. This satisfaction was related to the convenient transportation along the greenway and the sensible arrangement of the route.

The visitors' satisfaction value for the ecological and cultural landscape was also 4.018, which was higher than the overall visitor satisfaction value. Scenery and environment and plant landscape had values of 4.156 and 4.212, respectively, which reached the level of "satisfied." However, the principles of harmony and unity and regional cultural characteristics were rated low at 3.991 and 3.642, respectively. Future optimization and development should consider local cultural and historical characteristics and further enhance the greenway's cultural significance.

The satisfaction value of service facilities was 3.564, which was lower than the overall visitor satisfaction value. The satisfaction value of diversity of activities along the route was only 3.315. The field research revealed that there were no related activities or events organized along the greenway.

The lowest visitor satisfaction value was 3.535 for infrastructure. Bicycle parking locations had the lowest satisfaction value of 2.841, which is between "unsatisfied" and "average." Unlike the rural greenways in Guangdong and Zhejiang, Greenway No. 1 is pedestrian-oriented and does not encourage bicyclists to enter the greenway. Therefore, there are few bicycle parking locations. Many areas do not provide bicycle parking, which led to a low visitor satisfaction level. The satisfaction values for trash can locations and quantities, rest facilities, and play facilities were 3.530, 3.511, and 3.486, respectively, all lower than the satisfaction value for infrastructure. Rest seating did not meet the needs of high visitor traffic. There is an extreme shortage of recreational facilities, especially fitness facilities. These factors are important reasons for the low level of visitor satisfaction with these aspects.

3.2.2 IPA of the satisfaction rating

IPA produces a matrix with four quadrants based on the importance and level of satisfaction [17]. This article used the importance of Greenway No. 1 to visitors as the horizontal axis and satisfaction according to the evaluation indices as the vertical axis. The four quadrants were divided according to the intersection of

the average of the horizontal and vertical axes, and 20 indices were analyzed.

As shown in Figure 1, quadrant I represents high importance and high satisfaction, which includes the seven indices of transportation convenience, route arrangement, signage system, landscape and environment, plant landscape, overall experience, and willingness to recommend. These indices represent the advantages of Greenway No. 1 that should be maintained. Quadrant II is of high importance but low satisfaction, and no indices are present in this quadrant. This finding shows that the development of Greenway No. 1 fully highlights its advantages and avoids disadvantages. Quadrant III is of low importance and high satisfaction and includes the two indices of the principle of harmony and unity and road length and width. The low importance of these two indices is relative. Efforts should be made to maintain their high satisfaction. The remaining indices are in quadrant IV, which is of low importance and low satisfaction. These indices include resting facilities, location and quantity of trash cans, bicycle parking locations, play facilities, and others. These factors are the disadvantages of Greenway No. 1 and deserve more effort to improve their satisfaction and therefore the overall satisfaction level of the evaluation.

