Research on eco-city planning based on comprehensive evaluation model

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Abstract
In this paper, a reasonable eco-city planning is used as the goal; firstly, the weights are determined by the hierarchical analysis, a comprehensive evaluation mathematical model is established. Taking Tangshan city as an example, the study conducts an evaluation analysis of the eco-city planning of Tangshan, in the process of the analysis, the ecological environment of Tangshan, unreasonable industrial structure, etc are found, affecting the evaluation results. The reasonable planning of the collected data improves the comprehensive evaluation score of ecological city, which is more in line with the policy options of the national ecological urban planning. In this study, through the reasonable evaluation on the scheme of eco-city planning, scientificity of ecological city planning evaluation is greatly raised, and the evaluation reliability of the planning is improved. It is hoped to provide a new way to achieve good results for the ecological city planning and to make our city construction be more and more reasonable, and development be more and more harmonious.
Key words:COMPREHENSIVE EVALUATION,HIERARCHICAL ANALYSIS,CITY PLANNING,EVALUATION MODEL

1. Introduction

Urban development, urban management and construction can be guided by urban planning. Urban planning is the reasonable urban overall planning generally developed based on the city's economic development, human conditions, geographical environment, and other conditions; it integrates several aspects of the city, enables the city to have coordinated development, and thus comprehensively deploys and overall arranges the city, including how to reasonably use the land, how to carry out a series of comprehensive and strategic planning for overall layout of the urban space, construction of infrastructure and ecological environment.

At present, there are some obvious problems in the management and planning.In order to make full use of the role of regulatory effect of urban planning, the city should be scientifically rigorous planned.In this case, the relevant laws has been promulgated,and has effectively promoted the process of urban ecological planning so as to ensure the implementation results of the planning to effectively detect and measure the implementation of urban planning effectiveness, and feedback and supervise the actual situation after the planning.On this basis, the adjusted the planning content can be further implemented. The constantly adjusting and revising the planning policy can improve the operation of urban planning, and form a virtuous circle, better promote the development and construction of the city.

Through investigation, forecasting, analysis and other initial preparations, and the management of the city's health is regarded as the purpose of the development, the reasonable planning of ecological city is based on the scientific forecast to a certain extent to establish a future planning model of an ideal city. Although the establishment of this model can reasonably plan the overall framework of the future of the city, it can only lead and control the development of the city to a certain extent. As the development of the city is a dynamic process, it is very difficult to simulate the development process of urban planning.The establishment of scientific and rational urban planning scheme has become one of the problems to be solved. Only under the guidance of scientific planning, can the construction of the city achieve greater results in a short period of time, and advance urban construction.

2. Analysis method of comprehensive evaluation

The comprehensive evaluation can make a relative ranking and evaluation of the effectiveness of the same type of decision-making, and make an in-depth analysis of the reasons for the useless decision making and the scheme of the improvement as well, and then provide the decision makers with valuable management plans.

Hierarchical analysis determines the weights.A schematic diagram of the factors affecting the ecological city planning is shown in Figure 1.

