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Improving Waterfront Slow Greenway's Environmental Perception and Strategy for Healthy Cities: Xiaodong River Case Study in Maoming City

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Abstract: With the concept of national fitness deeply rooted in people's hearts, outdoor slow-moving space has become an important content of urban construction, and urban waterfront slow-moving greenway is an important activity space for citizens to have leisure and recreational exchanges, which is of great significance to building a healthy urban environment. This paper selects the Xiaodong River slow-moving greenway in Maoming City as the research object, deeply analyzes the citizens' environmental perception experience in walking, and constructs the pedestrian landscape perception evaluation system of the waterfront slow-moving greenway. Based on the post-occupancy evaluation (POE) investigation analysis method and Analytic Hierarchy Process (AHP), this paper assigns values to each index element, analyzes and summarizes the shortcomings of slow-moving greenway design, and puts forward suggestions for improvement, aiming at providing wisdom for its development.

1. Introduction

In the post-epidemic era, people's enthusiasm for physical health and outdoor sports reached an unprecedented height, and improving and optimizing the outdoor environment suitable for national fitness has also become an important topic. The World Health Organization (WHO) began to introduce the concept of healthy cities into China in the 1990s [1]. As an important linear element, waterfront green channel refers to the open road area close to water area for the purpose of connection, ecology, aesthetics and other multiple objectives, and is one of the important ways for the sustainable development of urban coastal areas [2]. The waterfront slow green road refers to the space that can be used for people to enter, carry out walking, cycling, wheeling and other slow activities, organically organize green space, slow space and service facilities together, and create a more comfortable and cordial slow activity environment for residents [3]. At the same time, it provides a large number of social opportunities for residents, provides a place for expressing their own emotions, relieving psychological tension and insecurity, and obtaining a positive psychological state. It is an important outdoor activity place in cities, and is also one of the very important elements in the construction of healthy cities. The slow travel system needs to take on the responsibility of fully satisfying the basic

life "Rigid" demand, shared production "high-order" demand. Three major functions with cultural aesthetic "spiritual" needs [4].

2. Study Subjects and Methods

2.1. Brief Introduction of Xiaodong River Waterfront Slow Green Road

The Xiaodong River runs through six townships in Maoming City District and Maonan County of Guangdong Province, eventually flowing into Wayao Town, Wuchuan Province. The government has implemented the "living in water" policy to improve the river's water quality and facilities, but there are still issues to be addressed, particularly in ensuring that the green road space is environmentally sound. This remains a topic for further exploration, especially as public health awareness increases and stricter standards for green road use are introduced.

The scope of investigation and research was selected as the green road area of Xiaodong River in Maoming City, from south to permanent bridge and north to Gigh range of citizens' desire to travel, and the infrastructure is relatively perfect and has a good walking environment. Therefore, the selection of this range has the representativeness of investigation and research, which makes the theory more persuasive.

2.2. Evaluation Study Method

Mainly used literature survey, field investigation, questionnaire survey and interview methods. Based on the concept of healthy city, the walking environment of Xiaodong River greenway in Maoming City was evaluated by pedestrian angle, and each investigator was randomly invited to calculate the scores of various indicators. We conducted field investigations, questionnaire surveys, and interviews to obtain the satisfaction score of pedestrians walking around Xiaodong River in Maoming City. Based on the results, we developed a research idea to construct an evaluation system, conduct a green road environment evaluation, and propose modification suggestions.

2.3. Study Direction

2.3.1. Walking Environment Safety

Security is the most basic and root activity demand in people's lives. The security is divided into two kinds, one is the ecological security of a wide range around, the other is the ecological security of a small range when people use the green road. The former is more inclined to the overall environmental safety needs, such as air pollution, water pollution, potential safety hazards and so on. The latter is a security requirement that tends to be specific to the scope class. People use green road high frequency behavior is no more than running walking, etc., for this behavior corresponding to linear site space will have different needs. For example, the width of green road, night lighting mode, the diversion of traffic flow, street crossing mode and so on are closely related to it.

