Research Article

Advances in Urban Regional Development and Planning

Country Park Landscape Quality Evaluation and Optimization Strategies Based on the AHP-TOPSIS-POE Model: A Case Study of Four Country Parks in Shanghai

Yunpeng Li[1*], Jianwei Liu[2], Wei Zhu[3] and Jingyu Luo[4]

[1]*School of Art and Design, Shanghai University of Engineering Science, Shanghai 201620, China.*

[2]*School of Art and Design, Shanghai University of Engineering Science, Shanghai 201620, China.*

[3]*School of Art and Design, Shanghai University of Engineering Science, Shanghai 201620, China.*

[4]*School of Art and Design, Shanghai University of Engineering Science, Shanghai 201620, China.*

[*]Corresponding Author
Yunpeng Li, School of Art and Design, Shanghai University of Engineering Science, Shanghai 201620, China.

Submitted: 2024, Jan 29; **Accepted**: 2024, Feb 19; **Published**: 2024, Mar 04

Citation: Li, Y., Liu, J., Zhu, W., Luo, J. (2024). Country Park Landscape Quality Evaluation and Optimization Strategies Based on the AHP-TOPSIS-POE Model: A Case Study of Four Country Parks in Shanghai. *Adv Urban Region Dev Plann ,1*(1), 01-21.

Abstract

To clarify the differences in the landscape environment quality of urban country parks, we used the analytic hierarchy process method (AHP) and the approaching ideal solution method (TOPSIS) to build a criterion layer from four points of view: ecological environment, visual landscape, service facilities and humanistic landscape. We selected 21 evaluation factors to form an index layer to evaluate the landscape quality of four country parks in Shanghai. The AHP-TOPSIS evaluation system was validated using the post occupancy evaluation method (POE) to verify the accuracy and appropriateness of the system. We proposed landscape improvement strategies based on the evaluation results. The results showed that the combined AHP-TOPSIS-POE model can be used to effectively assign weights to evaluation indexes when evaluating the landscape quality of country parks and to avoid the one-sidedness of single-factor decision making and the errors caused by human subjective factors. The AHP-TOPSIS-POE model provides a new framework for evaluating the landscape quality of urban country parks.

1 . Introduction

1.1 Description of the Study Area

A country park is a defined zone that is near downtown, the purpose of which is ecological conservation and the provision of leisure, recreational and educational services to the public [1]. Country parks located in the transition zone between urban and rural areas meet people's psychological need for experiencing nature. Country parks provide short-distance recreational opportunities due to their convenient geographical location and natural, tranquil environment, as well as protecting natural resources in the suburbs, combatting the problem of urban sprawl caused by rapid urbanization, and promoting urban construction [2].

With the number of confirmed COVID-19 cases and deaths increasing, the outbreak represents an unprecedented health crisis for human society [3]. Country parks have gradually become key to balancing urban development and natural ecological protection, and they also play an important role in relieving people's mental and psychological stress. The demand for countryside landscapes is increasing, and urban parks serve the dual functions of providing scenic locations for leisure activities and also supplying various ecosystem services [4]. Improving residents' satisfaction with the quality of country park landscapes has important long-term implications for the sustainable development of country parks.

Shanghai is a pioneer in the construction of country parks and urban ecological conservation in China.In 2008, the construction of pilot country parks in the suburbs of Shanghai was proposed. Shanghai has been planning the construction of country parks since 2012 as an exploratory program designed to solve a series of ecological and environmental problems such as rapid urban expansion [5]. The preliminary site selection of 20 country parks in the "Shanghai Basic Ecological Network Planning" with a total land area of about 400km2 [6].

Was undertaken.In 2014, two new pilot sites were added in Jinshan

,Langxia and Songjiang Guangfulin, and in 2020, the number of country parks was increased to more than 30 in the "Shanghai Ecological Space Special Plan (2018-2035)." By 2023, Shanghai will have built 8 country parks, mainly in areas between 20km and 50km from the city center(Figure 1).

At present, there are increasing numbers of studies being conducted on the landscape design of country parks [7]. this research hotspot focuses on plant creation and configuration, Regional cultural landscapes, Country Park Design Strategies and Applications, Country Parks Vernacular Landscape Design and the Construction of the Country Parks Evaluation System [8]. Most of the studies examining the evaluation of country parks are based on the evaluation of social functions such as the quality of open space and the degree of recreation, as well as the evaluation of ecological functions such as the value of ecological services, landscape patterns, plant communities and planning layouts [9]. The rational and quantitative evaluation of country park landscapes using multi-disciplinary knowledge can provide a scientific basis for decision-making regarding country park construction. In terms of development needs, to make full use of the existing park environment and to effectively promote both resident health and the environment exploring how residents evaluate country parks after visiting them in greater depth is necessary [10]. To accurately assess the ecological benefits and values of country parks, the established country parks need to be improved and the planning of future country parks needs further guidance[11].

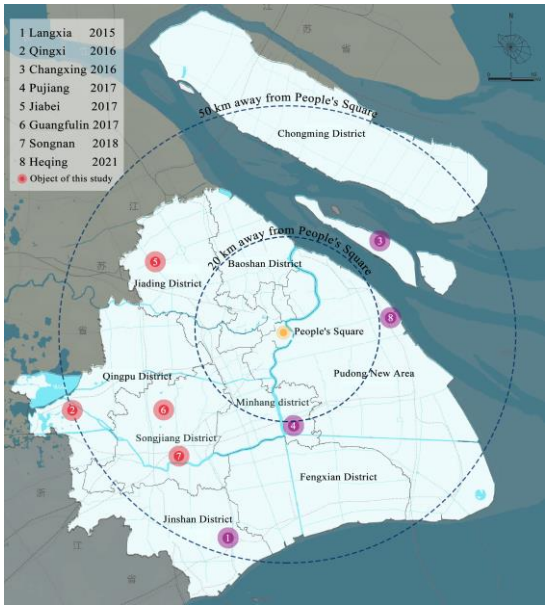

Figure 1: Distribution of Country Parks in Shanghai

AutoCAD(version2021),Photoshop(version2020),GIS(version10.5) were used for data analysis and visualization.

Figure 1 The map in picture was drawn by our team, using Baidu Map as a reference.
URL: https://map.baidu.com/@13501954,3627403,13z

Presently, the main challenge regarding the development of country parks is determining how best to improve the existing planning and design methods and balance the various landscape factors in practice. In this study, the requirements for the characteristic landscape and ecological themes of country parks in the Design Standards for Shanghai Country Parks (DG/TJ 08-2335-2020) are taken as a reference. As the design themes of country parks vary according to their location and surrounding environment, the six thematic functions of holiday and leisure, agricultural experience, special workshops, food and catering, vibrant creativity and new agriculture are used as the basis for selecting the sample of parks (Figure 2). Through the field research conducted on the extant country parks, the country parks located in the countryside were selected as the samples for this study. Among them, the site layout of Langxia Country Park is overly dispersed, and only Phase I of Heqing Country Park was opened by 2021, exhibiting a shorter time of completion and operation and thus being omitted for the time being from the study sample. The theme of Guangfulin Country Park was identified as cultural heritage, that of Qingxi Country Park as natural water veins, that of Jiabei Country Park as idyllic scenery, and that of Songnan Country Park as ferry ports and forested landscape. A study was conducted on the specific embodiment of the six thematic functions in the evaluation of landscape quality in country parks across different themes.

Figure 2: Embodiment of the Six Thematic Functions in Country Parks

We conducted a field survey to study several country parks in Shanghai and classified them according to theme: Guangfulin Country Park, located in the northwestern part of Songjiang District, includes land use types such as arable land, forest land, garden land, other agricultural land, water, etc., and the park as a whole forms a landscape characterized by farming fields, ecological forests, and wetland fish ponds. Relying on the thousand-year cultural roots of Songjiang Guangfulin, the cultural landscape of the park is based on the "deer" element, which reflects the regional culture of Songjiang and the pattern of the south of the lower reaches of the Yangze River; Qingxi Country Park is located in the southwestern part of Qingpu District, and the surrounding land use types are dominated by watersheds, basic farmland protection zones and agro-forestry complex areas. It contains 10 administrative villages, where rural buildings and the surrounding water system and farmland together form a unique texture south of the lower reaches of the Yangze River. In the overall design and planning of this park, water is used to thematically organize farmland, wetlands, forests and other green spaces, highlighting the modern concept of idyllic life. Jiabei Country Park is located in the northwestern part of Jiading District, and its planning and design uses the field as the central original landscape design theme, and represents an endeavour to utilize agro-forestry ecology-based, natural wildlife as the basis of the farming theme of this country park. About 12 per cent of the area comprises rural settlement land housing eight administrative villages, thus forming a landscape mosaic structure with farmland as the matrix, waterways and roads as corridors, and rural settlements as embellishments. Songnan Country Park is located in the Songjiang District, and is characterized by rich woodland resources and farmland, positioning water, forests, fields and villages in harmony and interdependence within the landscape of this riverside ecological forest country park (Table 1).

