

Evaluation of Urban Green Transportation Development Level Based on Traveler Perception——Taking Hohhot as an Example

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Abstract. China's continuous progress toward the strategic goal of a strong transportation nation has made green transportation one of the key development directions. Therefore, it is necessary to research the level of green transportation development within the city. This paper constructs an urban green transportation evaluation system from four dimensions, transportation function level, environmental protection and energy, information and policy, and social impact. Meanwhile, the green transportation evaluation classification index is proposed based on the perspective of traveler perception combined with the national policy on green transportation. Combinational optimization was conducted with the reference point in the prospect theory and the comprehensive evaluation value of each index was calculated based on the information assembly in group decision-making. Then, rationalization analysis was put forward. Taking the city of Hohhot as an example, the results show that Hohhot has achieved remarkable results in public transportation, environmental protection, and new energy promotion in the green transportation system. It is suggested that the municipal government should pay more attention to the green transportation policy, transportation information, transportation law enforcement, transportation inclusiveness, and slow-moving transportation.

Keywords: Green Transportation, Transportation Evaluation, Traveler Perception, Information Aggregation.

1. Introduction

Green transportation refers to the development of a low-pollution, urban environmentally friendly, and diversified urban transportation system to reduce traffic congestion, reduce environmental pollution, promote social equity, and save construction and maintenance costs [1]. However, the contradiction between human beings and the environment has intensified with the progress of society, economy, and technology, especially in the transportation-related fields. The existing pollution has also confirmed the necessity of developing green transportation. Since the 18th National People's Congress of China, China's Ministry of Transport has been committed to ecological civilization development and a series of reforms. The 14th Five-Year Plan Modern Comprehensive Transportation System Development Plan has proposed that ecology should be prioritized by comprehensively promoting the green and low-carbon transformation of the entire life cycle of transportation planning, design, construction, operation, and maintenance. The reduction of pollution and carbon emissions should also be considered as a long-term mechanism for green and low-carbon development, thus making transportation more environmentally friendly and travel more low-carbon. Therefore, an in-depth study of the level of urban green transportation development has practical significance.

Previous studies evaluated the level of green transportation development through qualitative and quantitative methods, including the Grey Correlation Analysis [2], the TOPSIS [3], the Cloud-Matter Element Analysis [4], the Fuzzy Evaluation Method [5], the Analytical Hierarchy Process [6], and the DPSIR model [7].

However, shortcomings exist. First, too many quantitative indicators and a lack of qualitative judgment of the indicator system, along with its inability to combine both to construct new indicators, result in an incomprehensive evaluation indicator system. Second, most of the green transportation

research starts from the perspective of the state and society to set the evaluation standards rather than the perspective of the travelers. Third, one single evaluation method or comparison of multiple ones tends to be used by researchers without further optimization.

To solve the shortcoming, this paper mainly focuses on four dimensions, transportation function level, environmental protection and energy, information and policy, and social impact. Based on the perception of the travelers and the national green transportation evaluation standards, 29 green transportation evaluation indexes were identified to construct the urban green transportation evaluation system. The city of Hohhot was taken as an example and relevant references were proposed for its green transportation. In this paper, data from experts in the fields of transportation and environment was collected. Combining the optimized reference point, information aggregation in group decision-making was used to calculate the comprehensive evaluation value of each indicator and analyze it.

2. Evaluation System of Green Transportation Development Level

The evaluation index system for urban green transportation development needs to comprehensively consider the benefits of transportation, environment, information, and society. Scientific, objective, holistic, and operational principles selected by indicators should be combined. The evaluation system of this paper has mainly four layers. The first layer is the general objective layer, the level of urban green transportation development. The second is the sub-objective layer with 4 objectives, the transportation function level, environmental protection and energy, information and policy, and social impacts. The third is the criterion layer and the fourth is the indicator layer.