2.3.2. Walking Environment Comfort

Walking environment comfort can be simply understood as the comfort in the space in which behaviors such as walking and running are located, that is, there are two ways of feeling physical and psychological. Green road should make full use of existing urban traffic hubs, parking lots and other facilities to ensure the convenience of traffic. For example, the road is spacious, there will not be too large fluctuations when walking, affecting people's comfort when walking [5]. To ensure the comfort of tourists and pedestrians, we will improve supporting service facilities such as Green Road Stations,

public toilets, and seating in important nodes of the Green Road. As such, this paper uses the combination of our POE data as an indicator to evaluate the walking environment's comfort.

2.3.3. Walking Environment Interest

Walking environment interest is in walking, to meet the safety and comfort of these two points of requirements, to pursue a higher level of spiritual needs. That is, people in the use of green road not only satisfied with physical comfort, but also tend to psychological and visual happy mood. It is necessary to maintain a certain interest in Green Road, so that people can also have a sense of pleasing when walking, but also provide a tourist full display of themselves, friendly communication with friends of the space. Therefore, the evaluation of walking interest includes field topography design, surrounding landscape richness, greening ornamental, interactive entertainment.

Table 1: Landscape perception evaluation index of waterfront slow green road

Target Layer	Indicator layer	Element Layer
Environmental Perception Evaluation System A for Waterfront Slow Green Channel	Safety B1	Street crossing mode C1
		Walking channel width C2
		Watershore safety level C3
		Number of night lighting C4
		Pedestrian physical separation C5
	Comfort B2	Step Continuity C6
		Pavement flatness C7
		Pavement Pavement Comfort C8
		Water quality C9
		Number of recreation facilities C10
	Fun B3	Field Topography Design C11
		Waterfront landscape richness C12
		Building sketch richness C13
		Landscaping Ornamental C14
		Interactive Entertainment Facility C15

3. Environmental Perception Evaluation of Xiaodong River Slow Greenway

3.1. Evaluation System Construction

On the basis of the above discussion, we construct the ecological experience evaluation framework of waterfront slow green road based on humanistic perspective, in which the first layer is the target level; the second level is the index layer, which is divided into three indices: walking environment safety, comfort and interest; the third level is the factor layer, which is the specific refinement of the index level and is divided into fifteen factors.

Based on the landscape perception assessment index of waterfront slow green road (Table 1), ten university teachers (architecture and landscape direction) were consulted and professional answer sheets were issued to form a matrix vector diagram, and professional evaluation questionnaires were provided and weights were set. Each questionnaire was tested for matrix consistency and entered into the yaahp 10.3 program. In the research of expert group, the average geometric value of the matrix results of expert group is estimated by power method, and then the weight values of criterion level and index level are statistically analyzed and obtained.

Table 2: Overall satisfaction evaluation criteria

Element Layer	Scoring Criteria				
	Very satisfied	Somewhat satisfied	Basically satisfied	Minor dissatisfaction	Very dissatisfied
	5 ≥ Score > 4.5	4.5 ≥ Score > 3.5	3.5 ≥ Score > 2.5	2.5 ≥ Score > 1.5	1.5 ≥ Score > 0
C1	Safe	Safer	General	More dangerous	Hazard
C2	Width	Wide	General	Narrow	Narrow
C3	Perfect	Better	General	Poor	Poor
C4 (cells/km)	≥ 40	[30, 40)	[20, 30)	[10, 20)	Less than 10
C5	Superior	Good	Pass	Poor	Poor
C6	Perfect	Better	General	Poor	Poor
C7	Smooth	Smooth	General	Poor	Poor
C8	Comfort	More comfortable	General	Poor	Poor
C9	No odor	Odor occasional	Odor present	Major Odor	Severe odor
C10/(cells/km)	≥ 20	[15, 20)	[10, 15)	[5, 10)	< 5
C11	Superior	Good	Pass	Poor	Poor
C12	Beautiful	Better	General	Poor	Poor
C13	Reasonable quantity and rich color Beautiful shape	Reasonable quantity and more color Beautiful shape	Low Quantity, Color Beautiful shape	Low quantity, color Single shape	No landscape building, construction small product
C14	Abundant variety and beautiful shape	Many types and beautiful shapes	General type, good shape	Fewer types and single shapes	Single species, dull shape
C15	Perfect	Better	General	Poor	Poor