Name	Area [km^2]	Forest land	water area	cultivated land	Orchard
Guangfulin Country Park	4.25	27%	21%	42%	7%
Jiabei Country Park	14.0	6%	12%	12%	3.5%
Qingxi Country Park	22.35	15%	40%	13%	6%
Songnan Country Park	23.71	26%	5%	41%	13%

Table 1: Design Themes and Regional Overview of the Four Country Parks in Shanghai

From the profiles of the four country parks, it can be seen that despite the differences in geographical area, each of these parks are designed and planned around farmland, woodland, waters, orchards and villages, and the functions of the country parks include ecological environmental protection, the coordination of urban and rural development, the provision of open space, etc. Exploring the comparative landscape quality of country parks with similar environments and summarizing the characteristics of their planning and design, as well as those of their potential problems, through inductive analyses and scientific evaluations to present targeted optimization strategies that can facilitate the dual development of the theory and practice of country parks is of great importance (Figure 3).

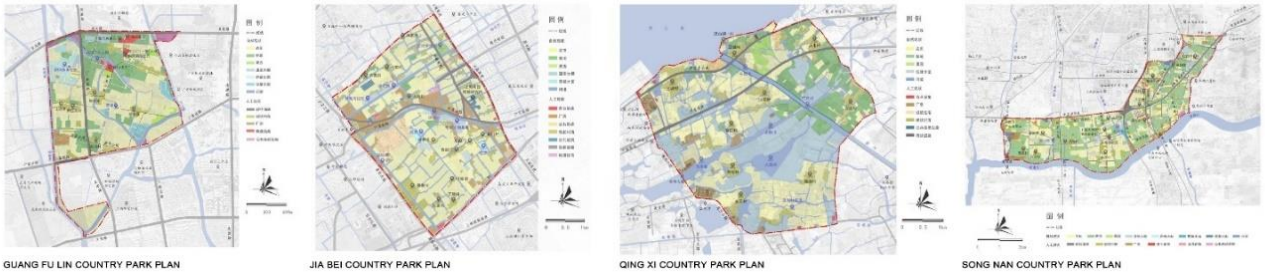

Figure 3: Map of Four Country Parks Areas in Shanghai

Figure 3 The map in picture was drawn by our team, using Baidu Map as a reference.
URL: https://map.baidu.com/@13501954,3627403,13z

1.2 Evaluation Methods

Landscape quality actually implies both "Visual and Audible Esthetic Quality." In the 1960s and 1970s, Europe, America and other developed countries began concurrently initiating research on landscape esthetic resources, etc., and issuing related laws and regulations to strengthen the level of environmental protection through increasingly higher awareness of this issue [12]. Further, researches on the theories and methods of landscape evaluation has also been conducted, and four different schools of thought regarding landscape quality developed: the specialist school emphasizes formal beauty; the psychological school sees landscape esthetic appreciation as a stimulation-reaction relationship; the cognitive school uses the theory of evolution as their guiding theory; and the empirical school emphasizes the social cultural attributes of human beings [13]. The main difference between these four schools of thought lies in the different starting points taken for evaluation, and the evaluation models used are subdivided into six types, namely, formal aesthetic, ecological, cognitive, empirical, psychological and psychophysical models, which have, in turn, spawned a wide range of distinct evaluation methods[14]. Such methods include the Scenic Beauty Estimation Method (SBE), BIB-LCJ, Analytic Hierarchy Process (AHP), Semantic Differential Method (SD) and the Physiological Psychology Index Testing Method (PPI) [15].

The amount of scholarly research on country park landscape design is increasing, and this research is focused on several aspects: the growth and configuration of plants, Regional Cultural Landscapes, Country Park Design Strategy and Application [16]. country park vernacular landscape application[17]. The spatial and temporal characteristics of visitor activities in country parks, and other broad topics in landscape green space planning and design [18]. Ling-Yan Xiang et al studied landscape evaluation and the optimization of township parks using POE and AHP in combination with GIS technology [19]. Li Danning et al conducted a post occupancy evaluation (POE) study based on multiple sources of data, and they combined GPS and remote sensing data with traditional questionnaire data to explore the specific spatial point associations of visitor use characteristics and recreation preferences [20]. Lu Xiusheng et al studied the landscape quality of country park recreation space, integrated a literature review and expert consultation results, and explored the establishment of a comprehensive, targeted evaluation system [21]. Wang Ruiqi et al evaluated the habitat quality of the study area using the InVEST evaluation model to provide a scientific basis for country park site selection [22]. Liu Miao et al used hierarchical analysis to construct an evaluation system for country park plant landscapes and studied the use of landscape, ecological, and practical functions as evaluation criteria [23]. Visual quality assessment is a prominent approach for assessing landscapes as aesthetic entities has become an essential research topic in this area. Further research on this topic must be based on the evaluation model and leverage the selection and application of relevant indicators [24]. The combined use of multiple methods has also become a common trend [25].

The AHP method is mainly applicable to the multi-objective, multi-criteria, decision-making structures of complex decision-making problems. It is used to decompose the relevant elements into objectives, criteria, programs and other level elements, on the basis of which qualitative and quantitative analysis of the decision-making methods Is conducted [26]. From the evaluation results using AHP and SBE, the consistency of the two evaluation results can be seen to be high, the use of the SBE method can be seen to favor visual effects, and the use of the AHP method can be seen to account for the principles of aesthetics and of ecology in plant landscaping, and it is a fairer and more accurate evaluation of plant landscapes[27]. The use of AHP by scholars has been common in landscape evaluation, including planting landscapes, urban green space landscapes and urban road landscapes [28,29]. However, the AHP method also has some limitations: it can be used to distinguish only the advantages and disadvantages of a number of programs, but it really cannot be used to design new and better programs; the amount of data used is relatively small, the level of quantitative research enabled is insufficient, the evaluation of the indicators mainly relies on the unilateral judgement of the experts, and it necessitates the introduction of a wider range of evaluating groups [30].

TOPSIS is a widely used evaluation method. Since Hwang first proposed the TOPSIS n method, it has been widely applied in an extensive range of fields such as economics, sociology, and the natural sciences. This method is based on calculating the Euclidean distance between each evaluation program and the ideal and negative ideal solutions and then ranking them according to resulting data to obtain the effectiveness of these evaluation programs [31]. A number of scholars have used the TOPSIS method in rural landscape, coastal environmental protection, clump plant vision and other aspects of scholarly studies [32]. The TOPSIS method also suffers from several shortcomings, including the fact that the indicators have a weak influence in evaluating programs, and public groups are unable to get a real feel for them through field research [33,34].

1.3 Post Occupancy Evaluation

Preiser et al. defined POE as a systematic series of evaluations of the built environment that are conducted over time, with POE emphasizing the psychological needs of users and the performance of the built environment in practice [35]. POE has become one of the mainstream methods for evaluating the use of parks. There are two main approaches to landscape evaluation research using POE. The first is aesthetic research, i.e., the landscape evaluation of urban open spaces, where a landscape evaluation system is constructed through research and information feedback [36]. The other type of study is practical, in which feedback is collected in the form of questionnaires and field visits for the comprehensive evaluation of the use of urban parks in terms of user behavior and satisfaction to suggest improvements. Currently, POE is generally applied to studies on the landscape and facility enhancement of single or multiple parks and green spaces , There are relatively few studies on urban park green space systems, but evaluating the use of urban park green space as a whole has important reference value for improving the green space service function of the entire city [37,38].

2. Materials and Methods

2.1 Research Method

In this study, we applied the AHP-TOPSIS-POE evaluation model, which combines qualitative and quantitative evaluation, to establish a more suitable method for country park landscape quality assessment. The hierarchical analysis method was used to scientifically determine the weight values of each evaluation factor and the superiority and inferiority solution distance method was used to overcome the issue of the scientific ranking of decision objects in multiobjective decision making. The results of the AHP-TOPSIS model were assessed using the condition evaluation method to verify the accuracy of the model, and appropriate corresponding optimization and enhancement strategies were applied in response to these evaluation results. The AHP-TOPSIS comprehensive evaluation model organically combines the two to increase the effectiveness of the evaluation method, to improve its operability, and to enhance the objectivity and accuracy of the evaluation results. Firstly, the hierarchical analysis method was used to decompose the multi-objective decision-making problem into a number of levels of criteria and indicators, and the qualitative indicators were then fuzzy quantified to determine the weight value of each indicator. The weights derived from the hierarchical analysis are then ranked using the TOPSIS method so that the assessment results reflect the subjective intentions of the experts to the greatest extent possible [39]. Combining the advantages of both methods enables better differentiation in landscape evaluation and classification and is also applicable to the evaluation and classification of different landscape construction levels [40]. Finally, the POE method was adopted to evaluate the usage status in an attempt to fill the gap regarding the landscape quality evaluation system for Shanghai country parks and provide a basis for the planning and construction of future country parks (Figure 4) [41].

