# Research on Evaluation of Regional Sustainable Development Level Based on AHP——Taking Jilin Province as an Example

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**Abstract:** Based on the analysis of the status quo of sustainable development in Jilin Province, the comprehensive evaluation index system of sustainable development level in Jilin Province is constructed from three aspects: economic subsystem, social subsystem, and resource environment subsystem. The level of sustainable development in the 8 cities of Jilin Province. The results show that Changchun City, Baishan City, Liaoyuan City, and Songyuan City have reached a sound sustainable development level, and Jilin City, Tonghua City, Baicheng City, and Siping City are generally sustainable development level. Finally, corresponding suggestions are made for the sustainable development level of cities and towns in Jilin Province.

## 1. Introduction

The term “sustainable development” first appeared in the “World Conservation Outline” formulated by the International Union for Conservation of Nature in 1980 [1]. In 1987, “Our Common Future” was submitted to the UN General Assembly to propose the concept of “sustainable development formally” mode. “Sustainable development” is defined as “a development that meets the needs of the present and does not constitute a hazard to the ability of future generations to meet their needs.” It is a comprehensive concept covering economic, social, resource and environmental aspects. [2]. At present, scholars from various countries have carried out extensive theoretical research on sustainable development, and their understanding of connotation and extension has been deepened. However, some problems in the realization of socially sustainable development as a global system engineering are not very clear, especially Sustained development evaluation issues.

Regional sustainable development [3-4] refers to the coordinated development of population, resources, environment, economy, and society at different regional scales. Measuring the sustainability of a region's development and judging its status requires sustainable development evaluation. The comprehensive evaluation method divides the sustainable development system into several subsystems such as economy, society, population, resources, and environment. Combined with the theory of sustainable development and the characteristics of the research area, the index system is established [5], and the relevant mathematical methods are used to construct the model. To evaluate the development status of each subsystem and then to judge the sustainability of the entire system.

Jilin Province is located in the middle of the northeastern region of China, with a total area of 187,400 square kilometers, governing 8 prefecture-level cities and 1 autonomous prefecture. As one of the pilot provinces of the “ecological province” approved by the State Environmental Protection Administration earlier, since the construction of the ecological province in 2001, the protection of the environment and ecological construction have achieved excellent results. After more than ten years of governance, the quality of the ecological environment Great improvements have been made. Taking this as an opportunity, we have established and evaluated the Jilin Province Sustainable Development Index System under the conditions of equal emphasis on economic construction, social development, and environmental protection.

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## 2. AHP

The AHP method, also known as the analytic hierarchy process [6], was proposed by the American operations researcher T.L. Satty in the 1970s and has now become a more sophisticated mathematical method suitable for evaluating the level of sustainable development. It is a combination of qualitative analysis and quantitative analysis. The basic idea is to decompose the elements that need decision-making into the target layer, the plan layer, the criterion layer, etc., and the elements of the same level are compared and compared. Calculate the weight of each element and finally determine the pros and cons.

## 3. The level of regional sustainable development based on AHP——Taking Jilin Province as an example

### 3.1 Building a hierarchical model

Table 1. The level of regional sustainable development based on AHP

| Target layer | Guidelines layer | Scheme Layer |
|---|---|---|
| Jilin Province sustainable development level evaluation (A) | (B1) economic subsystem | (C1) GDP per capita (yuan/person)<br>(C2) Per capita industrial output value (yuan/person)<br>(C3) Per capita tertiary industry output value (yuan/person)<br>(C4) Foreign trade export value (US$10,000)<br>(C5) Per capita postal business income (yuan)<br>(C6) Per capita telecommunications business income (yuan) |
| | (B2) social subsystem | (C7) Natural population growth rate (%)<br>(C8) 18-60 years old as a percentage of the total population (%)<br>(C9) Urbanization rate of household registration population (%)<br>(C10) Number of beds in medical institutions |
| | (B3) subsystem resources and environment | (C11) Industrial exhaust emissions (10,000 cubic meters)<br>(C12) Centralized treatment rate of sewage treatment plant (%)<br>(C13) Per capita water resources (cubic meters)<br>(C14) Air quality reached and better than the second grade (%) |

### 3.2 Data standardization processing

The original data of this article are from the "Jilin Province Statistical Yearbook" (2017), some indicators such as per capita industrial output value, per capita tertiary industry output value, per capita postal business volume, per capita telecommunications business volume, number of beds per 10,000 people, per capita water. The number of resources owned and the area planted per capita are calculated from the raw data.