According to the comprehensive satisfaction evaluation criteria of each index (Table 2), a questionnaire on the satisfaction of nearby residents was formed to investigate the residents in the survey area. From November 31 to December 6, 2022, questionnaires were distributed to Green Road users at different time periods to cover all ages as much as possible to ensure a comprehensive evaluation. A total of 100 questionnaires were distributed and 87 valid questionnaires were returned, with a recovery rate of 87%. In the returned valid questionnaire, the correlation between each index and the five-level scale was given 1-5 decreasing gradient values, and the data of the returned questionnaire were input into yaahp 10.3 to make a nearby resident satisfaction evaluation form, and the fuzzy comprehensive score was calculated to obtain a fuzzy comprehensive evaluation form for satisfaction [6].

3.2. Data Source

In this paper, the data source of on-site investigation questionnaire survey, through a number of specific time period of green road users to a certain amount of questionnaire survey, the questionnaire scoring criteria prepared by school teachers and research groups, questionnaire survey through the teacher's affirmation has a certain reference value. From September to October 2022, the research team distributed a total of 100 questionnaires on a day during the morning, middle and evening period within 5 random days during this month, and a total of 92 questionnaires were returned, including 88 valid questionnaires and 4 invalid questionnaires, with an effective rate of 88%.

3.3. Statistics of Evaluation Results

Table 3: Fuzzy comprehensive evaluation of satisfaction

Weight on Element Layer	Evaluation Score	Element layer indicator	Weight	Satisfaction	Evaluation Score	Evaluation ranking
0.4369	1.5929374	C1	0.0864	2.24	0.193536	8
		C2	0.1425	3.94	0.56145	1
		C3	0.0338	4.04	0.136552	12
		C4	0.0645	3.45	0.222525	6
		C5	0.1097	4.56	0.500232	2
0.3132	1.1206296	C6	0.0565	3.32	0.18758	9
		C7	0.0684	4.06	0.277704	3
		C8	0.0544	3.98	0.216512	7
		C9	0.0715	3.55	0.253825	4
		C10	0.0624	2.98	0.185952	10
0.2499	0.8016792	C11	0.0369	3.67	0.135423	13
		C12	0.0832	3.01	0.250432	5
		C13	0.0399	3.12	0.124488	15
		C14	0.0401	3.23	0.129523	14
		C15	0.0498	3.01	0.149898	11

Table 3: Fuzzy comprehensive evaluation of satisfaction

In the index layer weight evaluation results, the walking environment safety index has the largest weight (0.4963), which reflects that the nearby residents generally believe that the walking environment safety is the first, followed by the walking environment comfort and walking environment interest, 0.3072 and 0.1965, respectively. In the factor layer index evaluation results, the top five weights are physical separation of pedestrian vehicles, pavement width, pavement flatness, rest facilities and waterfront landscape richness. The first two are safety indicators, the third and fourth are comfort indicators, and the fifth is interest indicators. Thus, safety is the first priority in walking environments, and spacious and undisturbed walking environments are also important. In addition, experience, recreational, and ornamental demands are growing during daily walking activities. High quality experience and high quality landscape can attract more urban residents. According to the fuzzy comprehensive evaluation score of satisfaction (Table 3), it can be seen that the residents' evaluation score for the use of the slow green channel system in Xiaodong River waterfront is 3.4696 points, and their overall evaluation is satisfactory after use; the evaluation of various indicators in the criterion layer is higher than 3.0, basically meeting the needs of residents' use. C5 and C7 were evaluated as very satisfied by residents, while C1 and C10 were evaluated as less than 3, resulting in poor slow walking experience. In particular, the score for C12 was only 0.0897