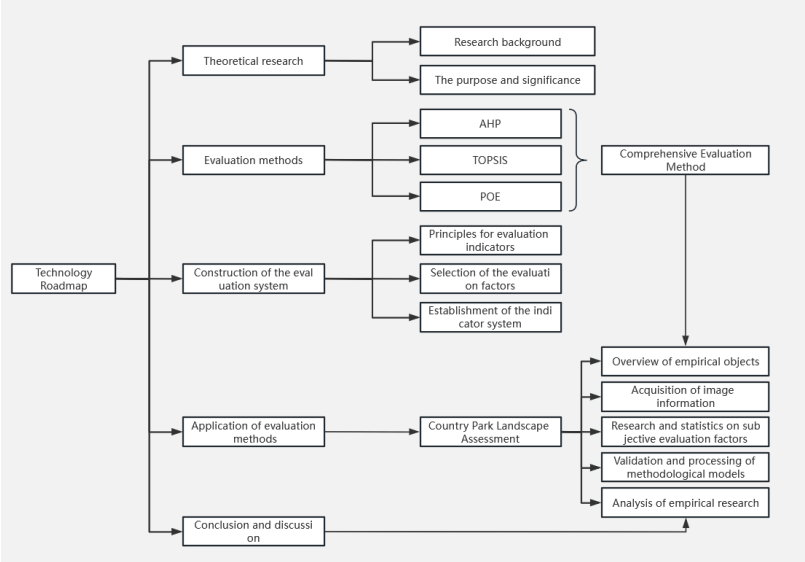

Figure 4: Technology Roadmap for Evaluating

2.2 Construction of Shanghai Country Park Evaluation Index System

The evaluation of the landscape quality of Shanghai country parks is based several indicators, and the evaluation indexes are relatively comprehensive. The evaluation index system was established mainly from the perspective of "human-action-space-place-environment" [35]. Based on the behavior of its users. Existing national and local standards were used as a reference: Park Design Code (GB 51192-2016), Urban Green Space Classification Standard (CJJ/T 85-2017), Shanghai Country Park Design Standard (DG/TJ 08-2335-2020), and other relevant guidelines. Combined with a review and analysis of domestic and foreign literature related to park landscape quality evaluation and field research, this information was used to select four evaluation indexes to reflect the real landscape quality and the landscape characteristics of country parks. To ensure that the evaluation indexes were objective and practical, 10 experts from local universities, including faculty members of landscape architecture, urban and rural planning and design, were invited to compare, screen and revise the 24 evaluation indexes and finally determine four target layers of ecological landscape, visual landscape, subsidiary landscape and humanistic landscape, with 21 indexes to build the country park evaluation index system (Table 2).

Objective layer（A）	**Criterion（B）**	**Plan（C）**	**Selection basis**	**Program layer（D）**
Country park landscape quality evaluation systemA	B1 Ecological landscape	C1 Diversity of plant species	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	Four country parks in Shanghai: Guangfulin Country Park, Jiabei Country Park, Qingxi Country Park and Songnan Country Park in Songjiang District.
		C2 Diversity of wetland types	Literature[42]	
		C3 Eco-river landscape	Literature[43]	
		C4 Eco-conservation construction	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
		C5 Species habitat quality	Literature[44]	
		C6 Landscape scale	Literature[45]	
		C7 Vertical design[46]	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
		C8 Landscape color	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
		C9 Nature and wildlife	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
		C10 Plant seasonal phases	Literature[47]	
		C11 Iconic landscape structures	Literature[48]	
	B3 Accessory landscape	C12 Optimization of visitor services	Literature[49]	
		C13 Accessibility of spatial routes	Literature[50]	
		C14 Rational service facilities	《Park Design Specification》GB 51192-2016	

		C15 Safety and accessibility design	《Park Design Specification》GB 51192-2016 ;	
		C16 Intelligent science system control	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
		C17 Regional culture showcase	《Park Design Specification》GB 51192-2016 ; 《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
	B4 Humanistic landscape	C18 Scientific research and the popularization of science	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
		C19 Agricultural tourism experience	《Shanghai Country Park Design Standards》DG/TJ08-2335-2020	
		C20 Human landscape shaping	Literature [26]	
		C21 Cultural and artistic innovation	Literature [26]	

Table 2: Evaluation Index System of Country Park Landscape Spatial Configuration

2.3 Ahp-Topsis-Poe Combinatorial Model Construction

The main process of constructing the combined AHP-TOPSIS-POE model proposed in this paper is as follows:

2.4 Constructing the Judgment Matrix

Referring to the 1-9 scale method in AHP evaluation, experts are invited to make a two-by-two comparison of the relative importance of each index at each level and construct a judgment matrix

$$A = (a_{ij})_{n\times n},\ \ a_{ij} > 0, a_{ij} = 1/a_{ji}\ , \qquad (1)$$

where a_{ij} (i,j=1,2,K,K_n) represents the proportional scale of the contribution of elements A_i and A_j relative to the index at the upper level.

2.5 Checking Matrix Consistency

When constructing judgment moments, there is a possibility of logical errors, and a consistency check is needed. The random consistency ratio CR is calculated. When CR<0.10,the matrix passes the consistency test and the weight indicators are considered reasonable; otherwise, the matrix calculation needs to be readjusted as follows:

Calculate the maximum characteristic root λ_{max} of the judgment matrix A

$$\lambda_{max} = \sum_{i=1}^{n} \frac{1}{nQ_i} \sum_{j=1}^{n} X_{ij} Q_j \quad (2)$$

Calculate the consistency evaluation index

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (3)$$

Calculate the random consistency ratio

$$CR = \frac{CI}{RI} \quad (4)$$

2.6 Determining the Topsis Weighted Ranking of Evaluation Objects

The evaluation using the TOPSIS method requires normalization of the original data of the indexes by homotrending and sum of squares to eliminate errors to construct a weighted standardized matrix. The normalized matrix Z and the weighted matrix Z' are constructed from the matrix A,whose elements are Z_{ij} and Z_{ij}'; the positive ideal solution and the negative ideal solution of the evaluation object are determined, where the positive ideal solution matrix is Z^+ , and the negative ideal solution matrix is Z^-.

$$Z^+ = [maxZ_{ij} | j \in J, minZ_{ij} | j \in J'] = [Z_1^+, Z_2^+ \ldots\ldots Z_m^+]$$
$$Z^- = [minZ_{ij} | j \in J, maxZ_{ij} | j \in J'] = [Z_1^-, Z_2^- \ldots\ldots Z_m^-] \quad (5)$$

2.7 Calculating the Distance Between the Evaluation Object and the Positive Ideal Solution and the Negative Ideal Solution

The Euclidean distance values of the object to be evaluated and the positive ideal solution S_i^+ and the negative ideal solution S_i^- are calculated respectively.

$$S_i^- = \sqrt{\sum_{j=1}^{m} (Z_{ij} - Z_j^-)^2} \qquad S_i^+ = \sqrt{\sum_{j=1}^{m} (Z_{ij} - Z_j^+)^2} \quad (6)$$

2.8 Calculating the Relative Proximity of Each Evaluation Object to the Optimal Value

The relative proximity of each solution to the ideal solution is calculated according to the Euclidean distance, and the superiority sequence of the samples to be evaluated is ranked according to the relative proximity from the largest to the smallest.

$$C_i = \frac{S_i^-}{S_i^+ + S_i^-} (i = 1,2, \ldots\ldots, n), 0 \le C_i \le 1 \quad (7)$$

3. Results and Discussion

Ahp Method for Determining Index Weights

The indicator weights were calculated from the data derived from the indicator system weighting questionnaire. Four representative Country Parks were selected for the evaluation analysis: Shanghai Guangfulin Forest Country Park, Jiabei Country Park, Qing Xi Country Park and Song Nan Country Park (Table 3). The evaluation indexes consisted of qualitative and quantitative indicators, and the qualitative indicators were scored by experts according to the evaluation criteria. The scores were in the range of 0 to10, with higher scores representing better performance in the opinion of experts. The quantitative indicators were obtained from questionnaires administered to residents of the surrounding areas and tourists.

Index	Guangfulin Country Park	Jiabei Country Park	Songnan Country Park	Qingxi Country Park
Diversity of plant species C1	0.65	0.53	0.68	0.71
Diversity of wetland types C2	0.33	0.48	0.54	0.75
Eco-River Landscape C3	0.55	0.62	0.71	0.82
Eco-conservation construction C4	0.75	0.72	0.79	0.81

Species Habitat Quality C5	0.84	0.80	0.81	0.93
Landscape Scale C6	0.78	0.82	0.83	0.88
Vertical design C7	0.75	0.71	0.82	0.86
Landscape Color C8	0.73	0.70	0.75	0.82
Nature and Wildlife C9	0.84	0.82	0.88	0.85
Plant seasonal phases C10	0.72	0.69	0.75	0.84
Iconic Landscape C11	0.82	0.76	0.85	0.92
Perfection of visitor services C12	0.61	0.57	0.65	0.73
Accessibility of spatial routes C13	0.84	0.89	0.92	0.95
Reasonableness of service facilities C14	0.62	0.57	0.53	0.64
Safety and Accessibility Design C15	0.81	0.84	0.85	0.87
Intelligent science system control C16	0.67	0.65	0.68	0.71
Regional Culture Showcase C17	0.62	0.56	0.57	0.68
Scientific research and popularization of science C18	0.60	0.57	0.59	0.66
Agricultural tourism experience C19	0.75	0.71	0.72	0.83
Human landscape shaping C20	0.71	0.68	0.72	0.81
Cultural and artistic innovation C21	0.74	0.70	0.68	0.79

Table 3:Values of Landscape Quality Evaluation Factors Of Four Country Parks In Shanghai

To ensure the scientificity and accuracy of the evaluation system, 15 experts and scholars engaged in landscape gardening-related professions at institutions such as Shanghai University of Engineering and Technology, Shanghai University and Shanghai Construction and Landscape Design Institute, were invited to compare 21 different indicators according to the degree of importance, determine the weighted average of the data, calculate the weight value of each evaluation factor (Table 4), and compound the consistency test requirements.