Table 2. Various indicator values

| City | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| Changchun | 86465 | 35622 | 40607 | 191863 | 358 | 971 |
| Jilin | 52729 | 15958 | 29975 | 63116 | 207 | 650 |
| Siping | 29187 | 8278 | 13781 | 21597 | 152 | 505 |
| Liaoyuan | 55192 | 28064 | 23080 | 19252 | 183 | 619 |
| Tonghua | 38267 | 13611 | 19271 | 8250 | 212 | 608 |
| Baishan | 54750 | 25980 | 24247 | 19012 | 267 | 669 |
| Songyuan | 49602 | 15608 | 27192 | 16349 | 114 | 508 |
| Baicheng | 32168 | 10807 | 14798 | 7893 | 133 | 628 |

| City | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 |
|---|---|---|---|---|---|---|---|---|
| Changchun | -6.39 | 64.73 | 49.28 | 49857 | 20672233.89 | 88.98 | 482.96 | 76 |
| Jilin | -12.34 | 64.79 | 52.80 | 28709 | 22057100 | 94.97 | 2250.15 | 72 |
| Siping | -9.82 | 63.78 | 36.67 | 15429 | 7187271 | 84.69 | 511.55 | 77 |
| Liaoyuan | -11.91 | 65.41 | 50.54 | 6261 | 3983290.47 | 99.05 | 444.26 | 79 |
| Tonghua | -7.99 | 65.23 | 51.88 | 13667 | 9052348.13 | 93.71 | 1846.65 | 92 |
| Baishan | -9.78 | 65.30 | 74.60 | 9787 | 3225996.03 | 84.23 | 5965.53 | 86 |
| Songyuan | -9.11 | 65.90 | 33.09 | 9355 | 3066518.39 | 96.25 | 601.65 | 82 |
| Baicheng | -8.44 | 66.35 | 44.21 | 8590 | 5253754.66 | 88.25 | 838.96 | 93 |

Due to different dimensions of different index values, the order also poor. In order to enable the original data to eliminate the difference dimension, making it more comparable to the raw data was normalized spread.

The bigger, the better for the index, taking the formula:

$$Xij'=Xij/Xjmax \quad (1)$$

For the smaller, the better indicators, take the formula:

$$Xij'=Xjmin/Xij \quad (2)$$

Wherein the raw data Xij represents the j-th sample of the i-th index

Table 3. Various indicator values

| City | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| Changchun | 1 | 1 | 1 | 1 | 1 | 1 |
| Jilin | 0.61 | 0.448 | 0.738 | 0.329 | 0.578 | 0.669 |
| Siping | 0.388 | 0.232 | 0.339 | 0.113 | 0.425 | 0.520 |
| Liaoyuan | 0.638 | 0.788 | 0.568 | 0.1 | 0.511 | 0.637 |
| Tonghua | 0.443 | 0.382 | 0.475 | 0.043 | 0.592 | 0.626 |
| Baishan | 0.633 | 0.729 | 0.597 | 0.099 | 0.746 | 0.689 |
| Songyuan | 0.574 | 0.438 | 0.670 | 0.085 | 0.318 | 0.523 |
| Baicheng | 0.372 | 0.303 | 0.364 | 0.041 | 0.372 | 0.647 |

