

A Study on the Coupling Coordination Relationship between Urbanization and Ecological System in Heilongjiang Province

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Abstract

This paper constructs an evaluation index system of urbanization and ecological environment, and uses the model of coupling and coordination degree to empirically analyze the development of the degree of coupling and coordination between urbanization and ecological environment system in Heilongjiang Province from 2003 to 2017. The results show that the level of urbanization and the quality of the ecological environment in Heilongjiang Province are on the rise as a whole. It can be seen from the comparison between the urbanization system and the ecological environment system that from 2003 to 2010, the development of the urbanization level is higher than the development level of the ecological environment quality, which means that the quality of the ecological environment restricts the coordinated and coordinated development of urbanization and the ecological environment in Heilongjiang Province. Factors, from 2011 to 2017, the quality of the ecological environment has developed rapidly, and the level of comprehensive development of the ecological environment has continued to rise, and has surpassed the quality level of urbanization. This shows that while the quality of the ecological environment is improving, the level of urbanization hinders the coordinated development of the two. On the whole, the degree of coupling and coordinated development of the coordinated development of urbanization and ecological environment in Heilongjiang Province showed a fluctuating upward trend from 2003 to 2017. The degree of coordination and coordination between urbanization and the ecological environment system in Heilongjiang Province increased from 0.594 to 0.748 between 2003 and 2007, and the degree of coordination increased from basic to moderate. From 2008 to 2012, the degree of coordination once rose to good coordination. For good coordination. This shows that in the past 15 years, the level of urbanization of Heilongjiang Province and the elements of the ecological-environment system have a good correlation, promote each other, and coordinated development.

Keywords

Urbanization ; ecological environment ; Heilongjiang Province.

1. Introduction

The increase in urbanization has brought economic and social benefits to the people, but also brought a series of ecological problems. While people enjoy a high quality of life, the requirements for the construction of the ecological environment are also getting higher and higher. General Secretary Xi Jinping proposed that the modernization we want to build is a modernization in which human beings and nature harmoniously coexist. We must not only create more material wealth and spiritual wealth to meet the people's increasing needs for a better life, but also provide more high-quality ecological products to satisfy the people Increasing demand for beautiful ecological environment. Therefore, if we want to realize the sustainable development of urbanization, we must pay attention to the construction of ecological civilization. Heilongjiang Province, as an old industrial base, has abundant natural resource advantages. In addition to its special geographical location, the level of urbanization

has always been at the leading level in the country. However, under the rapid development of urbanization, the use of ecological resources is unreasonable, resulting in insufficient urbanization. The fragility of cities is becoming increasingly apparent.

When more and more scholars realized that short-term economic behavior would directly affect the sustainable development of society, people began to emphasize the coupling relationship between the rational use of natural resources and the development of human society. As a resource and environment carrying capacity evaluation system, as a measure of the impact of urbanization, the ability of natural conditions to support human production and life has become a research focus. As the coordinated development relationship between urbanization and ecological carrying capacity is still in the exploratory stage, there are few related researches on the coordinated development between urbanization and ecological environment carrying capacity in Heilongjiang Province. Therefore, this article takes Heilongjiang Province as the research object and analyzes Heilongjiang Province. The coordinated development relationship between urbanization and ecological environment carrying capacity enriches relevant research content.

