

## ARTICLE

# Evaluation of recreational suitability of urban waterfront green spaces: A case study of Calligraphy Square in Linyi, Shandong, China

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## Abstract

Urban waterfront green spaces are key elements in the urban framework, enhancing city livability. Centered around water bodies, they often form the most vibrant open spaces in cities. They offer people leisure, entertainment, fitness, and other diversified activities, enriching the cultural life of citizens. In addition, developing waterfront green spaces helps enhance a city's image and foster residents' sense of belonging and pride. At present, there is limited research on evaluating the recreational suitability of urban waterfront green spaces. This study aims to establish an evaluation system for recreational suitability tailored for Linyi's waterfront green spaces. The Delphi method and analytic hierarchy process were employed to screen evaluation indicators and determine their weights, constructing the evaluation system. The evaluation standards were clarified, and Linyi Calligraphy Square was evaluated as an example. Data were gathered through questionnaires, on-site surveys, and reviews. The fuzzy comprehensive evaluation method showed that the recreational suitability score of Linyi Calligraphy Square is 4.004, indicating a high level of recreational suitability. Among these, the evaluation results rated the facility (0.42), recreational experience (0.484), and location and transportation (0.375) as "very good," the environment (0.503) and landscape (0.391) as "good," and the resources (0.439) as "average." Based on these results, suggestions were made for Linyi Calligraphy Square, including increasing children's activity facilities and venues, strengthening safety measures for water-related recreation, and providing reasonable and effective references for future development and construction.

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## 1. Introduction

With the continuous innovation of urban development concepts, the construction of green and ecological cities has gradually become mainstream.<sup>1,2</sup> The structure and function of urban waterfront green spaces, as the driving force of the economy and industry, have become increasingly complex.<sup>3</sup> Meanwhile, these spaces also play an important role in enhancing residents' well-being and meeting their spiritual needs.<sup>4,5</sup> Therefore, the construction of urban waterfront green spaces and the improvement of these existing spaces have received extensive attention.

Foreign scholars have researched the recreational suitability of urban waterfront green spaces from various perspectives. Japanese scholars selected five rivers in Japan as research samples for four dimensions: landscape shaping, recreational function, environmental protection effectiveness, and public participation level. They conducted a comprehensive analysis and evaluation of urban riverside greenways, concluding that the development of these greenways should integrate their natural resource endowments with local characteristics.<sup>6</sup> Similarly, Steinwender *et al.*<sup>7</sup> conducted a comparative study by investigating tourists' satisfaction with the water environment quality of urban waterfront spaces, selecting six static and six dynamic water bodies in Vienna. They concluded that differences in participants' impressions of the water spaces were also decisive factors affecting the final results. Sairinen and Kumpulainen<sup>8</sup> conducted research on the enhancement and transformation of urban waterfront green spaces in Helsinki, evaluating and analyzing them from the perspectives of resources and status, development experience, and recreation. Meanwhile, Kong-Jian and Di-Hua<sup>9</sup> studied the planning and construction of riverside areas from the perspectives of ecology and aesthetics, emphasizing the concept of ecological design in landscape creation. Liaoji and Huiqing<sup>10</sup> offered new insights into the recreational management model for urban waterfront spaces, proposing an ecological benefits-based recreational management model for these spaces and conducting relevant feasibility studies.

At present, domestic research primarily focuses on explorations from various perspectives, such as the ecological environment,<sup>11</sup> visual environment,<sup>12</sup> security pattern,<sup>13</sup> and tourist perception,<sup>14,15</sup> combined with case studies to analyze a specific park,<sup>16</sup> riverfront tourism corridor,<sup>17</sup> or greenway. The perspectives are diverse and varied, but there is a lack of comprehensive research on evaluating the recreational suitability of waterfront green spaces within a region.

Different scholars have employed various methods to conduct an overall evaluation of certain areas. For example, Zhan<sup>18</sup> summarized the characteristics of recreational spaces and the methods for constructing a recreational system in riparian green spaces at the current stage, aiming to address the urgent need for urban recreation. Cao<sup>19</sup> mainly conducted field research on 42 plant species of lakeside, riverfront, and riverfront green spaces in Ma'anshan city and used the analytic hierarchy process (AHP) method to build a naturalness evaluation system for plant species of Ma'anshan waterfront green spaces. Similarly, Xiangxiang *et al.*<sup>20</sup> explored the characteristics of conventional evaluation methods and proposed a set of evaluation index systems and methods for blue and green

spaces, suitable for evaluating the degree of urban blue and green integration. Li *et al.*<sup>21</sup> examined 36 representative urban waterfront green spaces, including Xihu Park and Zuohai Park in Fuzhou city, employing a landscape evaluation method that integrates image semantic segmentation and gray-scale statistical analysis. This approach investigated the relationship between urban park waterfront green spaces and public preferences, thereby assessing the esthetic quality of these urban waterfront areas. Meanwhile, Wang and Zhao,<sup>22</sup> using the AHP and incorporating the concept of night sky protection, screened and calculated the weights of evaluation indicators for the quality of nighttime landscapes in urban waterfront green spaces and established a corresponding evaluation system. Li *et al.*<sup>23</sup> combined AHP with an expert scoring method to establish a classification standard of evaluation indicators and conducted a comprehensive evaluation of the urban green space landscape pattern in the study area.

To construct an evaluation system, the focus must be on determining the weights of various evaluation indicators. The methods are primarily divided into three categories: subjective weighting methods, objective weighting methods, and a combination of both. Subjective weighting methods include the Delphi method, AHP, and expert scoring method. These methods are characterized by determining weights based on expert experience and subjective judgment, relying on human cognition and logic. On the other hand, objective weighting methods include the entropy weight method, principal component analysis, coefficient of variation method, and criteria importance through the intercriteria correlation method, calculating weights based on objective information, such as the data's inherent variation and correlation, thereby avoiding human interference.

This study aims to construct a multidimensional, multi-level indicator system that requires professional opinions and experience as references. After reviewing and researching literature on various evaluation system constructions, the AHP was employed to develop a recreational suitability evaluation system from multiple perspectives, and a comprehensive evaluation of the Linyi Calligraphy Square was conducted. This approach aims to propose rational suggestions from a more comprehensive perspective, providing a theoretical basis for future evaluations of the recreational suitability of waterfront green spaces.

## 2. Research methodology

### 2.1. Study location

This study used the Linyi Calligraphy Square in Linyi city, China, as a case study to establish a suitability evaluation system for waterfront green spaces and conduct a

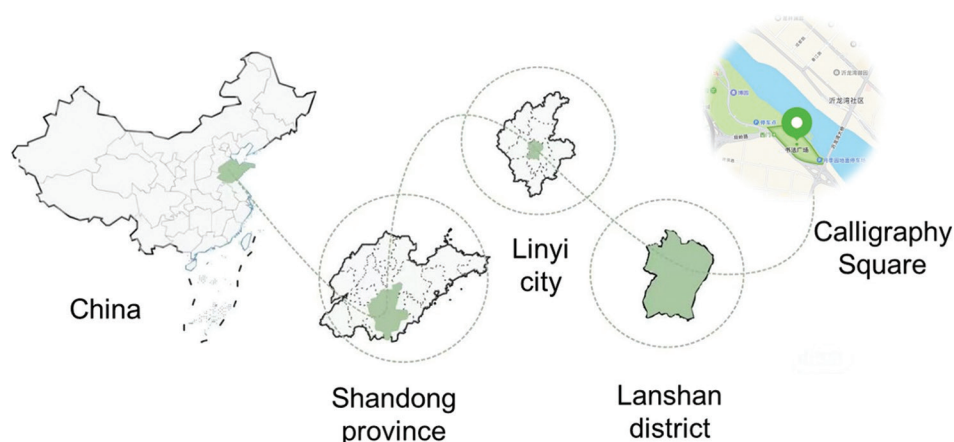


Figure 1. Area map of Linyi Calligraphy Square



Figure 2. Linyi Calligraphy Square. Photograph by the authors.