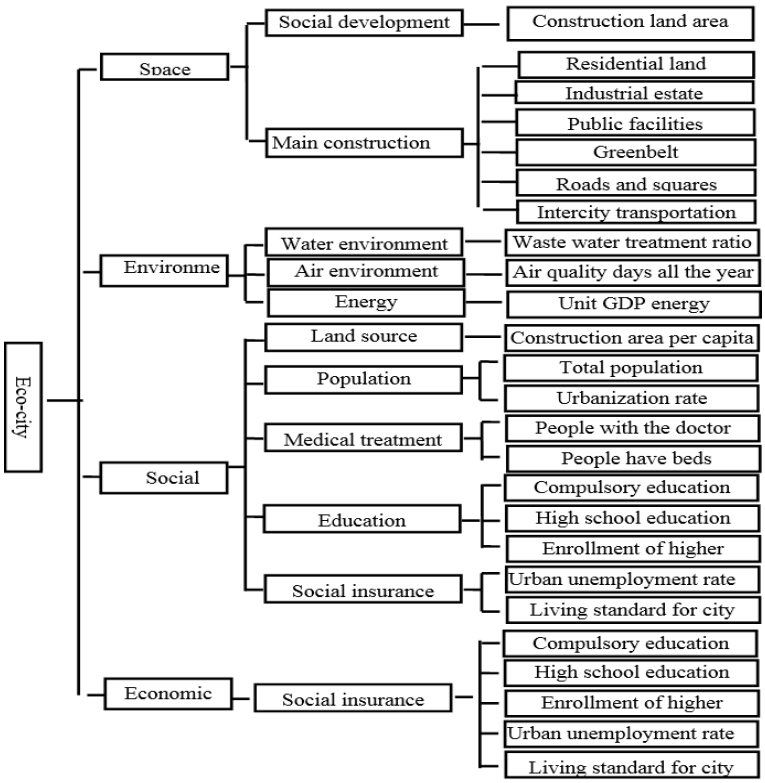

Figure 1. Various factors of ecological urban planning and multi-level hierarchical structure

The following is the determined the laddered coherence analysis of the index system, beginning with the goal layer of the first layer, and successively bases on the elements of the above layer, and compares them with those in the next layer to establish the judgment matrix. Taking the relationship between Criterion Layer B and target layer as an example, the judgment matrix can be described as:

A	B_1	B_2	$\cdots$	B_m
B_1	B_{11}	B_{12}	$\cdots$	B_{1m}
B_2	B_{11}	B_{11}	$\cdots$	B_{2m}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
B_m	B_{m1}	B_{m2}	$\cdots$	B_{mm}

Wherein, B^{ij} indicates the importance ratio scale of the target when the guidelines are compared to standards. At present, the 1-9 scaling method is widely used. B^{ij} indicates the relatively important degree of scale values of element i and element j . in actual problems, B^{ij} is obtained through the experience of the experts and their own knowledge or decision maker's management program, so it is concluded that the obtained matrix B is inconsistent. Therefore, the judgment matrix needs the consistency check.

$$CI = \frac{\lambda_{\max} - m}{m-1}$$ is used to check the consistency of matrix B. when $\lambda_{\max} = m$, $CI = 0$, indicating a complete agreement; when the value of CI has a greater distance from 0, indicating the consistency of the judgment matrix is the worse. In order to measure the consistency of the judgment matrix with different order numbers, the random consistency ratio CR is introduced in the paper , and

$$CR = \frac{CI}{RI}$$

Consistency check, when CR = 0.002<0.1, then the feature vector and feature root of judgment matrix is calculated through the MATLAB, taking the format of $[V, D] = eig(B)$, in which, V indicates a matrix composed of feature vectors of matrix B , D indicates a matrix composed of feature root of matrix B . In D , the diagonal elements are characteristic roots, the rest elements are 0 ; in V , after the element corresponding to the maximum characteristic root of D is normalized, that is the weight of the corresponding elements, which can be solved by matlab:

(1)The weight of the first decision layer is shown in Figure 2

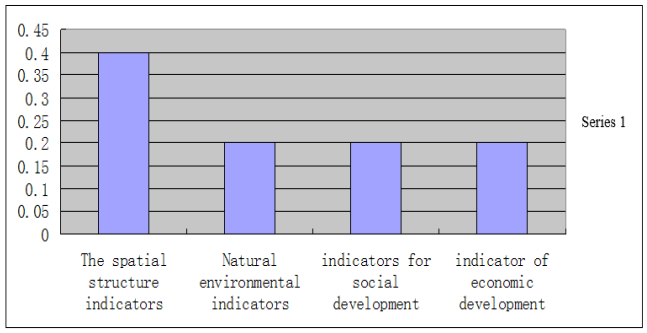

Figure 2. The weight of the first decision layer

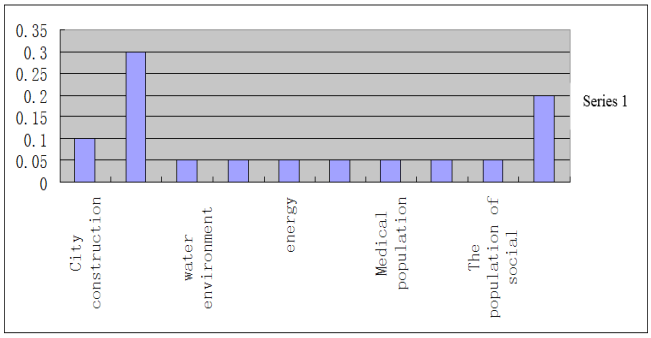

Figure 3. The weight of the second decision layer

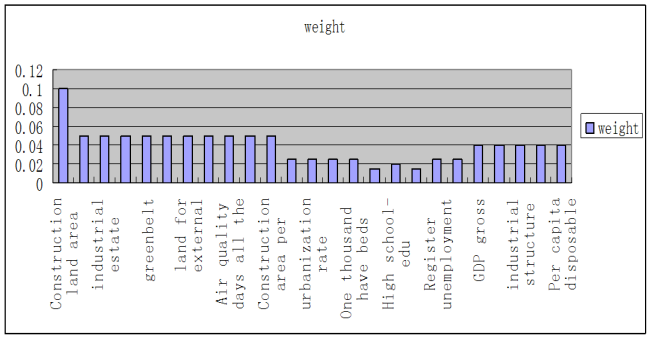

Figure 4. The weight of the third decision layer

It can be clearly seen through histogram that the contribution of each factor on the target layer. When the comprehensive evaluation of the city is in a low level, the government can catch the main factors and secondary factors, adjust and control of all items of urban planning through the size of the weights.

3. Establishment of a comprehensive evaluation model of urban planning

3.1. Establishment of evaluation factors level

Assuming there are m main factors that reflect the object of evaluation, respectively indicated with $u_1, u_2, \cdots, u_m$, the evaluation factor set formed is noted as $U = \{u_1, u_2, \cdots, u_m\}$. For each element of the evaluation factor set $u_i (i = 1,2,\cdots,m)$, to analyze the membership degree r_{ij} of it on evaluation rank $v_j (j = 1,2,\cdots,n)$,the evaluation result of element i of single factor is obtained: $r_i = (r_{i1}, r_{i2}, \cdots r_{in})$. In the

normal situation, $r_{ij} > 0$ and $\sum_{j=1}^{n} r_{ij} = 1$.

3.2. Determination of the planning level set

According to the status quo of the urban planning, in order to show the status quo and the evaluation results of urban construction more intuitionistically, the urban planning score is evaluated according to Table 1 in this study. That is, according to the current situation of urban construction and the definition of national standards for urban construction deviation. Scoring is conducted for Tangshan City.

Table 1. Score standard for urban planning

Deviation range (%)	± (0~5)	± (6~10)	± (11~15)	± (16~20)	± (≥210~5)
Score	100	80	60	40	20

According to the grading result to conduct the rank classification, partitioning results are shown in Table 2.

Table 2. Rank classification of urban planning evaluation

Rank	Very poor	Poor	General	Good	Excellent
Score range	(<20)	(20~40)	(40~60)	(60~80)	≥ 80

3.3. Establishment of evaluation matrix

For m elements, r_i is regarded as line i, forming a fuzzy matrix R of n evaluation rank integrating m elements. As shown in the following:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{21} & \cdots & r_{11} \\ \vdots & \vdots & \cdots & \vdots \\ r_{m1} & r_{m1} & \cdots & r_{mn} \end{bmatrix} \quad (1)$$

Determination of the weight distribution set w_i of each index u_i according to the results of hierarchical analysis,

$$w_i = (w_{i1}, w_{i2}, \cdots, w_{ik}) \ \ (i = 1,2,\cdots,s) \quad (2)$$

For the weight w_i, it is required that $w_i \geq 0$ and $\sum w_i = 1$.