Based on the travelers' perception, 12 guidelines for perception categories are identified combined with the Assessment and Evaluation Standards of Green Travel Creation Actions, Assessment and Scoring Standards for Green Transportation Demonstration Cities, and Evaluation Indicator System for Urban Road Traffic Management and other related documents. 29 qualitative and quantitative green transportation assessment and classification indexes are further constructed. The indicator system is shown in Table 1.

Table 1. Evaluation System of Urban Green Transportation Development Level

General Objective Layer	Sub-objective Layer	Criterion Layer	Indicator Layer
Level of Urban Green Transportation Development	Transportation Function Level A	Traffic Congestion Perception A_1	Average Urban Traffic Congestion A_{11}
			Level of Traffic Congestion in Commuting A_{12}
		Public Transportation Perception A_2	Level of Tidiness of the Public Transportation A_{21}
			Level of Coverage of Public Transportation A_{22}
			Level of Maintenance of Public Transportation A_{23}
			Level of Punctuality of Public Transportation A_{24}
			Comfort Level of Public Transportation A_{25}
		Non-motorized and Pedestrian Perception A_3	Level of Urban Walkability A_{31}
			Level of Setting for Non-motorized Trails and Sidewalks A_{32}
		Green Travel Perception A_4	Level of Weekly Use of Green Travel A_{41}
			Level of City Support for Green Travel A_{42}

			Level of Safety and Reliability of Green Travel in City A_{43}
	environmental protection and energy B	Air Quality Perception B_1	Level of Current Air Quality in City B_{11}
		Traffic Noise Perception B_2	Level of Traffic Noise in City B_{21}
		Green Energy Perception B_3	Penetration of New Energy Vehicles in City B_{31}
	Information and Policy C	Environmental Transportation Policy Perception C_1	Level of Convenience for the Public in Receiving Green Transportation Policies C_{11}
			Level of Implementation of Green Transportation Policies C_{12}
			Impact of Green Transportation Policies on Travel C_{13}
		Traffic Information Perception C_2	Level of Standardization of City's Disclosure of Transportation Information Reports C_{21}
	Social Impacts D	Traffic Safety Perception D_1	Level of Transportation System Construction for Travel Safety D_{11}
			Level of Traffic Enforcement in City D_{12}
		Social Development Perception D_2	Impact of Green Transportation on Urban Livability D_{21}
			Impact of Green Transportation System on Surrounding Commercial Activities D_{22}
			Impact of Green Transportation on Social Activities D_{23}
			Impact of Green Transportation on Surrounding Land Use D_{24}
			Level of Green Transportation Reducing Pollution D_{25}
Level of Green Transportation Reducing Congestion D_{26}			
Level of Green Transportation Improving Travel Convenience D_{27}			
Social Inclusiveness Perception D_3	Level of Inclusiveness Green Transportation for the Elderly and Disabled D_{31}		

Many scholars focus more on the objectivity of the indicators [8][9] while ignoring the falsity of objective data. This paper starts from the perspective of the main body of transportation, traveler's perception of the value of each indicator they gave, which can reflect the realistic problems and increase the operability of the indicators.

3. Evaluation Method of Urban Green Transportation Development Level Based on Group Information Aggregation

As a cross-disciplinary subject, group decision-making is to assemble the individual preferences of each evaluator into a single group under a certain decision criterion. Many scholars [10-13] commonly use this model for practical problems. As part of group decision-making, information

aggregation [14-15] summarizes the comprehensive evaluated value by aggregating individual preferences.

Considering each index in the paper is an evaluated one and each evaluator has a different preference, aggregating all evaluations can synthesize all evaluators' perceptions of a particular index for a relevant analysis.

3.1. Reference Point of Combinational Optimization

This paper selected reference points in prospect theory [16-18] which represent the comprehensive preference of the specific evaluators. Then the evaluated value of each evaluator was compared with the reference point to improve the decision-making efficiency. Previous studies have subjectively selected positive or negative ideal points [19-21] or expected values [22] [23] as the reference point. It is a simple way to determine, but may not be reasonable.

Therefore, this paper combined positive and negative ideal points and expected values to establish a combinational optimization model, form the reference point, and improve the reasonableness of reference point selection. The process is as follows.