comprehensive evaluation. Linyi Calligraphy Square is located in the urban area of Linyi city, Shandong province, China (Figures 1 and 2). It is an open, large-scale theme park or square on the bank of the Yi River, serving as a centralized display area for the calligraphy works of famous Chinese calligraphers throughout history. It has been selected as one of the top 10 cultural landmarks in Shandong province, known as the Qilu cultural landmarks. The square is 1,200 meters long from east to west and over 200 m wide from north to south, covering a total area of more than 200,000 square meters. Its design adopts a mixed garden layout, blending classical garden landscaping with modern water culture and calligraphy art.<sup>24,25</sup> It is a highly representative urban waterfront green space in the Lanshan district, Linyi city.

## 2.2. Research design and method

This study employed the Delphi method to screen data, the AHP to obtain the index weights, and the fuzzy

comprehensive evaluation method to evaluate the case sites and draw conclusions. The overall research process is illustrated in Figure 3.

The Delphi method is a technique developed based on individual expert judgment and expert meetings to consult expert opinions. At present, this method is widely used in various fields, including social surveys, opinion consultation, and data analysis. Its core is to refer experts as consultation subjects, leveraging their knowledge and insights to make scientific and reasonable judgments and analyses of the survey subjects, ultimately aiming to draw predictive conclusions. In a previous study, Zheng *et al.*<sup>26</sup> designed a Delphi expert method questionnaire, inviting 25 experts to conduct three rounds of surveys to evaluate and rate potential influencing factors. Likewise, Pei *et al.*,<sup>27</sup> using the Delphi method and cloud model, developed a theory and method for evaluating urban safety resilience in China, providing important guidance for enhancing resilience levels in urban safety.

The AHP is a subjective evaluation method proposed by the American operations researcher Saaty in the early 1970s. The AHP breaks down decision-related elements into multiple levels, such as goals, criteria, and alternatives, allowing for both qualitative and quantitative analysis. It is a systematic, simple, flexible, and effective decision-making method. This algorithm is a multi-criteria comprehensive evaluation tool. Due to its simplicity and practicality, it is widely used in real life, primarily for two purposes: determining indicator weights and quantifying alternative selections. For example, Zuo and Wang<sup>28</sup> used AHP to establish a comprehensive product evaluation system that is both reliable and valid. Similarly, Li *et al.*<sup>29</sup> proposed an improved AHP—a fuzzy comprehensive evaluation algorithm, which shows broad application prospects in evaluations.

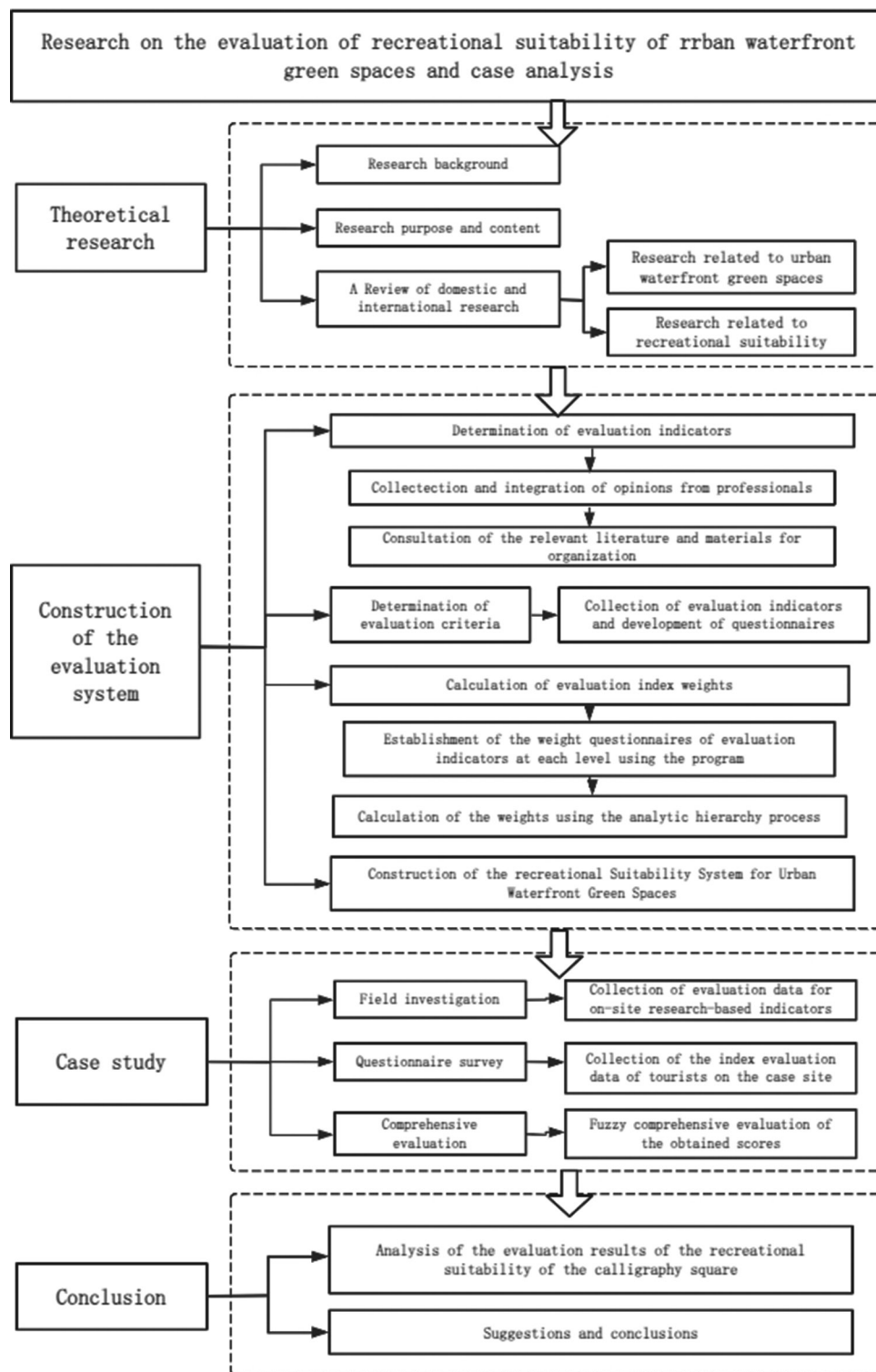


Figure 3. Technical flowchart

**2.2.1. Construction of the preliminary evaluation system**

The primary objective of this study was to establish a system for evaluating the recreational suitability of Linyi's

waterfront green spaces. The principles of scientific rigor, comprehensiveness, leadership, practicality, and guidance were adhered to when selecting evaluation indicators.

Factors affecting the recreational suitability of urban waterfront green spaces are diverse and multifaceted. For example, Xia *et al.*<sup>30</sup> noted in their research that visual environmental elements, such as vegetation and water bodies, can enhance the recreational experience. Mingde and Jiayi<sup>31</sup> analysis of the factors influencing the vitality of waterfront spaces identified location and accessibility as the primary driving factors. Based on the literature review, the factors influencing the recreational suitability of urban waterfront green spaces were discussed from various perspectives, including space, environment, facility, activity, and image.