2. Research Area and Data Source

Heilongjiang Province is located in the northeastern part of China, with geographic coordinates ranging from 43°26' to 53°33' North Latitude and 121°11' to 135°05' East Longitude. Its north and east are adjacent to Russia, and its west and south are bordered by Inner Mongolia and Jilin, respectively. The total area of the province is 473,000 km², which belongs to a temperate continental monsoon climate. Heilongjiang Province is a heavy industry base in China. It is rich in mineral resources, energy resources and forestry resources. The province has 12 prefecture-level cities and 1 regional administration. As of 2018, there were 250 nature reserves in the province, with an area of 7.785 million hectares. Rich natural resources provide the necessary resource support and strong ecological environment carrying capacity for the development of urbanization in the province. However, while using resources to promote the process of urbanization, we must always pay attention to the relationship between urbanization development and the quality of the ecological environment and practice. The concept of green development is the top priority of development tasks at this stage. This paper selects the relevant data of Heilongjiang Province from 2003 to 2017 as the original data for this study. The data is mainly from the "Heilongjiang Statistical Yearbook (2004-2018)", but in view of the lack of data in individual years, in order to ensure the authenticity and integrity of the study, this article also draws on the "China City Statistical Yearbook" and environmental protection websites.

3. Research Method

3.1. Selection of Indicators

This paper draws on the analysis of the coupling relationship indicator system constructed by related scholars, combined with the unique geographical advantages of Heilongjiang Province, uses the frequency statistical method to complete the selection of primary indicators, and consults with experts to form an evaluation index for urbanization and ecological environment in Heilongjiang Province. system. This article divides the urbanization system into two first-level indicators of economic urbanization and social urbanization, consisting of 11 second-level indicators; the ecological environment system includes two first-level indicators of ecological resources and environmental pressure, 11 second-level indicators, and specific indicators See Table 1 for details.

Table 1. Evaluation index system of urbanization and ecological environment

System layer	First-level indicators	Secondary indicators	Weights
Urbanization	Economic urbanization	GDP per capita (yuan / person)	0.098
		Total investment in fixed assets (excluding farmers) (10,000 yuan)	0.087
		Tertiary industry output value as a percentage of GDP	0.074
		Per capita disposable income of urban residents (yuan)	0.075
		Total retail sales of social consumer goods per capita (yuan / person)	0.071
	Social urbanization	Proportion of employees in the tertiary industry (%)	0.104
		Non-agricultural population as a percentage of total population (%)	0.105
		Number of beds per 10,000 people	0.064
		Urban road area per capita (m ²)	0.092
		Urban population density (people / km ²)	0.129
Ecosystem	Ecological resources	Minimum number of urban residents living guarantee (person)	0.101
		Water resources per capita (m ³ / person · year)	0.048
		Forest cover rate(%)	0.101
		Green coverage of built-up area (%)	0.129
		Park green area per capita (m ² / person)	0.109
	Environmental pressure	Per capita arable land area (m ²)	0.109
		Wastewater discharge (10,000 t / year)	0.101
		COD emissions (t / year)	0.097
		Ammonia nitrogen emissions (t / year)	0.081
		SO ₂ emissions (t / year)	0.040
		NO _x emissions (t / year)	0.094
		Smoke (powder) dust emission (t / year)	0.091

3.2. Determination of Indicator Weights

Because of the inconsistency of the data between different data, in order to eliminate the impact, this paper needs to perform dimensionless processing on the selected raw data. In order to ensure the objectivity of the research, the range index method is used to standardize the forward index and reverse index. The value range of each index after processing is between 0 and 1. According to the nature of the indicator, formula (1) is calculated for the forward indicator, and formula (2) is used for the reverse indicator.

$$x_{ij} = [X_{ij} - \min(X_{ij})] / [\max(X_{ij}) - \min(X_{ij})] \quad (1)$$

$$x_{ij} = [\max(X_{ij}) - X_{ij}] / [\max(X_{ij}) - \min(X_{ij})] \quad (2)$$

In the formula, X_{ij} is the raw data of the system i and j indexes, x_{ij} is the standardized values of the system i and j indexes, and the $\min(X_{ij})$ and $\max(X_{ij})$ represents the maximum and minimum values of the system i and j indexes.

In order to reflect the index weight of urbanization and ecological environment system of Heilongjiang Province more scientifically, this paper uses entropy weighting method to assign values to each index.