1) Defining Reference Points with Expected Values and Positive and Negative Ideal Points

In the setting, M denotes evaluators, i refers to individual evaluators, n is the index group, and k represents a specific index. The reference point was set as v^l . $l = l_1, l_2, l_3$ denotes the cases with the expected value, positive ideal points, and negative ones as the reference points respectively.

When $l = l_1$, the evaluated value of each evaluator for index k is $v_k = (v_k^1, v_k^2, \dots, v_k^M)$. This can be regarded as a set of discrete variables, $v_k^{l_1} = \sum_{i=1}^M v_k^i p(v_k^i)$, where $p(v_k^i)$ denotes the probability of occurrence of v_k^i . Thus, the reference point of the expected value for evaluated values of each index is obtained.

$$v^{l_1} = (v_1^{l_1}, v_2^{l_1}, \dots, v_n^{l_1}) \tag{1}$$

When $l = l_2$ and taking the positive ideal points as the reference, the positive ideal program is the maximum evaluated value of all evaluators for one index, that is, $v_k^{l_2} = \max(v_k^1, v_k^2, \dots, v_k^M)$. The reference point in this way is as follows.

$$v^{l_2} = (v_1^{l_2}, v_2^{l_2}, \dots, v_n^{l_2}) \tag{2}$$

When $l = l_3$ and taking the negative ideal points as the reference, the negative ideal program is the minimum evaluated value of all evaluators for one index, that is, $v_k^{l_3} = \min(v_k^1, v_k^2, \dots, v_k^M)$. The reference point in this way is as follows.

$$v^{l_3} = (v_1^{l_3}, v_2^{l_3}, \dots, v_n^{l_3}) \tag{3}$$

2) Modeling Combinational Optimization

Considering the advantages and disadvantages of each program, this paper took the minimum difference between the newly set combinational reference point and the above three types as the objective function. The optimization model is as follows.

$$\min F(v_k^{l_0}) = \alpha \sum_{k=1}^n (v_k^{l_0} - v_k^{l_1})^2 + \beta \sum_{k=1}^n (v_k^{l_0} - v_k^{l_2})^2 + \gamma \sum_{k=1}^n (v_k^{l_0} - v_k^{l_3})^2 \tag{4}$$

$$s. t. 0 < v_k^{l_0} < 1 \tag{5}$$

α , β and γ indicate the relative importance of the reference points of the expected value, the positive ideal program, and the negative ideal program respectively. They are determined according

to the standard deviation σ of the comprehensive evaluated value of each index for each reference point. Standard deviation reflects the difference between different indexes. the larger the difference is, the easier it is to illustrate the problem with corresponding recommendations. A larger standard deviation means greater importance.

The optimization model in this paper is the nonlinear optimization problem in operations research, which can be solved according to the Kuhn-Tucker condition. The model becomes the following.

$$\min F(v_k^{l_0}) = \alpha \sum_{k=1}^n (v_k^{l_0} - v_k^{l_1})^2 + \beta \sum_{k=1}^n (v_k^{l_0} - v_k^{l_2})^2 + \gamma \sum_{k=1}^n (v_k^{l_0} - v_k^{l_3})^2 \quad (6)$$

$$s. t. \begin{cases} g_1(v_k^{l_0}) = v_k^{l_0} > 0 \\ g_2(v_k^{l_0}) = 1 - v_k^{l_0} > 0 \end{cases} \quad (7)$$

The specific k is:

$$\begin{cases} \nabla F(v_k^{l_0}) = 2\alpha(v_k^{l_0} - v_k^{l_1}) + 2\beta(v_k^{l_0} - v_k^{l_2}) + 2\gamma(v_k^{l_0} - v_k^{l_3}) \\ \nabla g_1(v_k^{l_0}) = 1 \\ \nabla g_2(v_k^{l_0}) = -1 \end{cases} \quad (8)$$

The condition for $K - T$ is:

$$\begin{cases} 2\alpha(v_k^{l_0} - v_k^{l_1}) + 2\beta(v_k^{l_0} - v_k^{l_2}) + 2\gamma(v_k^{l_0} - v_k^{l_3}) - \mu_1 + \mu_2 = 0 \\ \mu_1 v_k^{l_0} = 0 \\ \mu_2(1 - v_k^{l_0}) = 0 \\ \mu_1 \geq 0, \mu_2 \geq 0 \end{cases} \quad (9)$$

It can be solved in several cases.