By referencing the recreational suitability evaluation systems for urban wetlands, comprehensive parks, and urban green open spaces constructed by Yang,<sup>32</sup> Zhang and Chen,<sup>33</sup> Sun,<sup>34</sup> Liu *et al.*,<sup>35</sup> and others, and incorporating Lang's<sup>36</sup> research on the evaluation index systems for waterfront space characteristics, along with expert consultations, a total of 52 indicators were predominantly selected from six categories:

- (i) Environmental elements: Ultraviolet rays, temperature, air humidity, air quality, rainfall, wind speed, water quality, noise, and environmental sanitation.
- (ii) Landscape elements: Plant landscape, landform landscape, revetment landscape, water body landscape, rock landscape, skyline landscape, garden path landscape, small architecture, historical and cultural relics, and facility landscape.
- (iii) Resource elements: Plant diversity, greening coverage, topography and landforms, water resources, cultural monuments, local customs, festival activities, and science education.
- (iv) Facility elements: Signage completeness, category comprehensiveness, usage status, maintenance status, comfort level, distribution status, diversity of recreational facilities, interest level of recreational facilities, management status of recreational facilities, safety of recreational facilities, safety of water-friendly facilities, interest level of water-friendly facilities, and rationality of water-friendly facilities.
- (v) Recreational experience elements: Diversity of recreational spaces, comfort of recreational spaces, safety of recreational spaces, water-friendliness of recreational spaces, diversity of recreational activities, participation in recreational activities, attractiveness of recreational activities, and entertainment value of water-friendly experiences.
- (vi) Location and transportation elements: Geographical location, visitor arrival distance, internal transportation conditions, and external transportation conditions.

The primary election indicators were screened using the Delphi method. Thirty professional teachers and

relevant practitioners were invited to score and evaluate, and the indicators were revised and sorted out based on their opinions. The requirements for expert selection were as follows: first, having engaged in the study or research of this field for 5 years or more and second, having rich practical experience and a certain understanding of related research. The Likert scale method was used to evaluate the primary election indicators according to five evaluation levels of "important, relatively important, generally important, less important, and not important," and their values were assigned as "5, 4, 3, 2, and 1 point," respectively (Appendix 1). The experts proposed corresponding rectification suggestions according to their opinions.<sup>37</sup> After integration and modification, a recreation suitability evaluation system for urban waterfront green spaces comprising six target layers, 12 primary indexes, and 43 secondary indexes was established.<sup>36</sup>

### 2.2.2. Determination of indicator weights

After the preliminary construction of the evaluation system for the recreation suitability of urban waterfront green spaces, it is necessary to calculate the weight values of the sub-indicators at each level. The AHP<sup>38-41</sup> and the nine-level scale scoring standard were used to construct the importance judgment matrix of indicators at each level. The weight questionnaires for the factor level, first-level indicator, and second-level indicator were designed respectively. In this study, the weight calculation of evaluation indicators was directly obtained using the AHP calculation in the "Wen Juan Xing" website (<https://www.wjx.cn/>). By constructing questionnaires with the AHP model in Wen Juan Xing, the system was broken down into different levels, and the importance of indicators was compared pairwise to build a judgment matrix. Then, through operations such as solving for the maximum eigenvalue and performing weighted summation, the final weight of each indicator was determined. The relevant calculation formula is presented in Equations I and II:

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \frac{(AW)_i}{W_i} \quad (I)$$

$$C.I. = \frac{\lambda_{\max} - n}{n - 1} \quad (II)$$

where  $\lambda_{\max}$  is the maximum eigenvalue,  $n$  is the number of dimensions, and  $AW$  is the product of the judgment matrix and the normalized weights.

Data from 30 experts and relevant practitioners were collected to calculate the indicator weights and perform a consistency check for each level. The principal model is illustrated in Figure 4.

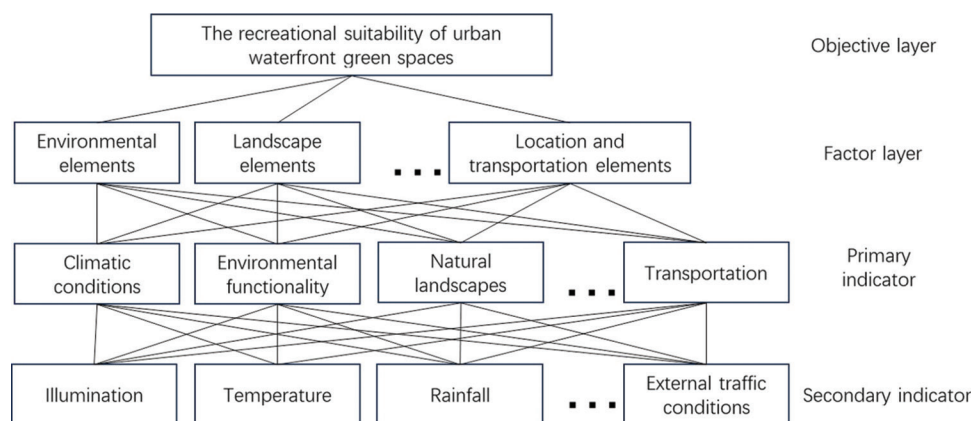


Figure 4. Schematic diagram of the hierarchical analysis model of the “Wen Juan Xing”

Source: <https://www.wjx.cn/>.

### 2.2.3. Determination of evaluation criteria

According to the current state of Linyi’s waterfront green spaces, the evaluation indices were divided into five levels, and the acquisition of evaluation index data was classified into three types: questionnaire survey, field investigation, and data collection. Among these, the questionnaire survey focused on collecting data from tourists and staff; the field investigation involved on-site observation of the research site; and data collection referred to the compilation of relevant literature and official statistics. After referring to relevant research literature and standards,<sup>42-44</sup> considering the actual situation, and consulting with relevant experts, the evaluation criteria for the recreation suitability of urban waterfront green spaces were finally established (Table 1).

### 2.2.4. Fuzzy comprehensive evaluation

Due to the numerous factors influencing the recreational suitability evaluation results of urban waterfront green spaces, alongside the differences in evaluators’ assessments and cognitive standards regarding various elements, the evaluation results can be affected to a certain extent. Therefore, the fuzzy comprehensive evaluation method was adopted to establish a multi-level model, ultimately obtaining the fuzzy comprehensive evaluation results and the final assessment value of the recreational suitability of urban waterfront green spaces. This method is based on the principles of fuzzy mathematics and fuzzy relation synthesis, providing a comprehensive evaluation approach that quantifies factors with unclear boundaries and difficult quantification.<sup>45-48</sup> A key aspect of the fuzzy comprehensive evaluation method is determining membership degrees, which involves dividing the indicators in the urban waterfront green spaces’ recreation suitability evaluation system into soft and hard indicators. Soft indicators refer to those that cannot be classified into standard grades with clear numerical values and can have their membership

degrees determined through social statistical methods. In this study, the soft indicators were evaluation indicators derived from questionnaire surveys. Hard indicators can be determined according to evaluation standards; if the evaluation indicator results are the same or fall within the corresponding standard value range, the data are recorded as 1; otherwise, it is recorded as 0. The results are summarized to form the membership degree of the evaluation matrix, and then, the degree is multiplied by the weight to calculate the membership degree of the primary indicators. Through this calculation, the fuzzy comprehensive evaluation score for Linyi Calligraphy Square was finally obtained.