Objective layer(A)	Criterion layer(B)	Weight on criterion layer	Index layer(C)	Weight on index layer	Total weight	Ranking
Country park landscape quality evaluation system	B1 Ecological landscape	0.4254	C1 Diversity of plant species	0.1351	0.0575	1
			C2 Diversity of wetland types	0.0804	0.0342	4
			C3 Eco-river landscape	0.0487	0.0207	9
			C4Eco-conservation construction	0.0605	0.0257	7
			C5 Species habitat quality	0.1007	0.0428	3
	B2 Visual landscape	0.1640	C6 Landscape scale	0.0193	0.0031	16
			C7Vertical design	0.0170	0.0028	18
			C8 Landscape color	0.0226	0.0037	14
			C9 Nature and wildlife	0.0509	0.0083	8
			C10 Plant seasonal phases	0.0414	0.0068	11
			C11Iconic landscape	0.0127	0.0021	20
	B3 Accessory landscape	0.0900	C12 Optimization of visitor services	0.0259	0.0023	13
			C13 Accessibility of spatial routes	0.0095	0.0010	21
			C14 Reasonableness of service facilities	0.0221	0.0020	15
			C15 Safety and accessibility design	0.0154	0.0014	19
			C16 Intelligent science system control	0.0171	0.0015	17
	B4 Humanistic landscape	0.3206	C17 Regional culture showcase	0.0651	0.0209	6

			C18 Scientific research and the popularization of science	0.0322	0.0103	12
			C19 Agricultural tourism experience	0.0447	0.0143	10
			C20 Human landscape shaping	0.1018	0.0326	2
			C21 Cultural and artistic innovation	0.0769	0.0247	5

Table 4: Country Park Landscape Quality Evaluation Factor Weights

The AHP method was used to calculate the index weights of the criterion layer. The largest weight was that of ecological landscape (0.4254), followed by humanistic landscape (0.3206), visual landscape (0.1640), and subsidiary landscape (0.0900) (Figure 5). The results suggested that the quality of the ecological landscape was the main factor for attracting visitors to country parks, and the diversity of plant species and the quality of habitat of species were the two factors with the greatest degree of influence; the humanistic landscape for regional culture, human landscape shaping, and innovation of culture and art were also important factors according to visitors.

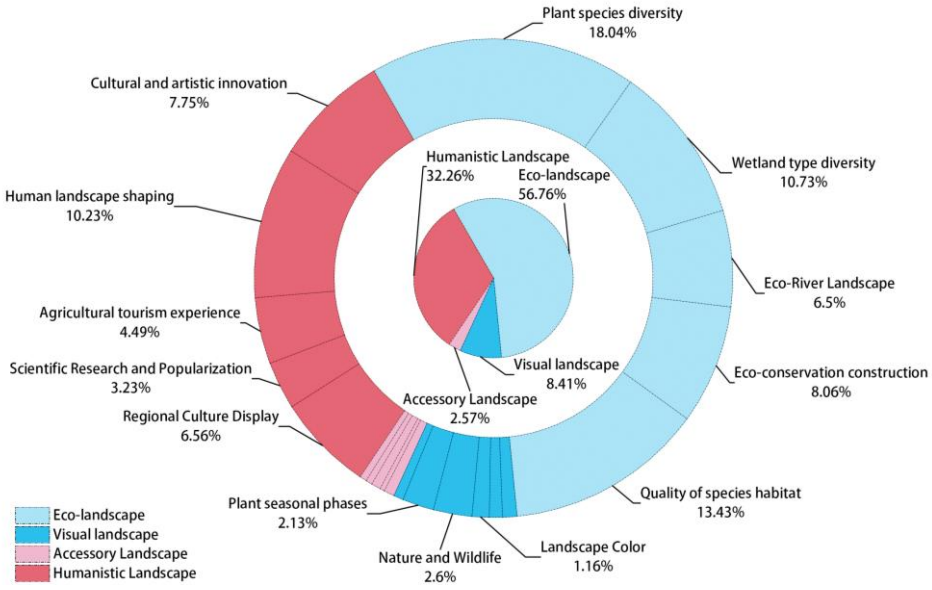

Figure 5: AHP Method to Calculate the Index Weight Percentage Diagram

Topsis Weighted Ranking

Based on the collected data, the evaluation matrix was established, the matrix was normalized, the weighting matrix was constructed by applying the index weights determined by the hierarchical analysis method, and the weighted values of each criterion layer and the weighted values of the index layer were obtained (Table 5). The ideal solution matrix Z^+ and the negative ideal solution matrix Z^- of the evaluation object were determined as follows:

Z^{+}=(0.83 , 0.75 , 0.82 , 0.79 , 0.93 , 0.88 , 0.86 , 0.82 , 0.88 , 0.84 , 0.92 , 0.73 , 0.95 , 0.64 , 0.87 , 0.71 , 0.68 , 0.66 , 0.83 , 0.81 , 0.79) ,

Z^{-}= (0.53 , 0.33 , 0.55 , 0.72 , 0.80 , 0.78 , 0.71 , 0.70 , 0.82 , 0.69 , 0.76 , 0.57 , 0.84 , 0.53 , 0.81 , 0.65 , 0.56 , 0.57 , 0.71 , 0.68 , 0.68)

Evaluation Indicators	Guangfulin Country Park	Jiabei Country Park	Songnan Country Park	Qingxi Country Park
Diversity of plant species C1	0.037	0.030	0.039	0.041
Diversity of wetland types C2	0.011	0.016	0.018	0.025
Eco-river landscape C3	0.011	0.013	0.014	0.017
Eco-conservation construction C4	0.019	0.018	0.020	0.020
Species habitat quality C5	0.035	0.034	0.034	0.040
Landscape scale C6	0.002	0.003	0.003	0.003
Vertical design C7	0.002	0.002	0.002	0.002
Landscape color C8	0.003	0.003	0.003	0.003
Nature and wildlife C9	0.007	0.006	0.007	0.007
Plant seasonal phases C10	0.005	0.004	0.005	0.006
Iconic landscape C11	0.002	0.002	0.002	0.002
Perfection of visitor services C12	0.001	0.001	0.002	0.002
Accessibility of spatial routes C13	0.001	0.001	0.001	0.001
Reasonableness of service facilities C14	0.001	0.001	0.001	0.001
Safety and accessibility design C15	0.001	0.001	0.001	0.001
Intelligent science system control C16	0.001	0.001	0.001	0.001
Regional culture showcase C17	0.013	0.012	0.012	0.014
Scientific research and the popularization of science C18	0.006	0.006	0.006	0.007
Agricultural tourism experience C19	0.011	0.010	0.010	0.012
Human landscape shaping C20	0.023	0.022	0.023	0.026
Cultural and artistic innovation C21	0.018	0.017	0.017	0.020

Table 5: Weighted Values of Landscape Evaluation of Four Country Parks in Shanghai

The Euclidean distance and proximity C_i between the positive ideal solution S_i^+ and negative ideal solution S_i^- of the four country parks were calculated according to the formulae, and the four country parks were ranked from the largest to the smallest according to the calculated proximity C_i. In the same way, the Euclidean distances and proximity C_i of the four country parks were calculated for each criterion layer, the landscape quality of the country parks was ranked under the constraints of each criterion layer, and the ranking and scores of the country parks were compared for four different criterion layers: ecological environment, visual landscape, service facilities, and human landscape (Table 6) (Figure 6).

Country Park	Positive ideal solution S_i^+	Negative ideal solution S_i^-	Overall Score Index	Ranking
Guangfulin Country Park	0.081	0.026	0.243	4
Jiabei Country Park	0.070	0.027	0.276	3
Songnan Country Park	0.048	0.050	0.511	2
Qingxi Country Park	0.002	0.091	0.983	1

Table 6: Positive and Negative Ideal Solutions and Overall Ranking of Advantages and Disadvantages of Four Country Parks in Shanghai