- (1) $\mu_1 > 0, \mu_2 > 0$, insoluble
- (2) $\mu_1 > 0, \mu_2 = 0, v_k^{l_0} = 0$, falling short
- (3) $\mu_1 = 0, \mu_2 > 0, v_k^{l_0} = 1$, falling short
- (4) $\mu_1 = 0, \mu_2 = 0, v_k^{l_0} = \frac{\alpha v_k^{l_1} + \beta v_k^{l_2} + \gamma v_k^{l_3}}{\alpha + \beta + \gamma}$

The optimized combinational reference point is obtained.

$$v^{l_0} = (v_1^{l_0}, v_2^{l_0}, \dots, v_n^{l_0}) \quad (10)$$

$$v_k^{l_0} = \frac{\alpha v_k^{l_1} + \beta v_k^{l_2} + \gamma v_k^{l_3}}{\alpha + \beta + \gamma}, k = 1, 2, \dots, n \quad (11)$$

3.2. Group Information Aggregation

1) Solving for the Distance between Evaluators and Reference Point

This research used the distance between the evaluator and the reference point to represent the total difference values between this evaluator and others. Based on the previous difference analysis, the greater the total value of the difference, the less weight the evaluator will be given, and the distance between the Evaluator i and reference point was set as $d_{li}, i = 1, 2, \dots, M$. From the evaluated value of the Evaluator i , $v^i = (v_1^i, v_2^i, \dots, v_n^i), i = 1, 2, \dots, M$, and the reference point, $v^i = (v_1^i, v_2^i, \dots, v_n^i), i = 1, 2, \dots, M$, the distance equation is as follows.

$$d_{l_0i} = \sqrt{\sum_{k=1}^n (v_k^{l_0} - v_k^i)^2}, i = 1, 2, \dots, M \tag{12}$$

2) Calculation of Evaluator Weights

The weight for the Evaluator i under the reference point was $\omega_i^{l_0}$ and $\sum_{i=1}^M \omega_i^{l_0} = 1$. Combined with the idea that the greater the difference, the smaller the weight, the weight equation was made to avoid too much similarity between the evaluation results which caused close results of d_{l_0i} and $\omega_i^{l_0}$, and ineffective comprehensive evaluated values.

$$\omega_i^{l_0} = \frac{\frac{1}{1+d_{l_0i}^2}}{\sum_{i=1}^M \frac{1}{1+d_{l_0i}^2}} \tag{13}$$

3) Solving for Comprehensive Evaluated Values

The comprehensive evaluated value after aggregation was set as $V_k^{l_0}$. Evaluated values of evaluators for each index can be aggregated combining the weights in the previous section. The comprehensive evaluated value equation is as follows.

$$V_k^{l_0} = \sum_{i=1}^M \omega_i^{l_0} v_k^i, k = 1, 2, \dots, n \tag{14}$$

4. Empirical Analysis

Located in the central part of Inner Mongolia Autonomous Region, Hohhot is an important center city in the border area of northern China. The weather in Hohhot is dry with scarce rainfall all year round. Closing to Western China, Hohhot has more particles in the air, which leads to sandy and dusty weather in spring every year. Therefore, analyzing the level of urban green transport development in Hohhot is of reference values for the cities along the borders of northwestern China as well as for the central cities within the urban agglomerations.

4.1. Data Source

Due to the special nature of the green transportation evaluation classification indexes, the data were obtained from travelers with their own experience. Therefore, a questionnaire survey was adopted for the data, and the scores of each index were from 1 to 7 points. An expert survey method was used to score the questionnaire to ensure the accuracy and rationality of the indexes. The number of experts involved was 22, all of whom were researchers in the field of transportation or environment working and living in Hohhot. The corresponding number of experts in specific research fields is shown in Fig. 1, and some of the raw evaluation data is presented in Table 2.