4. Environmental Enhancement Strategy of Xiaodong River Slow Greenway

4.1. Safety Aspects

As shown in Table 1. The investigation of safety mainly focuses on the relationship between people and vehicles. According to the table of evaluation results statistics, the evaluation ranking of safety factor layer is in the top 10 of all factor layers, and the average score of evaluation score is also the highest score of the three standard layers, which shows that the consideration of safety is very necessary for the masses. Residents' satisfaction with c1 to C5 was less satisfied, more satisfied, basically satisfied, basically full and very satisfied. Through the score comparison, Xiaodong River Line System has certain potential safety hazards in the way of crossing the street in the consideration

of safety. Through field investigation, it is found that its problems are mainly concentrated in the following points: First, part four lane road is too wide, zebra crossing is too long, and some pedestrians may not reach the street smoothly before the green light. Second, there are too few openings and zebra crossing to the opposite street, resulting in frequent crossing of the road. Third, the bend radius at the bend is too large, causing the driver to have a blind area of vision.Controlling the turning radius between 1.5-3 meters can effectively control the speed of the vehicle and increase the street safety area [7]. Promotion strategy: ① The problem of long zebra crossing can be solved by introducing overpass crossing, and people with obstacles are also given more time to cross the street. ② Introducing zebra line lights in smart cities increases the visibility of the zebra line, as well as adding street button facilities to give pedestrians the power to cross the zebra road. 3 Set as many street crossings as possible to reduce fencing. 4 Reduce the turning radius of the vehicle, increase the vision of the driver when passing the curved road, and force him to slow down the turning speed, learning from the traffic subsidence theory.

4.2. Comfort Aspects

To a certain extent, the intensity of residents' use in the greenway reflects their physical activity level and healthy quality of life, and is closely related to the level of environmental characteristics inside the greenway [8]. As shown in Table 3. Among them, the public satisfaction with pavement flatness, waterscape environment and paving comfort ranked in the top seven, and the experience was not poor. But satisfaction with green road continuity and seating facilities was on the penultimate sixth and fifth, respectively. Whether it is the construction of green road or the addition of rest facilities, the current state of Xiaodong River remains to be improved. Because the parking lots and parking spaces around Xiaodong River are scarce, the phenomenon that vehicles and non-vehicles occupy the green road parking is caused. It is necessary to plan the parking position around the Xiaodong River and solve the problem that vehicles stop and unrest can greatly improve the continuity of the green road. And for the rest space building is even more particular, not only to let people have feet but also let people have the desire to stop and rest, which should focus on the landscape, lawn, shrubs and other vegetation for re-matching to create a comfortable space, so that people are willing to stop in this environment, talk and so on. Therefore, there should be not only roadside stone chairs in the green road, but also pavilions for people to shade the sun and shade the rain at each node to improve people 's comfort when using the green road.

4.3. Interesting Aspects

As shown in Table 3. According to the data in the table above, passengers' satisfaction with waterfront landscape richness and architectural sketch richness is not high, ranking in the 15th and 14th, respectively. Whether it is humanistic landscape or natural landscape, Xiaodong River current state has room for development. In terms of humanistic landscape, we should pay attention to the exploration of its culture, pay attention to the diversified development of waterfront landscape, can combine waterfront space with local kindness culture and other cultures, build a historical cultural corridor along waterfront, and disseminate local cultural characteristics while using good waterfront. Some building sketches are built for tourists to rest and watch. These sketches divide the corridor space to make the overall space change, increase the interest in the space, and improve the tourists' sense of experience. And architectural sketches can be combined with urban culture, show regional culture, shape urban characteristics, beautify the surrounding environment. Humanistic landscapes should pay attention to the natural landscape this piece should also grasp firmly, to pay more attention to the visual feelings of plant landscapes to us, optimize the color and species matching, enrich the visual effect of different seasons, so as to improve people' interest in the use of green road [9]. Ensure

a healthy and safe living ecological environment, and increase public service scenarios with detailed quality [10].

5. Conclusion

With the epidemic era entering the end, the society as a whole has also entered the post-epidemic era, the state vigorously instilled to restore economic development at the same time, people's consumption concept has gradually turned to invest in their own health. Green Road, as an infrastructure gradually popularized in recent years, has been loved by people by advocating green travel and good human-car diversion. Green open space compared to other classes type of public open space has a more lasting appeal. Whether it is middle-aged and elderly people who love walking, young people who enjoy relaxation after work or adolescents who play and make trouble, the popularization of green road and a green road with complete and perfect functions can significantly improve the happiness index of residents. However, at present, there are still a lot of problems in the green road of most of the third and fourth tier cities in China, which makes the green road become decoration or do not play its due role at all. This time, we will study and investigate the xiaodong River in Maoming City and put forward improvement strategies to provide some ideas for improving the xiaodong River slow travel system.

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