This study employed the weighted average type fuzzy operator in the fuzzy comprehensive evaluation method for calculation. The core idea is to perform a weighted calculation on the weight vector and the evaluation matrix, obtaining the comprehensive evaluation result. Its calculation formula is as follows in Equation III:

$$M_k = \text{Min}\{1, \sum (a_j \times b_{jk})\} \quad (\text{III})$$

where  $a_j$  represents the weight of the  $j^{\text{th}}$  factor in the weight vector,  $b_{jk}$  represents the value of the  $j^{\text{th}}$  row and the  $k^{\text{th}}$  column in the evaluation matrix, and  $M_k$  represents the  $k^{\text{th}}$  evaluation value in the comprehensive evaluation result.

### 2.3. Data collection and processing

Using Linyi Calligraphy Square as a case study, this research collected data for evaluation indicators based on relevant research standards and official documents. Field investigations at Linyi Calligraphy Square were carried out to obtain index data related to the evaluation indicators, such as recreational facilities, recreational space types, and plant diversity. A questionnaire was designed to collect data for the survey-based evaluation indicators. The questionnaire covered three aspects: demographic and sociological characteristics (e.g., gender and age), recreational

**Table 1. Evaluation criteria for recreational suitability indicators of Linyi's waterfront green spaces**

Evaluation indicator	Data source	Evaluation criteria				
		Excellent (5)	Good (4)	Average (3)	Poor (2)	Very poor (1)
Sunshine hours (annual, hours)	Data collection	>2,600	2,400–2,600	2,200–2,400	2,000–2,200	<2,000
Temperature (annual average, °C)	Data collection	18–22	14–18	12–14; 18–20	X–12; 20–25	<X; >25
Air quality index	Data collection	≤35	35–75	75–115	115–150	>150
Rainfall (annual, mm)	Data collection	750–950	650–750; 950–1,050	550–650; 1,050–1,150	450–550; 1,150–1,350	<450; >1,350
Wind speed (km/h)	Data collection	<11	11–19	20–28	29–49	>50
Water quality <sup>a</sup>	Data collection	Better than Class III	Class III	Class IV	Class V	Worse than Class V
Noise levels	Questionnaire	Excellent	Good	Average	Poor	Very poor
Sanitation	Questionnaire	Excellent	Good	Average	Poor	Very poor
Vegetation landscape	Questionnaire	Excellent	Good	Average	Poor	Very poor
Geomorphic landscape	Questionnaire	Excellent	Good	Average	Poor	Very poor
Water landscape	Questionnaire	Excellent	Good	Average	Poor	Very poor
Rock landscape	Questionnaire	Excellent	Good	Average	Poor	Very poor
Pathway landscape	Questionnaire	Excellent	Good	Average	Poor	Very poor
Architectural sculptures	Questionnaire	Excellent	Good	Average	Poor	Very poor
Historical sites	Data collection	National level	Provincial level	Municipal level	Unlisted	Negligible
Plant diversity	Field survey	Excellent	Good	Average	Poor	Very poor
Greening coverage rate (%)	Data collection	>90	80–90	70–80	60–70	<60
Topography	Data collection	Excellent	Good	Average	Poor	Very poor
Water resources	Data collection	National level	Provincial level	Municipal level	County level	Below the county level
Cultural relics	Data collection	National level	Provincial level	Municipal level	Unlisted	Negligible
Folk customs	Questionnaire	Excellent	Good	Average	Poor	Very poor
Educational facilities	Questionnaire	Excellent	Good	Average	Poor	Very poor
Signage completeness	Questionnaire	Excellent	Good	Average	Poor	Very poor
Facility diversity (types)	Field survey	5	4	3	2	1
Maintenance status	Questionnaire	Excellent	Good	Average	Poor	Very poor
Comfort level	Questionnaire	Excellent	Good	Average	Poor	Very poor
Distribution	Questionnaire	Excellent	Good	Average	Poor	Very poor
Recreational facility diversity (types)	Field survey	6	5	4	3	2
Recreational facility fun	Questionnaire	Excellent	Good	Average	Poor	Very poor
Facility management	Questionnaire	Excellent	Good	Average	Poor	Very poor
Facility safety	Questionnaire	Excellent	Good	Average	Poor	Very poor
Waterfront facility rationality	Questionnaire	Excellent	Good	Average	Poor	Very poor
Recreational space diversity (types)	Field survey	5	4	3	2	1
Space comfort	Questionnaire	Excellent	Good	Average	Poor	Very poor
Space safety	Questionnaire	Excellent	Good	Average	Poor	Very poor
Waterfront accessibility	Questionnaire	Excellent	Good	Average	Poor	Very poor
Activity diversity (types)	Field survey	6	5	4	3	2
Participation level	Questionnaire	Excellent	Good	Average	Poor	Very poor
Waterfront entertainment	Questionnaire	Excellent	Good	Average	Poor	Very poor
Geographic location (km from downtown)	Data collection	<5	5–10	10–15	15–20	>20
Visitor proximity	Questionnaire	Excellent	Good	Average	Poor	Very poor
Internal transportation	Questionnaire	Excellent	Good	Average	Poor	Very poor
External transportation	Questionnaire	Excellent	Good	Average	Poor	Very poor

Note: <sup>a</sup>Classification of water quality based on environmental quality standards for surface water in China (GB 3838-2002).

frequency, and a recreational suitability evaluation form (Appendix 2). Through on-site distribution and online questionnaire survey, 320 questionnaires were distributed, and a total of 300 valid questionnaires were recovered, an effective rate of 93.75%. These data were imported into Microsoft Excel (version 2003), and the comprehensive score of recreational suitability was calculated using the fuzzy comprehensive evaluation method.

The Wen Juan Xing application is a professional online platform for surveys, examinations, assessments, and voting. It provides users with a range of services, including powerful and user-friendly online questionnaire design, data collection, custom reports, and survey result analysis. Compared to traditional survey methods and other survey websites or systems, the Wen Juan Xing application offers advantages such as speed, ease of use, and low cost. It has been widely used by both businesses and individuals.

To reflect the actual evaluation situation, the survey area encompassed the entire Linyi Calligraphy Square, and a random sampling method was adopted. The calculation formula is presented in Equation IV:

$$n = \frac{Z^2 \times P \times (1 - P)}{E^2} \tag{IV}$$

Where  $n$  is the overall size, which is the total number of individuals in the target population;  $Z$  is the confidence level, which is usually set at 95% with a corresponding  $Z$ -value of 1.96, indicating the level of confidence in the results;  $E$  is the margin of error, which is the allowable range of sampling error (e.g.,  $\pm 5\%$ );  $P$  is the population variability, which is typically estimated using a proportion (e.g., support rate  $p=0.5$ ), and if unknown, the default is 0.5 (the most conservative estimation).

This study employed a random sampling method and collected a total of 300 valid questionnaires. Based on statistical formulas, the margin of error is  $\pm 5.7\%$  at a 95% confidence level, indicating that the results can reliably represent the overall population of Lanshan Road ( $n = 160,000$ ). Although the margin of error is slightly higher than the general standard of  $\pm 5\%$ , the sample size still meets the scientific and feasibility requirements in resource-constrained scenarios. Future research can improve accuracy by increasing sample sizes. The survey subjects included tourists of all age groups. To ensure the objectivity and scientific validity of the survey results, questionnaires and interviews were also conducted with park management personnel.