First, calculate the normalized index proportion of index j:

$$A_{ij} = x'_{ij} / \sum_{i=1}^m x'_{ij}$$

Finally, calculate the entropy of the index j:

$$E_j = -(1/\ln m) \sum_{j=1}^m A_{ij} \ln(1/A_{ij})$$

Redundancy $\eta_j = 1 - E_j$, Therefore, the indicator weight ω_j :

$$\omega_j = \eta_j / \sum_{j=1}^n \eta_j$$

The specific weight calculation results are shown in Table 1.

3.3. Coordinated Coordinated Development Evaluation Model

Coupling degree is an important method to describe the degree of interaction and coordination between systems. This paper draws on the model of capacity coupling coefficient in physics to obtain the coupling degree model of urbanization and ecological environment system in Heilongjiang Province (Wang Zhaofeng, etc.):

$$C = \{(U * G) / [(U + G) / 2]^2\}^{1/2} \quad (3)$$

In formula (3), C is the coupling degree between the urbanization system and the ecological environment system, and $0 \leq C \leq 1$. When $C = 0$, it means that the coupling degree of the two is the smallest, and there is no dependency between the elements in the two systems and they interfere with each other; when $C = 1$, the urbanization system and the ecological environment system reach a benign resonance, that is, the system is moving towards an orderly state. The specific calculation results of the coupling degree C are shown in Table 3.

C in the Heilongjiang Province urbanization and ecological environment coupling model can only reflect the degree of dispersion and coupling of the indicators in the two systems, but it cannot explain the level of coordinated development of the two systems, that is, it cannot truly measure the development between the two systems. Degree of coordination. Therefore, this paper introduces a coordinated development model to analyze the coordination degree D of urbanization and ecological environment in Heilongjiang Province (Jia Jucai):

$$D = (C * T)^{1/2} \quad (4)$$

$$T = \alpha * U + \beta * G \quad (5)$$

In formulas (4) and (5), T is the comprehensive evaluation index of urbanization and ecological economy of Heilongjiang Province, which is used to reflect the overall development level of the two. α and β represent the respective coefficients of the two systems. Position, and $\alpha + \beta = 1$, $\alpha = \beta = 0.5$ is taken during calculation. Table 2 for the types of coupling and coordinated development.

Table 2. Types and classification criteria for coupled and coordinated development

D	Coupling coordination level
$0 < D \leq 0.1$	Extreme disorders
$0.1 < D \leq 0.2$	Severe disorders
$0.2 < D \leq 0.3$	Moderate disorder
$0.3 < D \leq 0.4$	Mild disorder
$0.4 < D \leq 0.5$	Endangered disorder
$0.5 < D \leq 0.6$	Basic coordination
$0.6 < D \leq 0.7$	Primary coordination
$0.7 < D \leq 0.8$	Moderate coordination
$0.8 < D \leq 0.9$	Well coordinated
$0.9 < D \leq 1$	Quality coordination

4. Analysis of Data Evaluation Results

According to the evaluation system for the coordinated and coordinated development of the urbanization index and the ecological environment in Heilongjiang Province in Table 1, the relevant formulas are used to calculate the comprehensive level evaluation value, the degree of coupling and the coordination of the two systems of the urbanization and ecological environment system in Heilongjiang Province(Table 3 and Figure 1).

Table 3. Coupling evaluation results of urbanization and ecological environment

YEAR	U	G	T	C	D	Coordinated Development Type
2003	0.468	0.033	0.251	0.496	0.594	Basic coordination
2004	0.570	0.045	0.308	0.521	0.633	Primary coordination
2005	0.578	0.073	0.326	0.631	0.673	Primary coordination
2006	0.490	0.175	0.333	0.881	0.736	Moderate coordination
2007	0.481	0.204	0.343	0.915	0.748	Moderate coordination
2008	0.578	0.444	0.511	0.991	0.844	Well coordinated
2009	0.705	0.519	0.612	0.988	0.882	Well coordinated
2010	0.762	0.602	0.682	0.993	0.907	Quality coordination
2011	0.430	0.672	0.551	0.976	0.856	Well coordinated
2012	0.449	0.737	0.593	0.970	0.871	Well coordinated
2013	0.554	0.801	0.678	0.983	0.903	Quality coordination
2014	0.528	0.824	0.676	0.976	0.901	Quality coordination
2015	0.589	0.866	0.728	0.982	0.919	Quality coordination
2016	0.821	0.909	0.865	0.999	0.964	Quality coordination
2017	0.872	0.941	0.907	0.999	0.976	Quality coordination