| City | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 |
|---|---|---|---|---|---|---|---|---|
| Changchun | 1.931 | 0.976 | 0.661 | 1 | 0.148 | 0.898 | 0.081 | 0.817 |
| Jilin | 1 | 0.976 | 0.708 | 0.576 | 0.139 | 0.959 | 0.377 | 0.744 |
| Siping | 1.257 | 0.961 | 0.492 | 0.309 | 0.427 | 0.855 | 0.086 | 0.828 |
| Liaoyuan | 1.036 | 0.986 | 0.677 | 0.126 | 0.770 | 1 | 0.074 | 0.849 |
| Tonghua | 1.544 | 0.983 | 0.695 | 0.274 | 0.339 | 0.946 | 0.310 | 0.989 |
| Baishan | 1.262 | 0.984 | 1 | 0.196 | 0.951 | 0.850 | 1 | 0.925 |
| Songyuan | 1.355 | 0.993 | 0.444 | 0.188 | 1 | 0.972 | 0.101 | 0.882 |
| Baicheng | 1.462 | 1 | 0.593 | 0.172 | 0.584 | 0.891 | 0.141 | 1 |

### 3.3 Mathematical model and the evaluation value calculation

The basic idea of sustainable development, using a mathematical statistics-based approach to establish a reasonable mathematical model. Press accounts corresponding weight to calculate the target layer and the layer guidelines for sustainable development index, calculated results in the table below.

Bi=∑Cj*Wj

Among them, Cj is the index, Wj is the index weight, j=1, 2, 3...n, n is the number of indicators.

A=B1+B2+B3

B1, B2, B3, respectively evaluation of sustainable economic subsystem, social subsystem, resources and environment subsystems, A 8, Jilin Province, the evaluation value of sustainable development.

| | B1 | B2 | B3 | A | Ranking |
|---|---|---|---|---|---|
| Changchun | 0.465 | 0.109 | 0.160 | 0.735 | 1 |
| Jilin | 0.286 | 0.093 | 0.346 | 0.725 | 2 |
| Siping | 0.280 | 0.088 | 0.242 | 0.611 | 3 |
| Liaoyuan | 0.243 | 0.096 | 0.270 | 0.609 | 4 |
| Tonghua | 0.275 | 0.087 | 0.192 | 0.554 | 5 |
| Baishan | 0.199 | 0.100 | 0.220 | 0.519 | 6 |
| Songyuan | 0.161 | 0.099 | 0.225 | 0.485 | 7 |
| Baicheng | 0.161 | 0.092 | 0.189 | 0.442 | 8 |

### 3.4 Evaluation Criteria

According to the rating value in the ability to determine the area of sustainable development capacity for sustainable development, drawing on the research results of domestic and foreign scholars, 0-1 in the sustainable development evaluation value is divided into five levels, each level corresponding to the different sustainable development level, the table below.

Table 4. Evaluation Criteria

| Level | Standard range | Sustainable development level |
|---|---|---|
| Ideal | 0.8-1 | Strongly sustainable |
| Better | 0.6-0.8 | Strongly sustainable |
| General | 0.4-0.6 | Generally sustainable |
| Not ideal | 0.2-0.4 | Sustainable |
| Bad | 0-0.2 | Under shameful |

## 4. Conclusions and recommendations

The regional sustainable development level evaluation system established in this paper has reference significance for other cities. At the same time, using the analytic hierarchy process to evaluate the sustainable development level of eight cities in Jilin Province, it can be seen that the evaluation values of the sustainable development level of the eight cities in Jilin Province in 2017 are all greater than 0.4, which is above the general sustainable development level. Among them, Changchun City, Baishan City, Liaoyuan City, and Songyuan City have achieved a sound sustainable development level, and Jilin City, Tonghua City, Baicheng City, and Siping City are generally sustainable development level. However, all cities have not reached the level of healthy sustainable development, and Jilin Province has a long way to go for sustainable development. In this regard, make the following suggestions

1) On the economic front, accelerate the transformation of the economic structure and increase the development and investment of a circular economy. Based on vigorously developing the second and third industries, we will vigorously develop new industries, find new economic growth points that are suitable for our advantages, and further increase the income of urban and rural residents.

2) In the social aspect, establish and improve the social security system and increase public health expenditures.

3) In terms of resources and environment, while focusing on the rational development and utilization of resources and environmental protection while developing economic and social levels, the three should not be neglected.

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