The reliability of each questionnaire was verified using Cronbach's alpha coefficient. The coefficients of each scale were all above 0.7, meeting the standard of the reliability test. The results are presented in Tables 2-4.

### 3. Results and discussion

#### 3.1. Index weight results

Scoring data from 30 experts and related practitioners were collected through the Wen Juan Xing application and questionnaires to calculate the weight and consistency test of indicators at each level. All matrices in this study passed the consistency tests (consistency ratio  $< 0.1$ ), and the recreational suitability evaluation system of Linyi's waterfront green spaces was finally constructed after normalization (Table 5). It can be seen from Figure 5 that the order of weights at the elemental

Table 2. Reliability analysis of the index screening questionnaire

Dimension	Project	Cronbach's alpha coefficient
Environmental elements	9	0.790
Landscape element	10	0.819
Resource elements	8	0.853
Facility elements	13	0.876
Recreational experience elements	8	0.872
Location and transportation elements	4	0.761

Table 3. Reliability analysis of the index weight questionnaire

Dimension	Project	Cronbach's alpha coefficient
Environmental elements	28	0.782
Landscape element	20	0.799
Resource elements	21	0.966
Facility elements	45	0.946
Recreational experience elements	21	0.936
Location and transportation elements	6	0.935

Table 4. Reliability analysis of the tourist evaluation questionnaire

Dimension	Project	Cronbach's alpha coefficient
Tourist evaluation	25	0.964

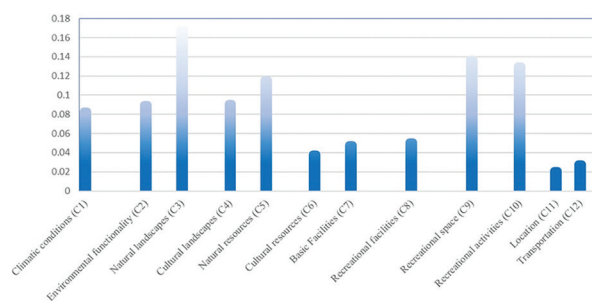


Figure 5. Weight chart of primary indicators

Table 5. Weights of the recreational suitability evaluation indicators of Linyi's waterfront green spaces

Objective layer	Factor layer	Weight	Primary indicator	Weight	Secondary indicator	Composite weight	Rank				
Urban waterfront green spaces' recreational suitability (A)	Environment (B1)	0.172	Climatic conditions (C1)	0.083	Sunshine hours	0.023	22				
					Temperature	0.024	19				
					Air quality	0.029	15				
					Rainfall	0.020	24				
					Wind speed	0.014	28				
			Environmental functionality (C2)	0.090	Water quality	0.019	25				
					Noise levels	0.014	30				
					Sanitation	0.029	14				
					Landscape (B2)	0.259	Natural landscapes (C3)	0.168	Vegetation landscape	0.044	3
									Geomorphic landscape	0.038	6
	Water landscape	0.040	4								
	Cultural landscapes (C4)	0.091	Rock landscape	0.032			10				
			Pathway landscape	0.039			5				
	Resource (B3)	0.154	Natural resources (C5)	0.116	Architectural sculptures	0.029	13				
					Historical sites	0.037	7				
					Plant diversity	0.026	18				
					Greening coverage rate	0.027	16				
					Topography	0.024	20				
			Cultural resources (C6)	0.038	Water resources	0.021	23				
					Cultural relics	0.023	21				
					Folk customs	0.019	26				
					Educational facilities	0.014	29				
					Facility (B4)	0.099	Basic facilities (C7)	0.048	Signage completeness	0.009	38
	Facility diversity	0.008	42								
	Maintenance status	0.010	36								
	Comfort level	0.011	34								
Distribution	0.010	37									
Recreational facilities (C8)	0.051	Recreational facility diversity	0.009	40							
		Recreational facility fun	0.007	43							
		Facility management	0.008	41							
		Facility safety	0.017	27							
		Waterfront facility rationality	0.010	35							
Recreational experience (B5)	0.267	Recreational space (C9)	0.137	Space diversity	0.031	11					
				Space comfort	0.061	1					
				Space safety	0.051	2					
				Waterfront accessibility	0.034	8					
				Recreational activities (C10)	0.130	Activity diversity	0.030	12			
		Participation level	0.032			9					
		Waterfront entertainment	0.027			17					
		Location/ Transportation (B6)	0.049			Location (C11)	0.021	Geographic location	0.009	39	
								Visitor proximity	0.013	33	
				Transportation (C12)	0.028	Internal transportation	0.013	32			
External transportation	0.013					31					

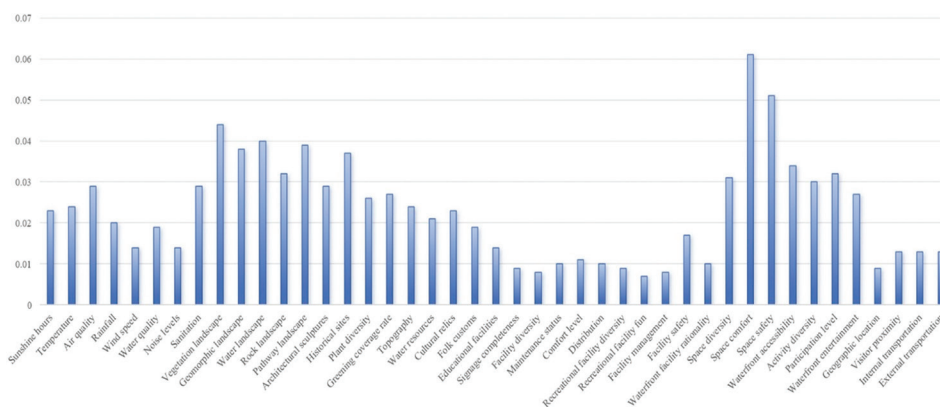


Figure 6. Weight chart of secondary indicators

level is recreational experience elements > landscape elements > environmental elements > resource elements > facility elements > location and transportation elements. This indicates that when evaluating the recreational suitability of Linyi's waterfront green spaces, greater emphasis was placed on whether the recreational experience met people's needs. Second, the construction of landscapes and the environment was also considered an important factor. The aspects of facilities and location/transportation had relatively less impact on the evaluation results. Among the first-level indicators, natural landscape, recreational space, recreational activities, and natural resources recorded high weights. These factors are often limited in urban environments, resulting in increased demand from tourists, which is reflected in their high weight proportions. It can be concluded from Figure 6 that among the secondary indexes, the comfort and safety of recreational spaces ranked highest. This indicates that the introduction of safe and comfortable recreational spaces in urban waterfront green spaces has a significant impact on the evaluation of recreational suitability.

In Yang's<sup>32</sup> evaluation of urban wetland park recreational suitability based on multivariate data, a rating system with 28 factors was developed, with the recreational landscape recorded the highest weight, highlighting its importance. Similarly, in the evaluation system constructed by Guo *et al.*<sup>49</sup>, 25 indicator layers were selected, with the recreational environment criteria exhibiting the highest weight. In contrast, the current study established an evaluation system with 43 secondary indicators, providing a more comprehensive selection of evaluation indicators. Among these, recreational experience and landscape elements received higher weights, aligning with previous studies.

