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Evaluation of Sustainable Development of Eco-environment in Tianjin

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Evaluation of Sustainable Development of Eco-environment in Tianjin

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Abstract. On the basis of discussing the relationship between urban ecosystem and sustainable development, the evaluation index system of sustainable development of human settlements environment in Tianjin was constructed from four aspects: social development level, economic development level, natural development level and sustainability level. The evaluation index of Tianjin ecosystem and its sustainable development level in recent 10 years were calculated by simple arithmetic average method. The relationship between sustainable development of ecosystem and economic development in Tianjin was quantitatively evaluated. The results show that the ecosystem of Tianjin is developing in a sustainable direction, basically in line with the stage of economic development, but there are still some shortcomings which need to be improved urgently.

1. Introduction

In recent years, with the aggravation of global warming and haze, more and more attention has been paid to environmental problems. Solving environmental problems, maintaining human settlements and ecological environment, and achieving coordinated and sustainable development of economy, environment, society and resources have also become the goal of unremitting efforts of governments. And cities, as human settlements, are also the most prominent places of environmental problems. The function of a city is to accommodate a high density population and provide a place for people's social and economic activities. Therefore, it is a typical eco-social-natural complex ecosystem, which can be called the urban ecosystem. The urban ecosystem contains all kinds of essential elements for the production and life of urban residents. The simple classification of these elements can be roughly divided into three parts, namely, the economic part, the social part and the natural part. Each part is not completely independent from each other, and the development of each part plays an important role in the development of urban ecosystem. Therefore, in order to promote the development of urban ecosystem, we should start from the three parts of economy, society and nature, and combine them to achieve the sustainable development of urban ecosystem. At the same time, urban ecosystem also has the principle of development and dynamic. Therefore, in the construction of urban ecosystem sustainability evaluation system and the selection of methods, we need to conform to its characteristics in order to ensure the accuracy of evaluation.



2. Sustainable Assessment Method of Urban Ecosystem

2.1. Relevant Research

Urban ecosystem is a complex network of interrelated factors, and the selection of indicators should be independent of each other (Q Pei 1988)[1]. The evaluation system should be simplified as far as possible, and be hierarchical according to the structure of the system. Indicators should reflect the connotation of sustainable development of the system as far as possible, and have relatively high amount of information (SY Hong 2000) [2]. Fuzzy multi-level comprehensive evaluation method can link the contribution of each factor to the overall development level (XR Liu 2006) [3]. By studying and analyzing the relationship between ecosystem service value and socio-economic development in a period of time, we can characterize the relationship between regional socio-economic and ecological environment (JG Cai 2017) [4].

2.2. Establishment of Evaluation System

The first point of the evaluation system is to be comprehensive. The selected indicators must cover the basic elements of economy, society and nature, and the elements should maintain relatively high independence and avoid duplication. Secondly, considering the dynamic nature of the system, the indicators are not invariable, and the data will be adjusted over time. Through the analysis of the data in a certain period, we can comprehensively reflect the characteristics of sustainable development of the environment. At the same time, the data sources of various indicators must be reliable and true, so that the evaluation of the system can be accurate and feasible. Based on the above principles, this paper establishes three first-level economic(S1)-social(S2)-natural(S3) evaluation indicators and 15 second-level evaluation indicators related to them, and selects Tianjin as a template for ecosystem sustainability analysis. As shown in Figure 1.