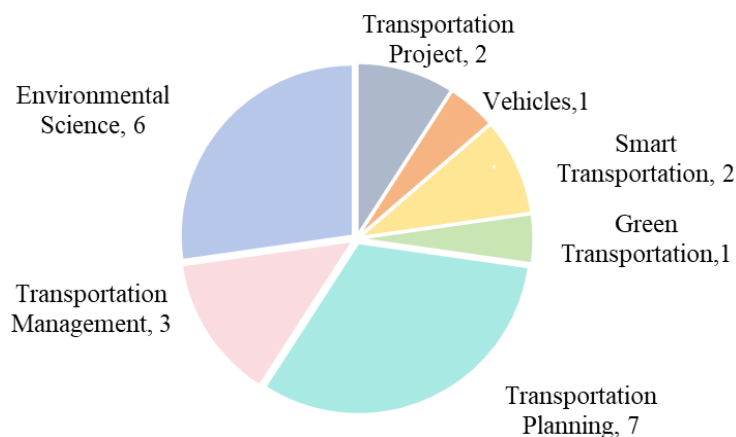


Figure 1. Research Field and Corresponding Number of Experts

Table 2. Partial Raw Evaluation Data

Expert	A ₁₁	A ₁₂	A ₂₁	A ₂₂	A ₂₃	Expert	A ₁₁	A ₁₂	A ₂₁	A ₂₂	A ₂₃
E ₁	5	3	7	6	7	E ₁₂	5	2	6	2	5
E ₂	5	1	7	5	6	E ₁₃	3	1	5	6	5
E ₃	4	3	6	7	6	E ₁₄	3	3	7	5	5
E ₄	5	4	5	4	4	E ₁₅	3	5	6	5	6
E ₅	3	5	6	6	5	E ₁₆	5	4	6	4	5
E ₆	4	3	3	4	4	E ₁₇	5	5	4	5	4
E ₇	5	4	5	6	5	E ₁₈	5	3	5	5	4
E ₈	5	6	5	6	5	E ₁₉	5	1	6	4	5
E ₉	5	2	5	6	6	E ₂₀	5	5	6	6	6
E ₁₀	3	1	5	3	3	E ₂₁	4	1	6	6	4
E ₁₁	5	2	6	5	5	E ₂₂	4	5	6	4	5

4.2. Comprehensive Evaluation

1) Comprehensive Evaluated Values of the Reference Point by Expected Values and Positive and Negative Ideal Points

The reference point of expected values, positive and negative ideal points were determined based on Eq. (1)-(3). The comprehensive evaluated values of the three were then calculated according to Eq. (12)-(14). Finally, the standard deviations of the three were calculated according to the comprehensive evaluated values, shown in Table 3.

Table 3. Reference Points of Positive and Negative Ideal Points, and Expected Values