### 3.2. Visitor demographics

As can be seen from Table 6, the majority of tourists visiting Linyi Calligraphy Square are between 26 and 50 years old, accounting for approximately 65% of the total sample. This indicates that

Table 6. Visitor demographic statistics

Category	Subcategory	Count	Proportion (%)
Gender	Male	101	34
	Female	199	66
Age	<18	9	3
	18–25	45	15
	26–30	62	21
	31–40	71	24
	41–50	61	20
	51–60	23	8
	>60	29	10
Transportation mode	Walking	94	31
	Cycling	94	31
	Driving	86	29
	Public transit	26	9
Visit frequency	Rarely	43	14
	Occasionally	128	43
	Frequently	129	43

the square primarily attracts predominantly adulthood and middle-aged tourists between 26 and 50 years old. Owing to the superior geographical location and convenient transportation access of Linyi Calligraphy Square, visitors frequently visit this place for recreation, with most traveling by bicycle or on foot. In addition, some visitors visit by private car.

### 3.3. Recreational suitability evaluation of Linyi Calligraphy Square

After collating the tourists' evaluations of Linyi Calligraphy Square, the survey results of the soft indicators are summarized in Table 7.

According to the result of the evaluation indicators, a fuzzy comprehensive evaluation matrix of 12 first-

**Table 7. Results for the evaluation indicators of Linyi Calligraphy Square**

Evaluation indicator	Evaluation criterion (%)				
	Excellent (5)	Good (4)	Average (3)	Poor (2)	Very poor (1)
Noise-limited condition	21.3	45.7	20.0	9.7	3.3
Environmental health	28.3	41.3	23.7	5.0	1.7
Vegetation landscape	35.0	40.7	18.0	4.0	2.3
Geomorphologic landscape	29.7	45.3	19.0	4.7	1.3
Water landscape	25.7	49.7	16.0	5.7	3.0
Rock landscape	29.7	41.0	22.7	4.0	2.7
Pathway landscape	26.3	48.7	20.7	3.0	1.3
Architectural sculptures	27.3	42.7	22.3	6.0	1.7
Folk customs	30.7	39.3	20.0	8.3	1.7
Educational facilities	29.3	41.0	26.0	2.7	1.0
Signage completeness	29.3	42.0	20.7	6.0	2.0
Maintenance status	33.7	40.7	20.0	4.0	1.7
Comfort level	33.0	44.0	16.3	5.0	1.7
Distribution	25.7	47.3	20.3	5.3	1.3
Recreational facility fun	31.7	37.7	22.0	6.7	2.0
Facility management	29.3	43.7	20.3	4.7	2.0
Facility safety	29.0	39.7	25.3	3.7	2.3
Waterfront facility safety	29.3	40.0	23.0	5.0	2.7
Space comfort	30.3	45.7	16.3	5.3	2.3
Space safety	32.0	44.3	19.3	1.7	2.7
Waterfront accessibility	29.7	40.3	23.0	5.0	2.0
Participation level	30.7	41.0	21.3	5.7	1.3
Waterfront entertainment	30.3	39.7	23.3	5.0	1.7
Visitor proximity	15.3	29.3	35.0	10.0	10.3
Internal transportation	26.3	46.3	22.3	2.7	2.3
External transportation	29.7	42.0	22.3	3.7	2.3

level evaluation indicators was established as follows in Equations V-XVI:

$$R_{C1} = \begin{pmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \end{pmatrix} \quad (V)$$

$$R_{C2} = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 0.213 & 0.457 & 0.2 & 0.097 & 0.033 \\ 0.283 & 0.413 & 0.237 & 0.05 & 0.017 \end{pmatrix} \quad (VI)$$

$$R_{C3} = \begin{pmatrix} 0.35 & 0.407 & 0.18 & 0.04 & 0.023 \\ 0.297 & 0.453 & 0.19 & 0.047 & 0.013 \\ 0.257 & 0.497 & 0.16 & 0.057 & 0.03 \\ 0.297 & 0.41 & 0.227 & 0.04 & 0.027 \end{pmatrix} \quad (VII)$$

$$R_{C4} = \begin{pmatrix} 0.263 & 0.487 & 0.207 & 0.03 & 0.013 \\ 0.273 & 0.427 & 0.223 & 0.06 & 0.017 \\ 1 & 0 & 0 & 0 & 0 \end{pmatrix} \quad (VIII)$$

$$R_{C5} = \begin{pmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{pmatrix} \quad (IX)$$

$$R_{C6} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0.307 & 0.393 & 0.2 & 0.083 & 0.017 \\ 0.293 & 0.41 & 0.26 & 0.027 & 0.01 \end{pmatrix} \quad (X)$$

$$R_{C7} = \begin{pmatrix} 0.293 & 0.42 & 0.207 & 0.06 & 0.02 \\ 1 & 0 & 0 & 0 & 0 \\ 0.337 & 0.407 & 0.2 & 0.04 & 0.017 \\ 0.33 & 0.44 & 0.163 & 0.05 & 0.017 \\ 0.257 & 0.473 & 0.203 & 0.053 & 0.013 \end{pmatrix} \quad (XI)$$

$$R_{C8} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0.317 & 0.377 & 0.22 & 0.067 & 0.02 \\ 0.293 & 0.437 & 0.203 & 0.047 & 0.02 \\ 0.29 & 0.397 & 0.253 & 0.037 & 0.023 \\ 0.293 & 0.4 & 0.23 & 0.05 & 0.027 \end{pmatrix} \quad (XII)$$

$$R_{C9} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0.303 & 0.457 & 0.163 & 0.053 & 0.023 \\ 0.32 & 0.443 & 0.193 & 0.017 & 0.027 \\ 0.297 & 0.403 & 0.23 & 0.05 & 0.02 \end{pmatrix} \quad (XIII)$$

$$R_{C10} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0.307 & 0.41 & 0.213 & 0.057 & 0.013 \\ 0.303 & 0.397 & 0.233 & 0.05 & 0.017 \end{pmatrix} \quad (XIV)$$

$$R_{C11} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0.153 & 0.293 & 0.35 & 0.1 & 0.103 \end{pmatrix} \quad (XV)$$

$$R_{C12} = \begin{pmatrix} 0.263 & 0.463 & 0.223 & 0.027 & 0.023 \\ 0.297 & 0.42 & 0.223 & 0.037 & 0.023 \end{pmatrix} \quad (XVI)$$

Using the multiplication bounded operator to comprehensively calculate the fuzzy vector, after normalization processing, the membership degree evaluation results of the first-level indicators were obtained. Similarly, the comprehensive evaluation results of the element layer and the target layer were calculated. As a result, the membership degree of Linyi Calligraphy Square was determined to be 0.352, 0.36, 0.244, 0.031, and 0.014. According to the principle of maximum membership degree, it can be concluded that the overall comprehensive evaluation of the recreational suitability of Linyi Calligraphy Square is “excellent,” and its membership degree is 0.36. To obtain the final score, the evaluation level  $V = (V_1, V_2, V_3, V_4, V_5)$  was assigned a value from 5 to 1, respectively. Finally, the score for the recreational suitability of Linyi Calligraphy Square is 4.004. According to the evaluation score and grade description for the recreational suitability of urban waterfront green spaces (Table 8), the recreational suitability degree of Linyi Calligraphy Square is high and belongs to the excellent level.