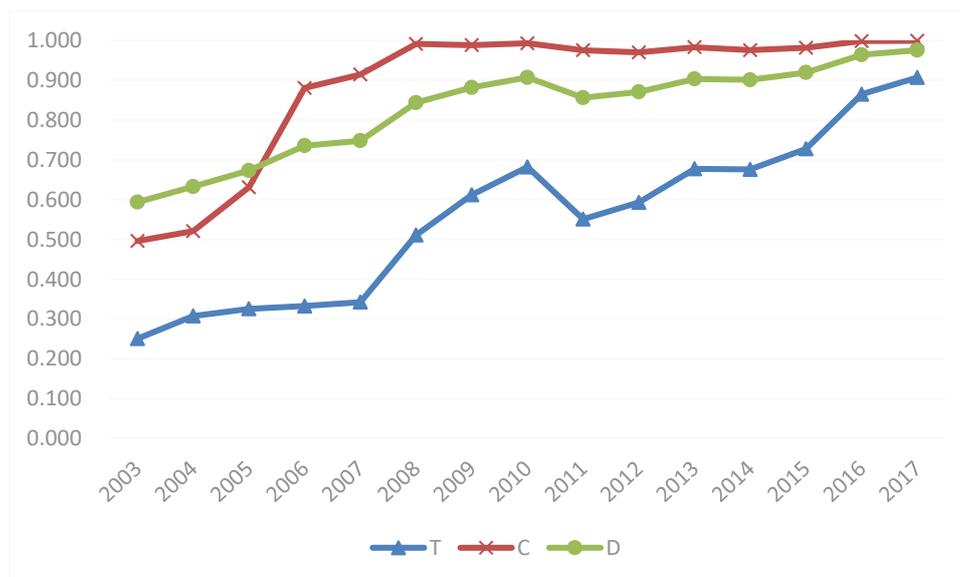


Figure 1. Coupling trend of urbanization and ecological environment system

It can be seen from the calculation results in Table 3 that the urbanization level and ecological environment quality of Heilongjiang Province are on the rise as a whole. It can be seen from the comparison between the urbanization system and the ecological environment system that from 2003 to 2010, the development of the urbanization level is higher than the development level of the ecological environment quality, which means that the quality of the ecological environment restricts the coordinated and coordinated development of urbanization and the ecological environment in Heilongjiang Province. Factors, from 2011 to 2017, the quality of the ecological environment has developed rapidly, and the level of comprehensive development of the ecological environment has continued to rise, and has surpassed the quality level of urbanization. This shows that while the quality of the ecological environment is improving, the level of urbanization hinders the coordinated development of the two. After 2011, the main reason for the great improvement in the quality of the ecological environment was the strengthening of ecological environmental protection and construction in Heilongjiang Province, vigorously promoting the policy of returning farmland to forests, and actively carrying out environmental pollution control. Through publicity and education, people's awareness of environmental protection was continuously enhanced. The environmental supervision capacity building has achieved remarkable results; and between 2016 and 2017, the ecological environment index reached a higher level. This may be due to the green development concept put forward by the Fifth Plenary Session of the 18th Central Committee and a series of major arrangements for ecological civilization and environmental protection. Deploy and integrate the overall improvement of the quality of the ecological environment into the goal system of building a well-off society in an all-round way. In addition, the Heilongjiang Provincial Government issued the "Thirteenth Five-Year Plan" for Ecological Environmental Protection in Heilongjiang Province in 2016, and various measures provided a strong impetus for environmental protection and construction.