l	Reference Point v ^l and Comprehensive Evaluated Points V ^l	σ ^l
l = l ₁	v ^{l₁} = (4.36,3.14,5.59,5.00,5.00,4.73,5.14,3.50,3.95,2.55,3.95,4.36,4.91,4.82, 2.77,4.82,4.50,4.45,4.18,4.27,4.50,4.14,4.91,5.14,4.82,5.32,5.36,4.55,3.91)	0.7413
	V ^{l₁} = (4.470,3.213,5.431,5.002,4.914,4.623,5.080,3.500,3.885,2.362,3.841, 4.272,4.858,4.785,2.650,4.906,4.604,4.544,4.193,4.260,4.448,4.242,4.801, 5.061,4.799,5.189,5.285,4.624,3.982)	
l = l ₂	v ^{l₂} = (5.00,6.00,7.00,7.00,7.00,7.00,7.00,6.00,6.00,7.00,7.00,7.00,7.00,7.00, 4.00,7.00,7.00,7.00,7.00,6.00,7.00,7.00,7.00,7.00,7.00,7.00,7.00,6.00)	0.7667
	V ^{l₂} = (4.318,3.433,5.834,5.149,5.357,5.110,5.338,3.851,4.166,2.877,4.544, 4.991,5.326,4.763,3.110,5.145,4.916,4.822,4.848,4.794,5.001,4.527,5.502, 5.700,5.204,5.862,5.842,4.968,4.271)	
l = l ₃	v ^{l₃} = (3.00,1.00,3.00,2.00,3.00,3.00,3.00,2.00,2.00,1.00,2.00,2.00,3.00,2.00, 1.00,2.00,2.00,2.00,2.00,2.00,2.00,2.00,1.00,3.00,3.00,3.00,3.00,3.00,2.00,1.00)	0.7531
	V ^{l₃} = (4.226,2.785,5.360,4.646,4.567,4.294,4.767,3.138,3.794,2.218,3.445, 3.682,4.500,4.803,2.497,4.276,3.900,3.887,3.513,3.730,3.970,3.716,4.428, 4.653,4.463,4.917,4.979,4.106,3.327)	

2) Combinational Reference Point

The standard deviations of the three were used to define α, β and γ, that is, α = $\frac{\sigma^{l_1}}{\sum \sigma^l} = 0.33$, β = $\frac{\sigma^{l_2}}{\sum \sigma^l} = 0.34$ and γ = $\frac{\sigma^{l_3}}{\sum \sigma^l} = 0.33$. The combinational reference point was calculated based on Eq. (10)-(11).

$$v^l_0 = (4.129, 3.406, 5.215, 4.690, 5.020, 4.931, 5.066, 3.855, 4.003, 3.552, 4.344, 4.479, 4.990, 4.631, 2.604, 4.631, 4.525, 4.509, 4.419, 4.109, 4.525, 4.076, 4.990, 5.066, 4.961, 5.126, 5.139, 4.542, 3.660)$$

3) Calculation of Distance and Weights of Experts

The distance between the expert and the combinational reference point and the weight of the expert were calculated based on Eq. (12)-(13) in Table 4 and 5.

Table 4. Distance between Expert’s Evaluated Value and the Reference Point l_0

i	d_{l_0i}	$d_{l_0i}^2$	i	d_{l_0i}	$d_{l_0i}^2$	i	d_{l_0i}	$d_{l_0i}^2$
1	10.2120	104.2842	9	5.9053	34.8722	17	5.0656	25.6602
2	6.6417	44.1122	10	9.2585	85.7202	18	7.6353	58.2982
3	5.6390	31.7982	11	6.7034	44.9362	19	5.7541	33.1102
4	4.0013	16.0102	12	5.9723	35.6682	20	8.1020	65.6422
5	8.0078	64.1242	13	5.9795	35.7542	21	7.0396	49.5562
6	5.4590	29.8002	14	5.9837	35.8042	22	6.1910	38.3282
7	4.8067	23.1042	15	7.8809	62.1082			
8	5.4011	29.1722	16	6.3152	39.8822			

Table 5. Weights of Experts

i	$\omega_i^{l_0}$	i	$\omega_i^{l_0}$	i	$\omega_i^{l_0}$	i	$\omega_i^{l_0}$
1	0.0167	7	0.0727	13	0.0477	19	0.0514
2	0.0389	8	0.0581	14	0.0476	20	0.0263
3	0.0534	9	0.0489	15	0.0278	21	0.0347
4	0.1031	10	0.0202	16	0.0429	22	0.0446
5	0.0269	11	0.0382	17	0.0658		
6	0.0569	12	0.0478	18	0.0296		

4) Comprehensive Evaluated Values

The comprehensive evaluated values of each index were calculated based on Eq. 14.

$$V^l_0 = (4.471, 3.256, 5.422, 4.957, 4.899, 4.624, 5.057, 3.556, 3.927, 2.433, 3.896, 4.313, 4.886, 4.770, 2.660, 4.892, 4.589, 4.530, 4.230, 4.252, 4.444, 4.231, 4.847, 5.089, 4.819, 5.220, 5.296, 4.626, 4.016)$$

4.3. Result Analysis

Because of the large number of indexes, this paper constructed line graphs for four aspects, including transportation function level, environmental protection and energy, information and policy, and social impact. Then, they were analyzed based on the comprehensive evaluated values of each index.