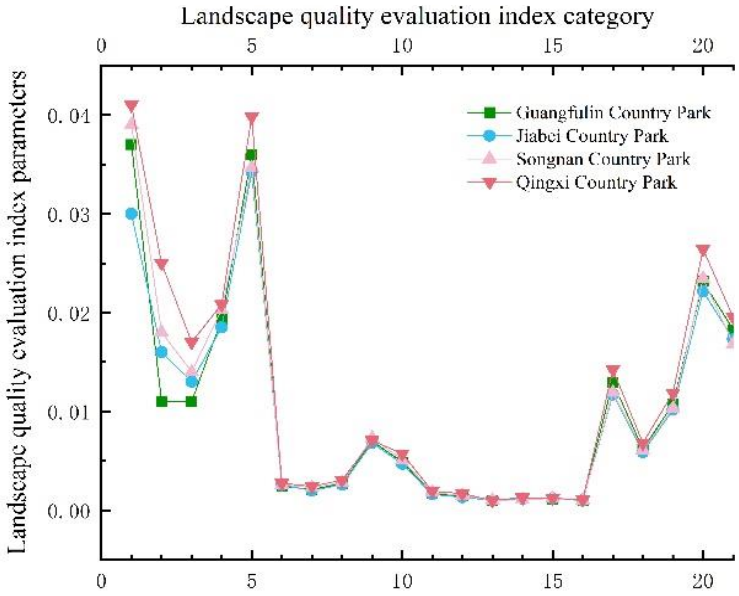

Figure 6: Folding Line Graph of Landscape Index Scores of Four Country Parks

By ranking the four country parks in terms of positive and negative landscape ideals, we found that Qingxi Country Park had the best landscape quality. Qingxi County Park benefits from a high ecological landscape and human landscape factor, with a diverse ecological environment of wetlands, lakes, rivers and forests, and is known as a gene pool of Shanghai's native aquatic species. A 5.8 km2 aquatic forest ecological zone has been established, with Metasequoia as the characteristic tree species in the area. A multiforested ecological woodland community was built and has become one of the must-visit attractions for tourists. The setting of the idyllic landscape area to carry out orchard sightseeing, picking experiences and characteristic plantation has been praised by tourists. The landscape quality rating of Guangfulin Country Park was slightly lower, despite its rich and colorful historical relics and cultural heritage. Most of the landscape is an imitation of ancient site shape or landscape sculpture, and lacks correlation with the landscape. Some of the tour routes are disconnected, affecting the spatial layout. In terms of the plant landscape, the overall lack of layers, mostly sparse grassland or nursery planting, the façade lacks multilevel collocation of trees, shrubs and grasses. The division of cultivated land in the park is relatively singular; the surface is disordered, lacking agricultural tourism experience and the shaping of humanistic landscape, and the quality is lower than that of other country parks.

3.1 POE Method Survey Validation

To test the accuracy and appropriateness of the evaluation system and reduce the influence of misleading factors and calculation errors on the evaluation results, a questionnaire survey was conducted on the users of the four country parks evaluated by the POE method. The landscape quality satisfaction was assessed by statistical analysis. The arithmetic mean of the scores of each evaluation element was calculated as the final score, and the score of the criterion layer was determined as the arithmetic mean of the combined scores of the subordinate index layers.

The questionnaire was designed based on the basic information of the respondents and the satisfaction evaluation system of urban park landscape quality (Table 7), and the Likert five-level scale was used to set the options of the satisfaction survey, which were classified into five categories: extremely dissatisfied, dissatisfied, average, satisfied and extremely satisfied. The arithmetic mean of the scores of each evaluation factor was used as the satisfaction score of the evaluation factor, and the arithmetic mean of the satisfaction scores of the lower-level indicators was used as the satisfaction score of the upper-level indicators.

Overall Objective	Evaluation Level	Evaluation Element
Country Park Landscape Quality Satisfaction	Environmental landscape satisfaction	Environmental Harmony Environmental comfort
	Service facility satisfaction	Environmental suitability Environmental Health Facilities
	Road traffic satisfaction	Recreational facilities Guidance facilities
	Place satisfaction	Publicity service facilities Road paving design
	Space satisfaction	Barrier-free pathway design Traffic route design
	Human landscape satisfaction	Diversity of functions The participatory nature of the place Variability of space The security of space Regional Culture Showcase Humanistic Landscape Design

Table 7: Satisfaction Index For Landscape Quality Of Country Parks

To ensure the accuracy of the data, four working days and weekends were selected for data collection between July and August 2022. Survey respondents were randomly selected in four country parks, and 1100 questionnaires were distributed for on-site completion and recovery. A total of 1068 valid questionnaires were returned (97.1% recovery rate). The proportion of female respondents was 61.61% (658), slightly higher than that of male respondents (38.39%, 410), and the proportion of respondents with children under 8 years old was approximately 39.6% (423). In terms of the age of the respondents, the greatest percentage was young people between 25 and 34 years old, accounting for 43.35% (463) of the visiting population, and most of them had children under 8 years old, followed by young adults between 35 and 46 years old and teenagers between 15 and 24 years old. These results suggested the visiting population of country parks was dominated by younger groups, and the proportion of children and teenagers is increasing as a result of the implementation of the three-child policy. Therefore, the planning and design of country parks should consider the needs of children and young adults.

3.2 Questionnaire Validity Analysis

The questionnaire had six dimensions and its validity was analyzed using validated factor analysis through a KMO test and a Bartlett test. When the KMO value is lower than 0.6, it indicates poor validity, and when it is higher than 0.8, it indicates high validity [51]. The analysis verified that all research items correspond to a commonality value of higher than 0.4, indicating that the information of the research items could be efficiently extracted and there were no unreasonable research items. The KMO value of 0.913 and Bartlett significance of 0.00, which is less than the significance level of 0.05, indicates that the research data is suitable for factor analysis. In addition, the variance explained by the six factors is 19.706%, 13.037%, 11.501%, 10.775%, 9.993% and 8.646%, and the cumulative variance explained by rotation is 73.658% > 50%, which indicates that the information of the research items can be effectively extracted. Finally, the absolute value of the factor loading coefficients is greater than 0.4, which means that the analyzed items and factors share a correspondence and that the final validity is good [52].

Objective	Very satisfactory	Satisfactory	Neutral	Dissatisfactory	Very unsatisfactory	Satisfaction percentage	Number of questionnaires
Guangfulin Country Park	179	38	28	11	5	83.14%	261
Jiabei Country Park	185	47	22	6	2	88.54%	262
Qingxi Country Park	193	56	24	3	2	89.56%	278
Songnan Country Park	186	41	28	8	4	85.01%	267

Table 8: Results of the Survey on Satisfaction with the Landscape of Shanghai Country parks

Survey respondents' satisfaction scores of 4<x<5 indicated that users were extremely satisfied; satisfaction scores of 3<x<4 indicated that users were satisfied; satisfaction scores of x=3 indicated that users had average satisfaction; satisfaction scores of 2<x<3 indicated that users were dissatisfied; and satisfaction scores of 1<x<2 indicated that users were extremely dissatisfied. The calculated landscape satisfaction ranking of Shanghai country parks was consistent with the landscape quality evaluation ranking of Shanghai country parks derived from the combined AHP-TOPSIS evaluation model (Table 8).

3.3 Landscape Quality Optimization Strategy

Through the application of AHP-TOPSIS-POE, the landscape quality of selected Shanghai country parks was evaluated and analyzed, and the results of the analyses show that the comprehensive rankings were obtained based on the relative proximity of each research object to the positive and negative ideal solutions, and these rankings proceed in the following order: Qingxi Country Park, Songnan Country Park, Jiabei Country Park, and Guangfulin Country Park.

Qingxi Country Park benefits from its location at the confluence of three water sources, namely Dianshan Lake, Mao Harbour and Taipu River, where 21 natural lakes and various sized pits and canals are located and form a variety of water environments such as lakes, beaches, swamps, embankments, islands, etc. This further results in a variety of tree species in the park. The overall score of the landscape quality evaluation index is the highest for this park, and it has no obvious low index score. The landscape quality design of Qingxi Country Park is worth referencing, as the overall planning and design of the zoning is clear, the functional zoning of agriculture, ecology and humanities around Dalian Lake clarifies the entire spatial area, which, combined with the openness and depth of the lake, forms a large area for ecological landscape experience. The area boasts idyllic scenery that is not only ideal for orchard sightseeing, fruit picking and other projects but also for the establishment of horticultural ecological garden, exotic flowers and plants and speciality materials for the planting of demonstration gardens, etc., to form a unique idyllic style.

Songnan Country Park ranked second in terms of overall score, with higher scores for the indicators of ecological landscape and visual landscape□The park presents a unique "ribbon" spatial pattern, which is designed to form three landscape spaces from north to south: a town transition zone, a forest and field ornamental zone, and a riverside recreational zone. Biodiversity is realized through the cultivation of a series of diversified forest types, such as riverside culverts, scenic sightseeing forests, comprehensive exhibition forests, recreational experience forests and road protection forests. Forest fruit tree picking, bird-watching houses, amphitheaters, camping sites and other functions are interspersed with the forest to create recreational forests and to satisfy people's needs for leisure and recreation. The accessory landscape and humanistic landscape in this park are slightly lacking in providing farming experiences as well as cultural and artistic innovations.

Jiabei Country Park ranks third in terms of overall rating, but scores low in the accessory landscape and humanistic landscape evaluation indicators. The park favors farmland experience and environment creation, providing visitors with a place for planting, picking, tasting and agricultural science education. In the creation of a cultural landscape that positions Gangshi culture as the main theme, aside from the atmosphere of the landscape, the level of restoration of some of the monuments, ancient villages, folk art villages, cultural neighborhoods and other functional projects is insufficient.

The overall rating of Guangfulin Country Park comes in fourth. Compared with the other three parks, the rating indicators of ecological landscape and visual landscape are relatively low, while the indicators accessory landscape and humanistic landscape are in the middle and upper segments, which is closely related to the fact that Guangfulin Country Park relies on the Guangfulin Cultural Heritage Site. Due to the relatively flat terrain of the environment in the park, its lack of open water and its rich geographic environment resources, which mostly take the form of grassy slopes in the plant landscape configuration and has mostly uniform sparse forest grassland or nursery columns, the elevation lacks a multi-layered collocation of trees, shrubs and grasses. Further, the arable land has not been dealt with, and the ground surface is messy and lacks order. The scoring values indicate that in the opinion of experts and the public, there is still much room for improvement to the quality of the landscape□Figure 7□.