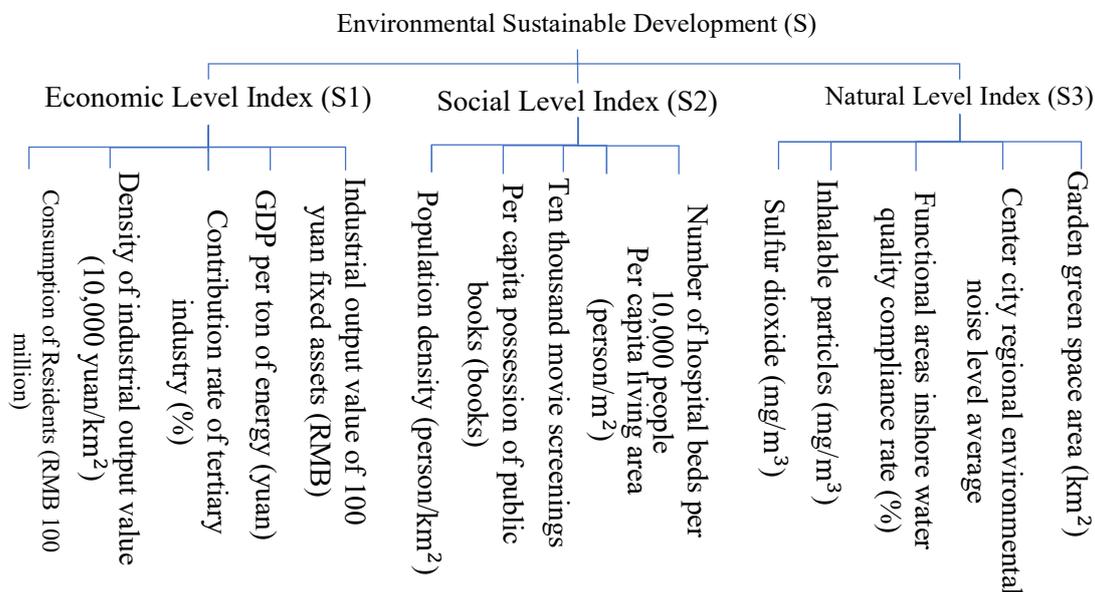


Figure 1. Comprehensive Evaluation System of Sustainable Development Level of Urban Ecosystem in Tianjin

3. Comprehensive Evaluation of Sustainable Development Level of Urban Ecosystem in Tianjin

When evaluating the level of urban ecological environment development in Tianjin, it should be a process of quantitative calculation. Through the comprehensive calculation of various indicators data in a specific way, the conclusion can be drawn. On the basis of single factor evaluation and weighted

summation method, the comprehensive evaluation results are obtained. The calculation formulas are as follows:

$$S = \sum N_i W_i \quad (1)$$

$$N_i = X_i / Y_i \quad (2)$$

In formula, $i = 1, 2, 3, \dots, m$. S is Evaluating the comprehensive index; N_i is the index of the No.i; X_i is the measured value of the No.i; Y_i is the evaluation value of No.i; W_i is the weight of the No.i ($0 \ll W_i \ll 1$ and $\sum W_i = 1$); m is the number of evaluation indices.

In order to simplify the evaluation process, the measured data in 2008 are defined as standard values Y . Formula (1.3) is used for the factors with larger positive effects on the environment, and for the factors with smaller values with larger positive effects on the environment, common values are used for the factors with larger positive effects on the environment. Formula (2).

$$S_i = \left(\frac{X_i}{Y}\right)W_i \quad (3)$$

$$S_i = \left(\frac{Y}{YX_i}\right)W_i \quad (4)$$

Through the calculation of secondary indicators, the sustainable development evaluation index and growth rate of each primary indicator are obtained. The evaluation index of sustainable development level of Tianjin can be obtained by repeated calculation of the primary indicator. In order to calculate the weights conveniently, the average weighted summation method is adopted to calculate the weights.

4. Result analysis

Table 1. Evaluation results and growth rate of environmental sustainable development indicators in Tianjin from 2008 to 2017

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	average
Economic Level Index	1.00	0.96	0.98	1.18	1.28	1.42	1.48	1.47	1.60	1.81	
rate of growth	0%	-4%	2%	20%	9%	11%	4%	-1%	9%	13%	6.34%
Social Level Index	1.00	0.94	3.43	4.36	5.63	6.29	6.60	7.12	8.86	10.70	
rate of growth	0%	-6%	266%	27%	29%	12%	5%	8%	24%	21%	38.58%
Natural Level Index	1.00	1.01	0.96	1.00	0.89	0.90	0.98	1.20	1.50	1.73	
rate of growth	0%	1%	-4%	3%	-11%	1%	10%	22%	25%	15%	6.20%
Sustainable Development Level Index	1.00	0.97	1.79	2.18	2.60	2.87	3.02	3.27	3.99	4.75	
rate of growth	0%	-3%	85%	21%	19%	10%	5%	8%	22%	19%	18.76%

From Table 1, we can see that the average economic growth rate of Tianjin has reached 6.34% in the past 10 years, showing an upward trend. This is mainly due to the implementation of the 12th Five-Year Plan. During this period, the overall economy of Tianjin has grown considerably. It is worth mentioning that in 2009, affected by the economic crisis, China's economic level dropped by 4 percentage points, and at the social level. It has caused some negative effects. The most rapid social development, with an average growth rate of 38.58%, especially in 2010. This is mainly due to the development of the film industry. In 2010, Tianjin built 10 cinemas, 53 film projection teams, and the number of film projections

increased by 256% year on year[5]. Since 2010, Tianjin's social economy has basically stepped out of the haze of the economic crisis, people's living standards have been rising year by year, and the social level index has grown steadily. But in nature, China's development in the past 10 years is relatively slow, the average growth rate is only 6.2%. In the first five years, the development of Tianjin's natural level always fluctuates and shows a retrogressive trend. However, since 2013, the development of Tianjin's natural level has become better and better in the next five years, showing an obvious upward trend. This is mainly due to the shutdown and control of heavy polluted enterprises in Tianjin from 2013 to now, which has strengthened the supervision of energy saving and emission reduction of production enterprises. From the data point of view, SO₂ concentration in the air has decreased by 73%, inhalable particulate matter has decreased by 37%, and the sustainable development of natural level.

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