As shown in Figure 1, the degree of coupling and coordinated development of the coordinated development of urbanization and ecological environment in Heilongjiang Province showed an upward trend in fluctuations from 2003 to 2017. The degree of coordination and coordination between urbanization and the ecological environment system in Heilongjiang Province increased from 0.594 to 0.748 between 2003 and 2007, and the degree of coordination increased from basic to moderate. From 2008 to 2012, the degree of coordination once rose to good coordination. For good coordination. This shows that in the past 15 years, the level of

urbanization of Heilongjiang Province and the elements of the ecological-environment system have a good correlation, promote each other, and coordinated development. Heilongjiang Province is the northernmost and easternmost province in China and is named after Heilongjiang in the province. It has rich forestry, arable land and water resources. It is one of the largest forestry provinces in the country. The ecological status of forestry is very important. The advantages of resources provide strong support for the promotion of ecological environment construction in Heilongjiang Province. In 2012, the party's eighteenth report proposed "Put ecological civilization construction in a prominent position and integrate it into all aspects and the entire process of economic, political, cultural, and social construction." Heilongjiang closely follows national policies, uses resources to actively promote new urbanization, and continuously strengthens ecological environmental protection and The construction efforts have achieved the improvement of the quality of the ecological environment while advancing the urbanization process, satisfying the people's longing for a better life.

5. Conclusion

The level of urbanization and the quality of the ecological environment in Heilongjiang Province are on the rise as a whole. It can be seen from the comparison between the urbanization system and the ecological environment system that from 2003 to 2010, the development of the urbanization level is higher than the development level of the ecological environment quality, which means that the quality of the ecological environment restricts the coordinated and coordinated development of urbanization and the ecological environment in Heilongjiang Province. Factors, from 2011 to 2017, the quality of the ecological environment has developed rapidly, and the level of comprehensive development of the ecological environment has continued to rise, and has surpassed the quality level of urbanization. This shows that while the quality of the ecological environment is improving, the level of urbanization hinders the coordinated development of the two. On the whole, the degree of coupling and coordinated development of the coordinated development of urbanization and ecological environment in Heilongjiang Province showed a fluctuating upward trend from 2003 to 2017. The degree of coordination and coordination between urbanization and the ecological environment system in Heilongjiang Province increased from 0.594 to 0.748 between 2003 and 2007, and the degree of coordination increased from basic to moderate. From 2008 to 2012, the degree of coordination once rose to good coordination. For good coordination. This shows that in the past 15 years, the level of urbanization of Heilongjiang Province and the elements of the ecological-environment system have a good correlation, promote each other, and coordinated development.

From the perspective of economic urbanization, social urbanization, ecological resources, and environmental pressure, this article selects Heilongjiang's urbanization-environment system evaluation system, and coordinates the development relationship between the urbanization and ecological environment data of Heilongjiang Province from 2003 to 2017. Diagnose and provide scientific reference for the coordinated development of urbanization and ecological environment construction in Heilongjiang Province. Although both of them are scientific in the selection of indicators, the comprehensiveness of indicators is still insufficient due to the fact that both urbanization and ecological environment systems are complex and huge systems. Based on the existing research results, the evaluation indicators selected in this paper have considered the data availability more. Therefore, in future research, the selection of indicators will be more innovative, systematic, and targeted, integrating multi-disciplinary thinking, and interpreting the relationship between urbanization development and ecological environment

in a more detailed and accurate manner, so as to develop urbanization and The construction of ecological civilization provides data support.

Acknowledgements

This paper is one of the achievement of the program supported by Heilongjiang Bayi Agricultural University (No.:RRCPY201901), and Project (No: DSGB2019057).

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