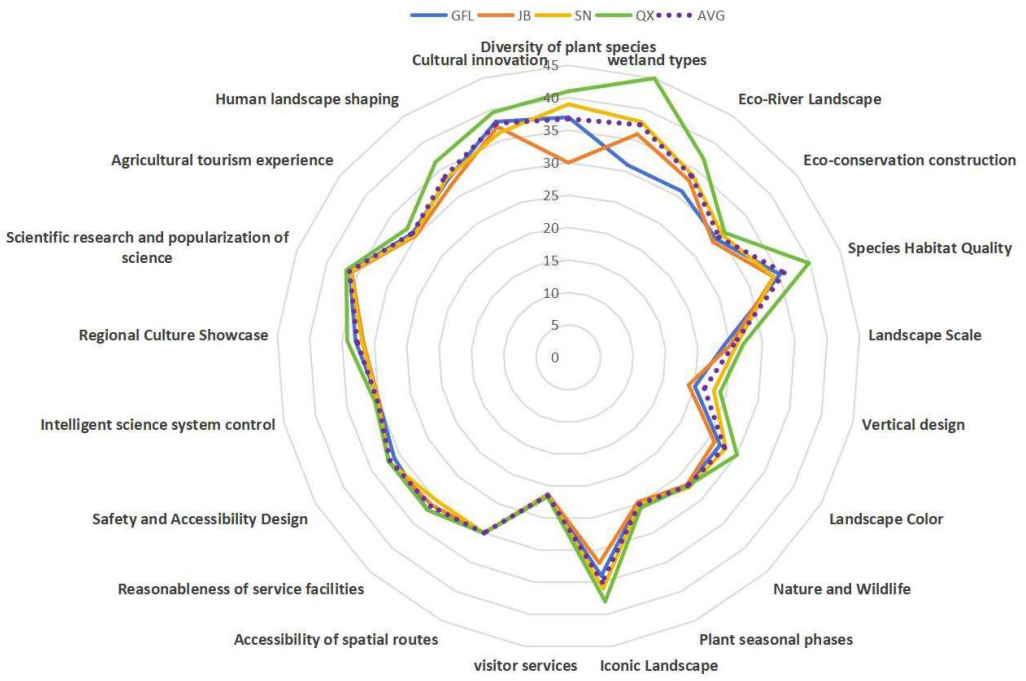

Figure 7: Comparison of the Mean Values for The Park Indicators

In view of the problems and future development direction in Shanghai country parks, corresponding landscape optimization design strategies and suggestions are proposed from four points of view: ecological landscape, agricultural landscape, humanistic landscape and subsidiary landscape. We considered the regional and cultural characteristics of Shanghai.

3.4 Restoration of the Natural Ecological Landscape

The landscape of country parks has transitional characteristics, and the landscape of country parks should emphasize both wildness and quality. In the planning and construction of country parks, the basic purpose is to "respect nature, conform to nature and protect nature" and make full use of various natural elements, such as farmland, water systems, roads, woodlands and villages. Based on the field research, we found that some areas in the park where the landscape design was not reasonable; the plant species were chosen based on their ornamental value, ignoring some of the use functions of the plants themselves. In the later construction of the park, the hard landscape can be appropriately removed, artificial communities such as large artificial grass areas can be reduced, and the natural appearance can be gradually restored. The ecological habits of plants should be fully considered in the selection of greenery. Native species in the Shanghai area have been preserved after long-term natural elimination; they are most suitable for environmental and climatic conditions, and they have the lowest use and management costs. Their use can promote the natural renewal and maintenance of the site environment and reduce damage to the off-site environment. Through the layered design of trees, shrubs and grasses, an appearance close to nature can be achieved and the characteristics of the countryside can be stored. Respecting the natural evolution of the site does not mean simply imitating and adhering to the traditional form; choices should be based on the natural process of the site, integrating the natural factors with site characteristics into the landscape design, adapting to the natural ecological process of the site, organically integrating with the surrounding environment, achieving the expected landscape benefits with fewer artificial interventions, and creating a landscape with Shanghai's regional ecological characteristics.

3.5 Optimization of Agricultural Production Landscape

The agricultural landscape in Shanghai country parks is mainly focused on farmland protection and agricultural production, with some agricultural experience activities, such as orchard sightseeing, picking experience and melon trellis tasting in Guangfu Lin Country Park and Qingxi Country Park. Based on the results of field research, the agricultural landscape in country parks suffers from the lack of design of agricultural tourism parks and regional relevance, the lack of aesthetics in spatial structure, and the lack of attractive visual images; in the theme of activity projects, there are similar forms and a lack of thematic characteristics, mostly activities such as picking and sightseeing, which are limited by climate and seasonal restrictions and fail to fully reflect the strong local folk culture. In addition to the display of traditional farming culture, it is also necessary to strengthen the brand image of farming products, high-tech fruit and vegetable planting technology support, such as the frog rice in Qingxi Country Park, which has been named the "Shanghai famous brand" product for six consecutive years, and strengthen the connotation of agricultural culture excavation, whether it is folk customs,

agricultural celebrations, or local humanities, special crafts, etc. Some local traditional non-heritage cultures and cultural practices are facing lack of inheritance crises, including the Grass Dragon Dance in the Yexie area of Songjiang, which is a traditional custom for residents in which they pray for good weather and celebrate a good harvest. Unfortunately, there are fewer and fewer inheritors who can design and perform it.Focusing on the excavation and integration of traditional agricultural cultural resources, the use of modern landscape concepts, technology, materials and other means of inheritance and innovation to enhance the attractiveness of agricultural experience and leisure.

3.6 Strengthening Humanistic Landscape Creation

In-depth excavation of intangible culture such as folk culture and traditional skills in the country park area, the use of information technology to record the intangible culture, the establishment of a database of information and a collection of images to ensure the limited transmission of folk culture and traditional skills are required. Using modern technology and new materials to promote and advance traditional folk culture through design and recreation and by combining the characteristics of the times is essential for encouraging cultural activities with regional characteristics so that villagers and tourists can directly participate in the practice and performance of folk culture and traditional skills. This promotes the sense of identity and participation in the humanistic landscape of the village through cultural activities and integrating them into the long-term management process.

3.7 Improving Accessory Landscape Facilities

There were varying degrees of missing functions or insufficient support facilities among the ancillary landscape facilities of all four country parks. For example, the illogical placement of the parking lot was an issue most frequently mentioned in the feedback. The existing road system in the park can be used to add parking lots, ecological toilets and other public service facilities to ease traffic pressure on weekends and holidays. In view of the design theme, landscape quality and spatial layout of different country parks, and deep excavation of village history and culture, regional cultural characteristics can be used to refine, combine, reconstruct and recreate the integral design of guide systems such as resting corridors, resting benches, bulletin boards and street lamps to enhance recognizability and orientation. Increasing the distribution of scientific information, integrating theory and practice, combining the features of the surrounding plant landscape, and highlighting the importance of the environment landscape ecology can improve the value of science education in landscape space.

3.8 Comparison of Related Studies

The construction of Shanghai's country parks is an important means for Shanghai to implement the requirements of the Central Government, including promoting the construction of an ecological civilization and pursuing integrated urban and rural development 6. At present, in terms of the direction of the planning, design and landscape quality of Shanghai's country parks, the problems that need to urgently be solved include the lack of relevant design and construction standards, the contradiction between the necessary basic supporting services for tourists and the relevant construction indexes, as well as the contradiction between the country parks and the "villages, forests, lakes, fields, houses and roads" 53. The main solutions proposed by scholars thus far include the following: Zhu proposed researching the design and excavation of the characteristics of Shanghai's country parks, the construction of near-natural plant communities, the construction of buildings, the designing of trails, the treatment of water bodies or water quality, the construction of intelligence and the control of costs. Wei summarized the current situation and the problems in the development of country parks, and presented strategies for ecological symbiosis, function sharing, landscape integration, and achieving win-win situations for both hosts and guests in the construction of country parks 54. Zhang believed that country parks should be involved in the study of crop selection and landscaping as if they were running a tourism business, and they should study woodland and farmland planting and management strategies to effectively enhance the level of rural revitalization and strengthen the participation of the local residents 55. Based on Zhang's analysis of the development of rural parks in Japan, he argues that it is important to adhere to the perspective of rural revitalization, focus on the integration of agriculture with secondary and tertiary industries, give full play to the historical and cultural characteristics of countryside areas, and explore the level of industrial integration and innovation to create positive interaction between tourists and residents 56.

Although scholars examine Shanghai's country parks from different perspectives, terms such as "historical and cultural characteristics," "benign interaction," "industrial integration" and "ecological characteristics" are frequently mentioned, which also reflects the fact that there are still some deficiencies in country parks. Ecological features is one of the more frequently mentioned terms, which also reflects the fact that there are still some deficiencies in the relevant aspects of country parks. In the future construction of Shanghai's country parks, despite the fact that arise from the same culture, it is still necessary to combine the characteristics of different regional environments, deeply excavate the historical lineage, strengthen the industrial combination to achieve the benign interaction of tourists and residents, and drive the development of rural revitalization in the general vicinity of country parks (Figure 8).