Based on the above analysis, the overall score for the recreational suitability of Linyi Calligraphy Square was obtained, providing a more quantifiable evolution result. The fuzzy comprehensive evaluation method played a key role in this analysis, offering significant advantages for the comprehensive analysis of both qualitative and quantitative indicators. This method was primarily informed by the evaluation system construction and case analysis conducted by Li *et al.*<sup>50</sup> and Wang *et al.*<sup>51</sup> The evaluation of the case area also verified the feasibility of the proposed recreational suitability evaluation system, offering valuable reference for future evaluations of recreational suitability in Linyi’s waterfront green spaces.

### 3.4. Overall evaluation of Linyi Calligraphy Square

After data consolidation, the results of the fuzzy comprehensive evaluation of the recreational suitability of Linyi Calligraphy Square are presented in Table 9. Based on the results, several secondary indicators, such as sunshine hours, temperature, rainfall, plant diversity,

greening coverage rate, and visitor proximity, were rated as “average.” Among these, sunshine hours, temperature, and rainfall are influenced by Linyi’s climate, which is characterized by a temperate monsoon climate with distinct seasons and concurrent rainy and hot periods, as well as low temperatures in winter. These factors, to some extent, affect the recreational experiences of visitors and are considered objective influences.

Similarly, plant diversity and greening coverage rate were rated as “average.” The current vegetation in Linyi Calligraphy Square is primarily composed of native species, leading to a relatively homogeneous species composition and a noticeable landscape uniformity. It is recommended that the park moderately introduce ornamental horticultural varieties that have been domesticated and selected to adapt to local climatic conditions, thereby enriching the plant community layers through scientific planning. This approach not only helps to build a more ecologically resilient vegetation system and optimize the park’s visual landscape effects, but also expands the tangible resources for public ecological education, creating a composite plant landscape system with both aesthetic value and educational function. According to the goals proposed by the government of Linyi city, the green land rate of built-up areas should not be <38%, and the greening coverage rate should not be <45% by 2025. The plant richness of Linyi Calligraphy Square can be improved to align with these goals, and the evaluation of recreational suitability in this aspect will also be enhanced.

Based on the analysis of survey questionnaires, visitors gave a generally high overall evaluation of Linyi Calligraphy Square. However, a significant number of visitors suggested adding a children’s play area and adult fitness equipment. This is because the park is located near residential areas, where the primary purposes of visitation include exercise and leisure activities for children. According to the actual situation, it is recommended that the park expand its functional zoning by increasing the provision of children’s activity areas, enriching recreational facilities for children, adding resting places, and enhancing the types of fitness equipment to better accommodate the needs of surrounding residents. At the same time, field investigations found that ongoing renovation and construction at Linyi Calligraphy Square have resulted in a lack of safety measures along the riverside walkways, posing potential risks to visitors. It is suggested that relevant management authorities implement appropriate safety protection measures, install warning signs or safety slogans, and improve safety infrastructure for water-related activities.<sup>52-54</sup>

**Table 8. Recreational suitability evaluation levels**

Level	Score range	Description	Final score
Excellent	>4.0	Very high recreational suitability	4.004
Good	3.0–4.0	High recreational suitability	
Average	2.0–3.0	Moderate recreational suitability	
Poor	1.0–2.0	Low recreational suitability	
Very poor	<1.0	Very low recreational suitability	

Table 9. Fuzzy comprehensive evaluation results of Linyi Calligraphy Square

Objective layer	Result	Factor layer	Result	Primary indicator	Result	Secondary indicator	Result				
Urban waterfront green spaces' recreational suitability (A)	Excellent	Environment (B1)	Good	Climatic conditions (C1)	Average	Sunshine hours	Average				
						Temperature	Average				
						Air quality	Good				
						Rainfall	Average				
				Environmental functionality (C2)	Good	Wind speed	Good				
						Water quality	Good				
						Noise levels	Good				
						Sanitation	Good				
		Landscape (B2)	Good	Natural landscapes (C3)	Good	Vegetation landscape	Good				
						Geomorphic landscape	Good				
						Water landscape	Good				
						Rock landscape	Good				
						Cultural landscapes (C4)	Excellent				
						Pathway landscape	Good				
				Resource (B3)	Average	Natural resources (C5)	Average	Architectural sculptures	Good		
								Historical sites	Excellent		
								Plant diversity	Average		
						Cultural resources (C6)	Excellent	Average	Excellent	Greening coverage rate	Average
										Topography	Good
										Water resources	Excellent
		Facility (B4)	Excellent	Basic facilities (C7)	Excellent	Excellent	Cultural relics	Excellent			
							Folk customs	Good			
							Educational facilities	Good			
							Signage completeness	Good			
							Facility diversity	Excellent			
				Recreational facilities (C8)	Excellent	Excellent	Excellent	Maintenance status	Good		
								Comfort level	Good		
								Distribution	Good		
Recreational facility diversity	Excellent										
Recreational facility fun	Good										
Facility management	Good										
Facility safety	Good										
Waterfront facility rationality	Good										

(Cont'd...)

Table 9. (Continued)

Objective layer	Result	Factor layer	Result	Primary indicator	Result	Secondary indicator	Result
		Recreational experience (B5)	Excellent	Recreational space (C9)	Excellent	Space diversity	Excellent
						Space comfort	Good
						Space safety	Good
						Waterfront accessibility	Good
				Recreational activities (C10)	Excellent	Activity diversity	Excellent
						Participation level	Good
						Waterfront entertainment	Good
		Location/ transportation (B6)	Excellent	Location (C11)	Excellent	Geographic location	Excellent
						Visitor proximity	Average
				Transportation (C12)	Good	Internal transportation	Good
						External transportation	Good

#### 4. Conclusion

This article reviewed research on the evaluation of recreational suitability for waterfront green spaces in both domestic and international cities, highlighting the need to establish a system tailored for assessing the recreational suitability of Linyi’s waterfront green spaces. This aimed to provide reasonable recommendations for enhancing the recreational suitability of existing waterfront green spaces in Linyi. By employing AHP, the Delphi method, and the fuzzy comprehensive evaluation method, a recreational suitability evaluation system for Linyi’s waterfront green spaces was developed, comprising six element layers, 12 primary indicators, and 43 secondary indicators. The evaluation of the recreational suitability of Linyi Calligraphy Square was conducted using questionnaire surveys and relevant data calculations, resulting in a recreational suitability evaluation score of 4.004 for Linyi Calligraphy Square. Based on the feedback from the questionnaires and survey results, the following suggestions for improvement are proposed for Linyi Calligraphy Square:

- (i) Increase the diversity of plant species in Linyi Calligraphy Square by introducing species suitable for the local climate, diversifying plant arrangements, and increasing both interest and aesthetic appeal.
- (ii) Install children’s play areas and fitness equipment to cater to the recreational needs of nearby residents and tourists.
- (iii) Enhance safety measures by improving warning signs

and notices to ensure visitor safety and improve the safety levels of water-related activities.

- (iv) Plan parking spaces effectively, with separate areas for motor vehicles and non-motor vehicles, to accommodate more people.

In conclusion, this study conducted a systematic evaluation of the recreational suitability of urban waterfront green spaces, summarizing the primary factors influencing this evaluation. It established an evaluation system tailored to the recreational suitability of Linyi’s waterfront green spaces, clarifying the standards for various indicators. With the continuous development of the economy, people are increasingly pursuing spiritual fulfillment. In the context of fast-paced urban life, there is a growing desire for access to natural landscapes. Urban waterfront green spaces combine both natural and cultural landscapes, with the presence of water bodies and greenery highlighting their uniqueness and importance. They not only enrich the comprehensive utilization of the city but also promote diversified urban development. The reasonable planning and construction of waterfront green spaces contribute to shaping the unique character and enhancing the overall image of the city. In addition, waterfront green spaces can effectively integrate with other functional areas of the city, forming an urban spatial pattern of complementary functions and coordinated development. Therefore, it is crucial to grasp the current level of recreational suitability of waterfront green spaces. In-depth research

and comprehensive evaluations of recreational suitability play a positive and promoting role in the construction and development of urban waterfront green spaces.