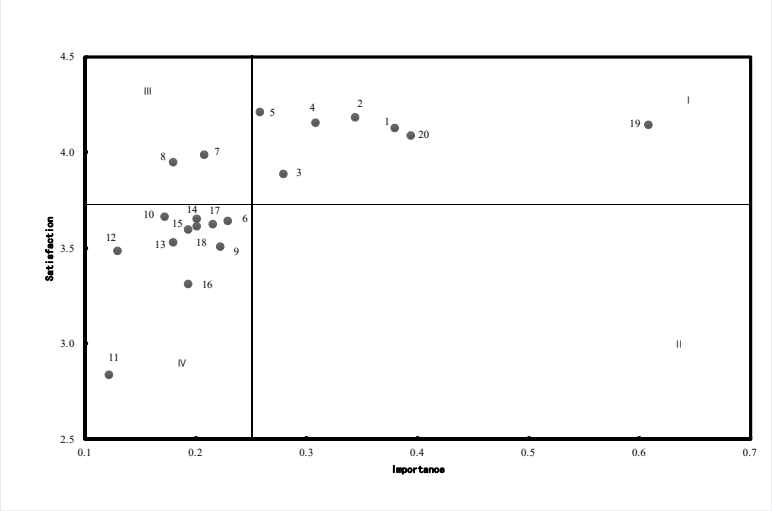

Figure 1. Classification of indices based on the IPA

4 Discussion

4.1 Establish an appropriate evaluation system to guarantee a comprehensive satisfaction evaluation

The establishment of an evaluation system has a direct impact on the comprehensive evaluation of satisfaction. Greenways such as the Pearl River Delta Greenway and the Nanjing Purple Mountain Greenway are mostly rural tourist greenways and cover a wide area. The public transportation system, bicycle rental, and restrooms along the route are important indicators for the satisfaction evaluation of these greenways [16, 18]. In contrast, greenways in Shanghai are mostly urban greenways and mainly designed to connect the city's fragmented landscape patches and provide recreational spaces for nearby residents. Visitors typically access the greenway by foot and public transportation, so there are usually no parking lots, bike routes, or restrooms. In the present study, the inclusion of bicycle parking locations in the evaluation system also lowered the overall satisfaction to some extent. However, an increase in bicycle parking locations is recommended to optimize the greenway to meet the needs of residents traveling from a long distance and improve the comprehensive service functions of the greenway. In addition, the satisfaction levels of different types of visitors also varied and affected the overall evaluation results. The main user group of Greenway No. 1 was middle-aged and elderly people, with elderly visitors being in the majority. A greenway near their residences satisfied their needs for walking and recreation. The greenway was highly accessible and convenient, so the results from the questionnaire were mostly "satisfied." Younger visitors were energetic and had a high demand for the length of the greenway and exercise facilities. Their questionnaire responses leaned toward "average." Therefore, in the design and distribution of questionnaires, it is also necessary to cover different subjects in a phased, targeted manner to ensure the effectiveness of the questionnaires and the fairness of the comprehensive evaluation results.

4.2 Pay attention to the location of greenways, improve accessibility, increase characteristic activities and regional cultural components, and improve the use of greenways

The location of greenways, travel time, and method all affect the number of people using greenways and their frequencies of use. Field research revealed that the Yinqiaohuayuan Greenway was the closest to the residential areas and had the largest number of visitors. The Hengjinggang Greenway was farther from residential areas, and there were more commercial areas in the vicinity. Its traffic volume was ranked second. The Huanlu Greenway was far from residential areas and had the fewest visitors. Therefore, a greenway should be

located in the vicinity of residential areas, and the accessibility of the greenway should be considered to ensure that visitors can enter the greenway quickly by foot. Additionally, the distances between the greenway entrance and subway entrances and bus stops should be shortened as much as possible to improve access to public transportation near greenways, provide convenience for visitors from farther away, and expand the radius of greenway services. Urban greenways are the best and easiest way to link historical sites and integrate social activities. The greenways around Ljubljana, Slovenia, hold an annual recreational walk to commemorate the history of World War II, and they also serve recreational and ecological education functions. Therefore, the development of Greenway No. 1 should also be based on regional characteristics to create a themed greenway. A diversity of activities should be organized based on historical heritage to improve the attractiveness of the greenway.

4.3 Improve the greenway infrastructure and therefore the comprehensive evaluation of the greenway

The findings showed that certain parts of the greenway lacked rest seating. The location and quantity of trash cans were also unreasonable. These aspects were reflected in the analysis results, as visitors had a low level of satisfaction with these factors. It is recommended that the arrangement of service facilities be improved. Greenways near residential areas can also increase exercise facilities to accommodate the various needs of visitors. Some visitors suggested that public restrooms along the greenway be increased. However, the construction and management of public restrooms were not within the scope of work of the local landscape management department. The safety facilities had the same problem. These issues demonstrate that the construction of urban greenways needs to be completed in coordination with the planning, land, transportation, and municipal departments. At the end of 2017, the Greening Department, in collaboration with other municipal authorities, added lighting to the Yinqiaohuayuan Greenway. Many visitors were attracted to watch and photograph a diverse and colorful light exhibition. Visitors were highly satisfied, and the comprehensive review was high. Therefore, the construction of greenways should be integrated and optimized with landscape resources in various ways to continuously improve their quality.

5 Conclusion

The visitors to Minhang Greenway No. 1 mainly came from nearby areas. Retired elderly visitors were the majority. The greenway was used frequently. Most people could reach the greenway for exercise and recreation within a 10-minute walk. The visitors had a good overall experience with Greenway No. 1 and a high willingness to recommend it.

Based on the fuzzy comprehensive evaluation method, visitors were overall “satisfied” with Greenway No. 1. The visitors had the highest level of satisfaction with the comprehensive impression and the lowest level of satisfaction with infrastructure. Most of the 20 indices of the greenway concentrated in the levels of “satisfied” and “average.” A basic level of satisfaction was reached. However, some indices had low levels of satisfaction.

The IPA revealed that seven indices were advantages, including the transportation convenience along Greenway No. 1, route arrangement, signage system, scenery and environment, plant landscape, overall experience, and willingness to recommend. The remaining indices needed to be improved to raise the overall satisfaction.

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