4. Comprehensive syntheses

Based on the determination of the weight vector w and matrix R, the weight vector w and matrix R are integrated, the membership degree of each evaluation grade of evaluation object can be obtained from the overall. The vector obtained through the comprehensive evaluation results is noted as $S = (s_1, s_2, \cdots, s_n)$, then $S = W \circ R$, wherein, $\circ$ is an operator notation. Due to the different operator notations, its corresponding comprehensive evaluation model is not the same. The study selects the comparison operator symbol $Zadeh$, selects the fuzzy operator for S calculation, after the calculation, it is needed to conduct the normalization S, make $\sum S_j = 1$.

Finally the weights obtained through the hierarchical analysis method are used to calculate the matrix of Smith's R matrix and 10 R matrixes are obtained. Tangshan eco city planning of the final score is 58.46 points, the evaluation level is general, which obviously does not conform to the reasonable planning of eco city, in this study, through the data base and data statistics library, the irrationality of the planning is further studied, shown as Table 3.

Table 3. Comparison of results obtained from urban planning index

Evaluation area	Evaluation index	Evaluation factor	Practical	Planning
The spatial structure indicators (0.4)	City construction (0.1)	Construction land area	13472	13514
	The main construction land layout (0.3)	Residential land	3644	4200
		Industrial estate	1415	1042
		Public facilities	2630	2234
		Greenbelt	2302	2106
		Roads and squares	3444	3346
		Land for external transport	36	32

Natural environmental indicators (0.2)	Water environment (0.05)	Waste water treatment ratio	67	80
	Air environment (0.05)	Air quality days all the year	106	240
	Energy (0.05)	GDP energy consump-level	13.4%	decline 15%
	Land resource population (0.05)	Construction area per capita	562.45	540.65
Indicators for social development (0.2)	Population (0.05)	Total population Urbanization rate	753.16 72	700.3 67
	Medical population (0.05)	One thousand with doctor One thousand have beds	2.14 3.34	2.8 4.1
	Educating population (0.05)	Compulsory-edu High school-edu Enrollment of higher-edu	97 80 above 25 above	99 90 26.5
	The population of social security (0.05)	Unemployment rate min standard of living	4.5%below 100	4.3% 100
Indicator of economic development (0.2)	Economic development (0.2)	GDP gross General financial revenu Industrial structure Total Investment in Fixed Per capita disposable income	5442.4 622.6 10:57:32 4500 19556	5342.6 476 5:54:419510 17623

In table 3, it is found that the environmental and economic development in Tangshan area is very unbalanced, the reason may as follows: as an industrial city, the rapid development of economy also brought serious environmental problems, in order to reasonably plan the construction of Tangshan city, in this paper, reasonable adjustment of individual factors is conducted, the solution of the model is re-evaluated, and the results are in Table 4.

Table 4. Comprehensive evaluation scores of the adjusted urban planning

Evaluation area	Evaluation index	Evaluation factor	Indicator	Weight	Goal
The spatial structure indicators (0.4)	City construction (0.1)	Construction land area	100	0.1	10
	The main construction land layout (0.3)	residential land industrial estate public facilities greenbelt roads and squares land for external transport	80 40 60 60 80 80	0.05 0.05 0.05 0.05 0.05 0.05	4 2 3 3 4 4