Due to limited time and energy, this study has several limitations. The evaluation indicators were compiled from existing literature and refined based on expert opinions. However, their comprehensiveness may still be limited, and certain dimensions warrant further exploration. In addition, the evaluation process may have been influenced by subjective factors, which should be addressed through improved methods in future research applications. Moreover, the field validation focused solely on Linyi Calligraphy Square as a single case study, resulting in a somewhat limited and context-specific analysis. An important future research direction is to incorporate more perspectives and increase the number of expert participants. In terms of case study analysis, more urban waterfront green spaces should be selected for comprehensive research to further explore the generalizability of the recreational suitability evaluation system.

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## Conflict of interest

The authors declare that they have no competing interests.

## Author contributions

*Conceptualization:* All authors

*Data curation:* All authors

*Formal analysis:* All authors

*Investigation:* Haixia Chen

*Methodology:* Qianda Zhuang

*Visualization:* Haixia Chen

*Writing—original draft:* Haixia Chen

*Writing—review & editing:* Qianda Zhuang

## Ethics approval and consent to participate

Informed consent was obtained from the participants before participation.

## Consent for publication

Participants consented to the publication of their data.

## Availability of data

The data presented in this study are available on request from the corresponding author.

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## Appendices

### Appendix 1. Questionnaire for screening evaluation indicators of recreational suitability in urban waterfront green spaces

Dear expert,

Hello! I am a professional student from the College of Agriculture and Forestry Science Garden, currently conducting research on the urban waterfront green space recreation suitability evaluation index system. Given your in-depth research in this field, I am seeking your professional knowledge and insights to determine the evaluation index. Hope you can, despite being very busy, take a glance and precious time to fill in this form! Dear experts, based on your professional judgment, please make important judgments and reasonable screenings for the indicators of this research, and score them according to their importance at the end: “Unimportant 1 point, relatively unimportant 2 points, moderately important 3 points, relatively important 4 points, important 5 points.” Thank you very much for your help and guidance!

**Table A1. Scoring table for recreational suitability indicators of urban waterfront green spaces**

Objective layer	Factor layer	Primary indicator	Classify and code	Secondary indicator	Score		
Urban waterfront green spaces' recreational suitability	Environmental elements	Climatic conditions	1	Ultraviolet radiation			
			2	Temperature			
			3	Air quality			
			4	Air humidity			
			5	Rainfall			
			6	Wind speed			
		Environmental functionality	7	Water quality			
			8	Noise levels			
			9	Sanitation			
			Landscape elements	Natural landscapes	10	Vegetation landscape	
					11	Geomorphic landscape	
					12	Revetment landscape	
				13	Water landscape		
				14	Rock landscape		
				15	Skyline view		
	Cultural landscapes	16	Pathway landscape				
		17	Architectural sculptures				
		18	Historical sites				
		19	Hard landscape				
		Resource elements	Natural resources	20	Plant diversity		
				21	Greening coverage rate		
	22			Topography			
	Cultural resources		23	Water resources			
			24	Cultural relics			
			25	Folk customs			
	Facility elements	Basic facilities	26	Festival activities			
			27	Educational facilities			
			28	Signage completeness			
			29	Facility diversity			
			30	Service condition			
			31	Maintenance status			

(Cont'd...)

Table A1. (Continued)

Objective layer	Factor layer	Primary indicator	Classify and code	Secondary indicator	Score
			32	Comfort level	
			33	Distribution	
		Recreational facilities	34	Recreational facility diversity	
			35	Recreational facility fun	
			36	Facility management	
			37	Facility safety	
			38	Safety of water-friendly facilities	
			39	The fun of water-friendly facilities	
			40	Waterfront facility rationality	
	Recreational experience	Recreational space	41	Space diversity	
			42	Space comfort	
			43	Space safety	
			44	Waterfront accessibility	
		Recreational activities	45	Activity diversity	
			46	Participation level	
			47	The appeal of recreational activities	
			48	Waterfront entertainment	
	Location/transportation	Location	49	Geographic location	
			50	Visitor proximity	
		Transportation	51	Internal transportation	
			52	External transportation	

1. Do you think the above indicators are reasonable?
  - A. Very reasonable
  - B. Reasonable
  - C. Basically reasonable
  - D. Unreasonable
  - E. Very unreasonable
2. In your opinion, the indicators that need to be added are:
  - A. The indicators that need to be deleted are:
  - B. The indicators that need to be modified are:

This concludes the questionnaire. To prevent any omissions, please check each question again to see if you have missed any. Thank you! I wish you a smooth work and good health!

Appendix 2. Questionnaire for the evaluation of the recreational suitability of Linyi Calligraphy Square

Dear visitors:

Hello! I am a student majoring in landscape architecture at Linyi University. My supervisor is Dr. Zhuang. I am currently conducting research on the recreational suitability of the Calligraphy Square in Linyi to better understand everyone’s attitudes and thoughts toward the Calligraphy Square in Linyi and to propose feasible construction and countermeasures for the recreational suitability of the Calligraphy Square. We hereby raise the following questions to you. We hope you can cooperate actively. Thank you for your cooperation! If you have any questions, please contact: 1786449XXXX.

I. Basic information of tourists

1. Your gender:
  - A. Man
  - B. Woman
2. Your age:
  - A. Under the age of 18
  - B. 18–30
  - C. 31–50
  - D. 51–60
  - E. Over 60
3. The main mode of transportation for you to come to the park:
  - A. Walk
  - B. Bicycle
  - C. Driving a car
  - D. Public transport
4. Your frequency of visiting the park for recreation:
  - A. Seldom
  - B. Occasionally
  - C. Frequently
5. The purpose of your visit to the park: (Multiple choices available)
  - A. Appreciate a beautiful scene
  - B. Be close to nature
  - C. Relax and live
  - D. Do physical exercise
  - E. Widen horizons
  - F. Communication and friends
  - G. Others
6. The distance from you to the park:
  - A. 500–1,000 m
  - B. 1,000–3,000 m
  - C. 3,000–5,000 m
  - D. over 5,000 m

II. Survey form on tourists’ evaluation of the recreational suitability of Linyi Calligraphy Square

Evaluation indicator	Evaluation criterion (percentage)				
	Excellent	Good	Average	Poor	Very poor
	5 point	4 point	3 point	2 point	1 point
Noise-limited condition					
Environmental health					
Vegetation landscape					
Geomorphologic landscape					
Water landscape					
Rock landscape					
Pathway landscape					
Architectural sculptures					
Folk customs					
Educational facilities					
Signage completeness					
Maintenance status					

Comfort level  
Distribution  
Recreational facility fun  
Facility management  
Facility safety  
Waterfront facility safety  
Space comfort  
Space safety  
Waterfront accessibility  
Participation level  
Waterfront entertainment  
Visitor proximity  
Internal transportation  
External transportation

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Your overall evaluation of this park is:

- A. Excellent
- B. Good
- C. Average
- D. Poor
- E. Very poor

Your opinions and suggestions on Linyi Square:

The questionnaire is over. Thank you for your cooperation. I wish you good health and smooth work. Thank you!