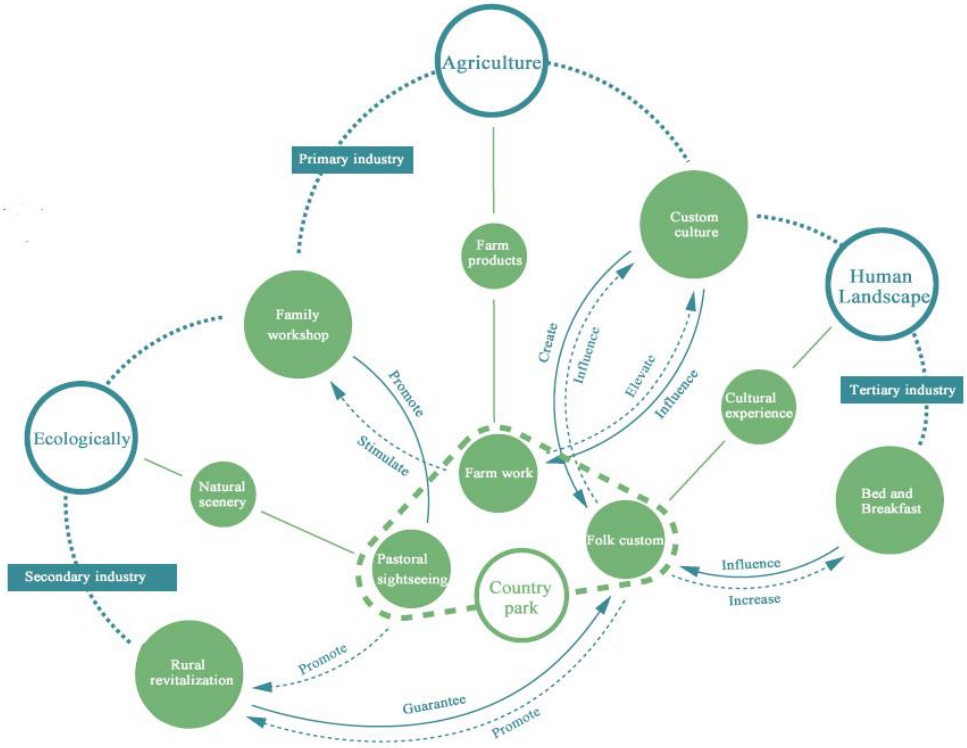

Figure 8: Interactive Design for Country Park Planning and Design

3.9 Limitations and Future Research

The purpose of this study is to assess the landscape quality of the established country parks in Shanghai, to explore their planning and design, and to evaluate their construction status using a combined AHP-TOPSIS-POE evaluation model. of the study is aimed at assessing the general characteristics of the planning and design of the country parks, improving the existing planning and design, and realizing the multiple attributes of country parks, which have both important ecological values and unique landscape values 57. There are several limitations in the research. First, This study is based on the evaluation and optimization strategy of the existing country parks in Shanghai, which is not universally applicable due to the influence of specific geographical environment and human resources. Second, restricted by the evaluation method of AHP-TOPSIS-POE, the numerical values of the existent indicators mainly rely on the judgement of experts, the source of the evaluation object is relatively single, and the public's understanding of the evaluation object is not comprehensive, which leads to the evaluation indicator system being insufficiently comprehensive. Finally, due to the low cultural level of the residents in the peri-urban areas, the expression and description of the scene is insufficient, and the evaluation of the needs and satisfaction of the interviewees tends to be ambiguous.

The current study is based on a multifaceted perspective that is applied to comprehensively explore the planning and design features and the use evaluation of Shanghai's country parks, which to a certain extent fills the current research gap. Future research can improve and supplement the results of this study to address its limitations. For example, in future research, more country parks can be included for comprehensive evaluation and comparison, and specialized in-depth studies can be conducted for soundscape, waterscape, and vernacular landscape creation to improve the quality of the park's environmental landscape and to promote the health and well-being of urban residents.

4. Conclusions

Based on the AHP-TOPSIS-POE combined model, we performed a comprehensive assessment of the landscape quality of Shanghai country parks using qualitative and quantitative indicators. We used the AHP method to determine the reasonable weights of the judgment indicators, reducing the influence of the evaluator's subjectivity, and addressing the problem of weight distribution caused by an excessive number of factors in the evaluation indicators. We used the TOPSIS method to purposefully implement multiobjective decision-making. The TOPSIS method is a targeted solution to the ranking problem in the multiobjective decision-making process that avoids human subjective factors and single-factor situations that generate decision-making errors, thus ensuring that scientific, reasonable and comprehensive assessments can be made. After analysis and comparison, we validated the ranking of landscape satisfaction of Shanghai country parks obtained by using the POE evaluation method and the ranking of Shanghai country park landscape quality evaluation by the combined AHP and TOPSIS model. The accuracy of the evaluation results using the combined AHP-TOPSIS model was verified; we concluded

that the constructed model can be used to make a reasonable and accurate evaluation of country park landscape quality.

The planning and site selection of Shanghai country parks are influenced by natural geographic features and local policies. The country parks cover the distant and suburban areas of the city on a large scale and innovatively integrate the concept of land remediation, providing a new framework for the ecological development of the city. In the subsequent construction of the country park landscape environment, strong impact factors should be emphasized, medium impact factors should be integrated, and weak impact factors should be considered; taken together, they can help improve the landscape quality of country parks and provide a reference for the landscape improvement of similar country parks. The evaluation of country park landscape quality is dynamic and complex; there are many details of our preliminary proposed model for evaluating the landscape quality of Shanghai country parks that still must be optimized and improved. For example, the weight distribution of influencing factors and scoring rules should be further combined with regional resources. The evaluation indexes must be adjusted and optimized continuously in practice to improve the scientific rigor and practical applicability of the method, leading to a more sophisticated and generalizable country park evaluation system and providing design strategies for subsequent countryside landscape planning and design.

Data Availability

All data included in this study are available upon request by contact with the corresponding author.

Experiments Statement

All test methods were performed in accordance with relevant guidelines and regulations.

All pilot schemes have been approved by the ethics committee of Shanghai Songjiang district landscaping management center Municipal government, including any relevant details.

Informed consent has been obtained from all participants in the questionnaire and/or their legal guardians.

Conflicts of Interest

The authors declare that there are no conflicts of interest with any financial organizations regarding the material reported in this manuscript.

Funding Statement

The study was supported by the General Topics of Shanghai Philosophy and Social Sciences Planning in 2020 (2020BWY028) and supported by the Youth Scientific Research Team Cultivation Program of Shanghai University of Engineering Science (QNTD202109).

Acknowledgments

The authors would like to thank the seven experts who supported this study and the individuals who participated in the questionnaire and interviews.

References

1. Kuang, Z., & Li, Z. (2016, May). Study on Establishing the Country Park's Resources Evaluation System. In *2016 International Forum on Energy, Environment and Sustainable Development* (pp. 323-334). Atlantis Press.
2. Zhang, T., & Che, S. (2009). Research and construction of country park. *Journal of Shanghai Jiaotong University-Agricultural Science, 27*(3), 259-266.
3. Chan, J. F. W., Yuan, S., Kok, K. H., To, K. K. W., Chu, H., Yang, J., ... & Yuen, K. Y. (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. The lancet, 395(10223), 514-523. Dong, Y. J.& Wan, F. X., Estimation and analysis of forest ecological benefit based on three-dimensional green quantity: A case study of Shanghai Pujiang Country Park. *Research of Soil and Water Conservation. 26,* 347-352(2019).
4. Zhu Y. Study on the Compound Function Design Strategy of Shanghai Heqing Country Park under the Background of Multiple Land Use Properties [J]. Chinese Landscape Architecture, 2021, 37(S2): 25-9.
5. Li,Y.L., Zhu,X.M. Guidelines for the Design and Construction of Shanghai Country Parks [J]. Chinese Landscape Architecture, 2015, 31(12): 61-4.
6. Lv,C.D., Wu,J.Y. Analysis on the construction and disposition of landscape plants in Country Park [J]. Flowers, 2020, 373(10): 120-1.
7. Chen, J. H. (2022). Evaluation of urban park landscape quality from a territorial perspective: A case study of Huanhuaxi Park in Chengdu. *J. Cent. South Univ. For. Technol, 42*, 152-159.
8. Du,D.N. Overview and Strategy of Beijing Country Park Design-- A case study of Wuliqiao Country Park [J]. Contemporary Horticulture, 2022, 45(06): 36-8.
9. Lou,G., Duan,Y.G. Research on Application Strategies of Native Landscape in Rural Parks——A Case Country Forest Park in Yuxi River Yulin City [J]. *J Northwest For Univ, 2018, 33*(06): 265-72.
10. Xiang, L., Tian, Y., & Pan, Y. (2022). Study on landscape evaluation and optimization strategy of Central Park in Qingkou Town. *Scientific Reports, 12*(1), 1978.
11. Brown, T. C., & Daniel, T. C. (1986). Predicting scenic beauty of timber stands. *Forest Science, 32*(2), 471-487.
12. Qi, T., Zhang, G., Wang, Y., Liu, C., & Li, X. (2017). Research on landscape quality of country parks in Beijing as based on visual and audible senses. *Urban Forestry & Urban Greening, 26,* 124-138.
13. Lv, C. D.& Wu, J. Y., Analysis on the construction and disposition of landscape plants in Country Park. *Flowers*. 373, 120-121(2020).
14. Chen, J. H. (2022). Evaluation of urban park landscape quality from a territorial perspective: A case study of Huanhuaxi Park