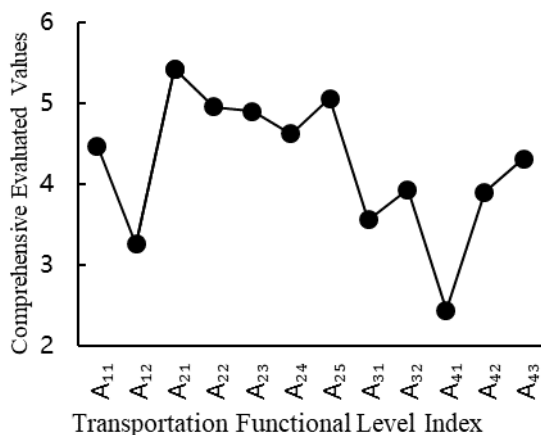


Figure 2. Comparison of Transportation Functional Level Index

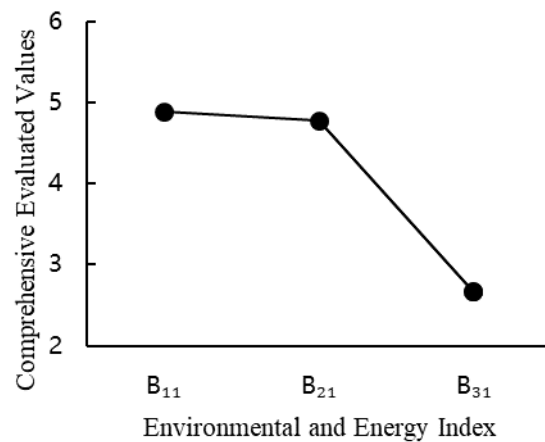


Figure 3. Comparison of Environmental and Energy Index

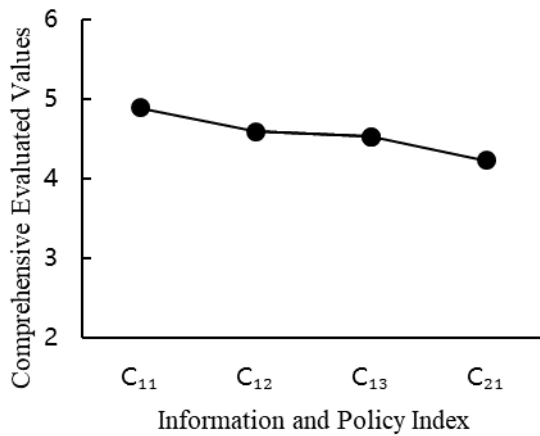


Figure 4. Comparison of Information and Policy Index

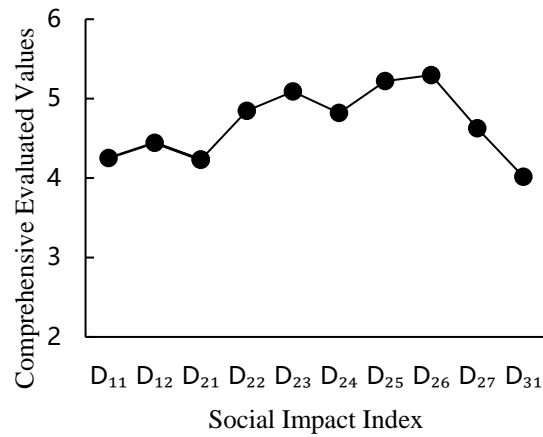


Figure 5. Comparison of Social Impact Index

In Fig. 2, the curve fluctuates with large amplitude. The lowest point is A_{41} and the evaluated values can be seen general for A_{11} and lower for A_{12} , A_{31} and A_{32} . The highest point is A_{21} and the evaluated values of A_{22} — A_{25} are relatively high. It indicates that the level of travelers adopting green transportation is the lowest, the average degree of congestion in the city is general, but the peak congestion is serious. The city’s current development of slow transportation is underdeveloped while the degree of public transportation neatness is optimal. In addition, the level of each index under the public transportation perception criterion is relatively high. Fig. 2 demonstrates that different groups of people have various tendencies for travel modes [24]. Some firmly practice green transportation, while others are influenced by self-interest motives [25] and thus consider external factors such as comfort, convenience, health considerations, and economic factors. The rest are motivated solely by self-interest, with little consideration of environmental factors [26]. In reality, the latter two categories are more prevalent, leading to lower levels of green transportation. In this way, the Government should take multiple measures, such as publicizing the importance of green transportation, encouraging the concept of low-carbon life, and completing rational transportation planning and infrastructure development.

Fig. 3 presents gradually declining curves with great amplitude. The lowest point is B_{31} but the evaluated values for B_{11} and B_{21} are high, denoting lower prevalence of new energy, higher air quality, and lower level of traffic noise pollution. Based on Figure 3, it is analyzed that new energy vehicles, as a product of the green transition, boast excellent power output, high levels of safety and reliability, and economic and energy efficiency [27]. They can effectively reduce the emission of solid particulate matter in the atmosphere and the risk of internal medicine diseases [28-29].

Fig. 4 demonstrates a relatively smooth curve change with a low-amplitude downward trend. The evaluated value of C_{11} is high while low for C_{12} , C_{13} and C_{21} . It shows that the convenience of travelers to receive environmental protection transportation policy is high, but the level of the Government publicity of transportation information, and the effectiveness of policies are general. Therefore, it is analyzed that advances in technology have enriched people’s access to policy information, including official websites, social media, news media, and advertising campaigns. Many organizations have also developed mobile applications and online platforms that use satellite technology to provide real-time information on traffic conditions. The Government has also made access to policies easier with road signs, markings, and stop signs to remind travelers of the requirements of environmental policies.