Natural Environmental indicators (0.2)	water environment (0.05)	waste water treatment ratio	80	0.05	4
	air environment (0.05)	Air quality days all the year	100	0.05	5
	energy (0.05)	GDP energy consump	60	0.05	3
	Land resource population (0.05)	Construction area per capita	80	0.05	4
Indicators for social development (0.2)	population (0.05)	total population urbanization rate	80 80	0.025 0.025	2 2
	Medical population (0.05)	One thousand with doctor One thousand have beds	60 60	0.025 0.025	1.5 1.5
	educating population (0.05)	Compulsory-edu penetration High school-edu penetration enrollment of higher-edu	100 100 100	0.015 0.02 0.015	1.5 2 1.5
	The population of social security (0.05)	Register unemployment rate min standard of living	100 100	0.025 0.025	2.5 2.5
Indicator of economic development (0.2)	Economic development (0.2)	GDP gross general financial revenue industrial structure Total Investment in Fixed Per capita disposable income	100 80 60 80 100	0.04 0.04 0.04 0.04 0.04	4 3.2 2.4 3.2 4
total				1	80.8

It can be known according to the results of Table 4, the comprehensive evaluation score of the adjusted urban planning in Tangshan is 80.8, and the level is excellent, which is more in line with the objectives of urban planning. And this table mainly adjusts the green area, air quality, the number of doctors in thousands of people, the industrial structure, that is, in such a heavy industrial city such as Tangshan, the problems faced in the urban planning are environmental pollution, human construction, the non-coordinated development of the three major industries.

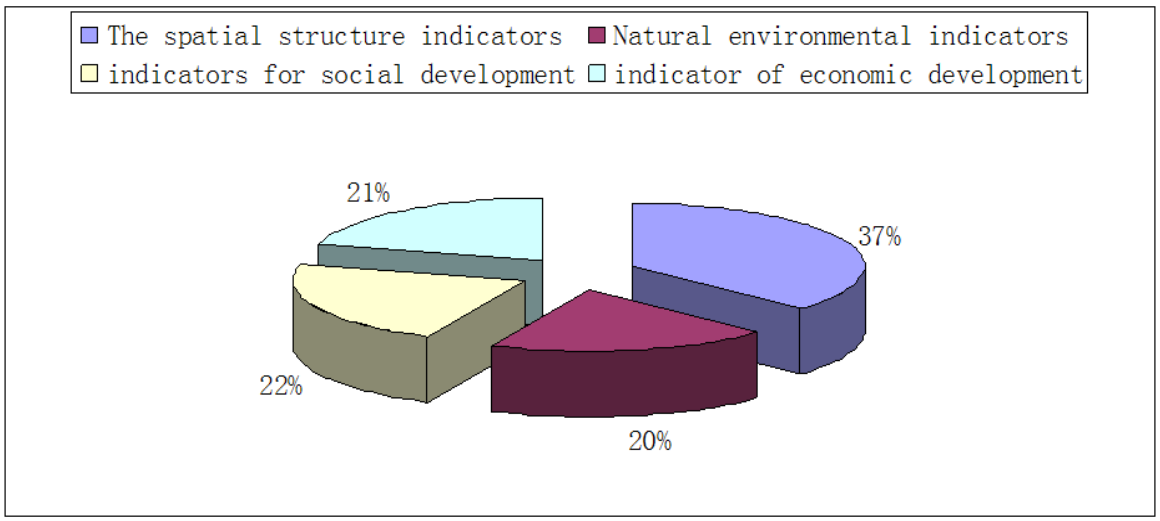

Figure 5. Decision level score

It can be known from the analysis of Figure 5, under the condition of ensuring the coordination of the overall layout of the space, achieving a relatively stable development of the natural environment, social development and economic development, it can make the urban planning in a more healthy and reasonable state.

5. Conclusions

Because of the growing concern about the city planning and construction, it is urgent to propose a reasonable planning scheme. Through the research of this paper, in a comprehensive evaluation model, we can get a comprehensive score of urban planning, and adjust some factors, so as to improve the comprehensive evaluation score. At the same time, the government can increase the investment in one factor. As it is found in the research on Tangshan, the industry structure and ecological environment development of Tangshan is quite not balanced, through the government's macro regulation and control, the rationality of the planning can be improved, so as to make the urban construction can be developed healthily and orderly.

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