in Chengdu. *J. Cent. South Univ. For. Technol, 42*, 152-159.
15. Du, D. N., Overview and Strategy of Beijing Country Park Design-- A case study of Wuliqiao Country Park. *Contemporary Horticulture. 45*, 36-38(2022).
16. Lou, G.& Duan, Y. G., Research on Application Strategies of Native Landscape in Rural Parks——A Case Country Forest Park in Yuxi River Yulin City. *Journal of Northwest Forestry University. 33,* 265-272(2018).
17. Niu, X., & Kang, N. (2021). Spatio-temporal Characteristics and Influencing Factors of Tourist Activities in Shanghai Country Parks. Chin. Landsc. *Archit, 37,* 39-43.
18. Xiang, L., Tian, Y., & Pan, Y. (2022). Study on landscape evaluation and optimization strategy of Central Park in Qingkou Town. *Scientific Reports, 12*(1), 1978.
19. Li, D. N.& Li, X., Post-use evaluation (POE) of urban country parks based on multi-source data - A case study of Beijing Winter Olympic Country Park. *Proceedings of the 2021 Annual Conference of the Chinese Society of Landscape Architecture*. 445-453(2021).
20. Lu, X. S.& Yang, X., Study on the Construction of Landscape Quality Evaluation System for Country Park Recreation Space in Beijing. *Proceedings of the Academic Exchange on Industrial Buildings 2021* (Middle Volume). 24-29(2021).
21. Ruiqi, W., Yuanxun, Q., & Xiong, L. (2021). Site selection methods of country park with priority of habitat protection in the second green isolated area of Beijing. *Journal of Beijing Forestry University, 43*(2), 127-137.
22. Li, Y., Liu, J., Zhu, W., & Luo, J. (2023). Country Park Landscape Quality Evaluation and Optimization Strategies Based on the AHP-TOPSIS-POE Model: A Case Study of Four Country Parks in Shanghai.
23. Kang, N., & Liu, C. (2022). Towards landscape visual quality evaluation: Methodologies, technologies, and recommendations. *Ecological Indicators, 142,* 109174.
24. Du, Y., Chen, W., Cui, K., & Zhang, K. (2019). Study on damage assessment of earthen sites of the Ming Great Wall in Qinghai Province based on Fuzzy-AHP and AHP-TOPSIS. *International Journal of Architectural Heritage*.
25. Cai,S.H., Zhang, Z.Y., Zhang,P.et al. Priority decision model of small reservoirs reinforcing project based on AHP-TOPSIS [J]. Journal of Yangzhou University(Natural Science Edition), 2009, 12(01): 71-5.
26. Weng,S.F., Ke,F., Li,C.M. Application of AHP and SBE Methods in the Study of Landscape Plant Composition in Guangzhou Parks [J]. Chinese Landscape Architecture, 2009, 25(04): 78-81.
27. Li, G., & Li, Y. (2021). Optimization spatial pattern method for vegetation landscape in bay based on AHP. *Microprocessors and Microsystems, 83*, 104041.
28. Chang, H. K., Liou, J. C., & Chen, W. W. (2012). Protection priority in the coastal environment using a hybrid ahp-topsis method on the Miaoli coast, Taiwan. *Journal of Coastal Research, 28*(2), 369-374.
29. Wang, W., & Li, N. (2013). Application of AHP in Highway Landscape Assessment System. *Applied Mechanics and Materials, 357,* 2134-2140.
30. Hwang, C. L., Yoon, K., Hwang, C. L., & Yoon, K. (1981). Methods for multiple attribute decision making. *Multiple attribute decision making: methods and applications a state-of-the-art survey*, 58-191.
31. Shen, L., Zhang, Y., Yao, M., & Lan, S. (2022). Combination weighting integrated with TOPSIS for landscape performance evaluation: A case study of microlandscape from rural areas in southeast China. *Sustainability, 14*(15), 9794.
32. Chang, H. K., Liou, J. C., & Chen, W. W. (2012). Protection priority in the coastal environment using a hybrid ahp-topsis method on the Miaoli coast, Taiwan. *Journal of Coastal Research, 28*(2), 369-374.
33. Mass, Lin S P, Yang, C. Quantitative Study on the Visual Ornamental Quality of Group Planting Plants by Using the Weighted TOPSIS Method [J]. Guangdong Landscape Architecture, 2021, 43(03): 55-60.
34. Hussein, H., & Jamaludin, A. A. (2015). POE of bioclimatic design building towards promoting sustainable living. *Procedia-Social and Behavioral Sciences, 168*, 280-288.
35. Ibes, D. C. (2015). A multi-dimensional classification and equity analysis of an urban park system: A novel methodology and case study application. *Landscape and Urban Planning, 137*, 122-137.
36. Ostermann, F. O., & Timpf, S. (2009). Use and appropriation of space in urban public parks: GIS methods in social geography. *Geographica Helvetica, 64*(1), 30-36.
37. Zheng, Q., Zhao, X., & Jin, M. (2019). Research on urban public green space planning based on taxi data: A case study on three districts of Shenzhen, China. *Sustainability, 11*(4), 1132.
38. Deng X, Li, J.M., Zheng, H.J., et al. Analysis of AHP method weight calculation method and its application research [J]. Mathematics in Practice and Theory, 2012, 42(07): 93-100.
39. Li, R., Liu, Z. G., & Pan, H. C. (2020). A study on the evaluation of emergency drill for urban rail transit based on AHP-TOPSIS model [J]. *Railway Transport and Economy, 42*(1), 110-115.
40. Yi-chuan, Z., Li-fang, Q., Wei, C., & Xing-zhi, P. (2009, April). Application of AHP-TOPSIS to the Evaluation and Classification of Provincial Landscape Construction Level of China. In *2009 International Conference on Future Computer and Communication* (pp. 399-402). IEEE.
41. Li, G., & Li, Y. (2021). Optimization spatial pattern method for vegetation landscape in bay based on AHP. *Microprocessors and Microsystems, 83*, 104041.
42. Li, T.& Wang, Y. Y., Research on Assessment of Water Environmental Quality Planning System in China. *Qinghai Social Sciences.* 64-72(2020).
43. Zhao, C. C.& Gao, Y. Q., Evaluation of ecological river construction based on cloud model. *Water Resources Protection. 38*, 183-189(2022).
44. He, J. H., Wang, C. X., Liu, D. F., Cheng, H., & Shi, Q. Q.

(2019). Evaluating the impact of land use change on habitat quality in metropolitan fringe areas from a perspective of ecological network. Resour. Environ. *Yangtze Basin, 28*(4), 903-916.
45. Shanshan, S. H. E. N., Shengmeng, H. U. A. N. G., Yan, S. H. I., & Zhiyi, B. A. O. (2020). Research on Urban Vertical Greening Design Method Based on Landscape Preference Theory. *Landscape Architecture, 27*(2), 100-105.
46. Yu, Z. Y., Zhu, S. X.& Roozen, N., Spatial Creation Based on Urban Model: Study on Landscape Space of World EXPO Park Shanghai. *Chinese Landscape Architecture*. 49-52(2007).
47. Wang, Y.& Chen, Z., Analysis of Characteristics of Landscape Architecture. *Journal of Yantai University(Natural Science and Engineering Edition. 30*, 232-236(2017).
48. Wang, X. F.& Liu, S. F., Research on the Aesthetic Intuition of Landmark Landscape Space Based on Intuitionalism. *Chinese Landscape Architecture. 30*, 74-77(2014).
49. Peng, W. H., National Center for Taiwan Traditional Arts Landscape Design——A Creative Park Combining Art Heritage and Leisure Tourism. *Chinese Landscape Architecture. 27*, 47-51(2011).
50. Ji, W. Q., Ge, G. L . Development and reliability analysis of a health literacy questionnaire for university students [J]. *Chinese Journal of School Health, 2012, 33*(10): 1235-6.
51. Zheng, Y. Development and Reliability Test of Internet De-Personalisation Questionnaire [J]. *Statistics & Decision, 2013,* (05): 90-3.
52. Zhu, X. M. (2019). Study on Shanghai country park construction key technology. *Chinese Landscape Architecture, 35*(S2), 103-106.
53. Wei, L.Y. Exploration on Country Park Construction Strategy——Taking Shanghai Langxia Country Park as the Example [J]. *Chinese Landscape Architecture,, 2019, 35*(S2): 107-11.
54. Zhang, J .Y. Study on the Combination of Country Park and Rural Tourism in Chengjia Town Chongming Shanghai [J]. Shanghai Construction Science & Technology, 2019, (06): 57-60.
55. Zhang, J., & Wu, C. (2019). Enlightenment of the 6th industrialization of Japan to the development of country park in Shanghai-taking the Sera Country Park of Hiroshima. *Acta Agriculturae Shanghai, 35*(3), 123-129.
56. Yang, F., Qin, J.Z. On Country Park Landscape Construction Practice——A Case Study of the Construction of Yunqi Park in Hangzhou [J]. Chinese Landscape Architecture, 2022, 38(S1): 35-8.