As can be seen from Fig. 5, the curve first rises and then falls with small amplitude. The evaluated values of D_{22} — D_{27} are higher but lower for D_{12} and D_{31} , representing a greater positive influence of the green transportation system on the surrounding activities in Hohhot. However, the level of traffic law enforcement efforts is general, and inclusiveness of the green transportation system is low. The analysis is that there are still problems such as the lack of patience of the staff, the difficulty for

the elderly to use the smart devices, and the complexity of the travel guidance signs, despite infrastructures for the elderly and the disabled. Therefore, measures should be taken to improve access to infrastructure, provide training and support, develop inclusive policies, and provide economic support for better inclusiveness. The needs and feedback of the elderly and the disabled should be considered to ensure their access to the benefits of green transportation.

To sum up, public transportation in Hohhot has developed at a faster pace with improved air quality, traffic noise pollution, and other problems. The popularity of new energy vehicles has seen an increase. In the future, the publicity of environmental protection policies should be appreciated and the disclosure of transportation information should be standardized. Science and technology can assist in traffic law enforcement. All these aspects help satisfy the travel needs of the elderly and people with disabilities, and push forward the continued development of slow-moving transportation, thus making green transportation the best choice for people.

5. Summary

This paper constructs a green transportation evaluation system combining quantitative and qualitative based on travelers' perceptions, and proposes an information aggregation evaluation method combining optimized reference points. The development of green transportation in the city Hohhot was evaluated.

Starting from travelers who are the main body helps the Government solve practical problems more accurately. This paper shows that the green transportation system in Hohhot has a significant impact with better public transportation and achievements in environmental protection and new energy. In the future, the Government should increase its investment in the promotion of green transport policies, pay attention to the disclosure of transport information, strengthen traffic law enforcement, enhance the inclusiveness of transport, and promote the development of slow-moving transport. In this way, safer and more efficient green travel is guaranteed.

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