

# Coupling Mechanism between the Quality of Urbanization Development and Ecological Environment in Qiqihar City

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## Abstract

**This article takes Qiqihar City, Heilongjiang Province as the research object, and uses the index data from 2008 to 2017 as a sample to construct a comprehensive evaluation index system for urbanization and ecological environment systems. The coupling degree and coupling coordination model are used to study the coupling and coordination relationship between the two. The results show: In the past 10 years, the overall level of urbanization in Qiqihar has been at a relatively high level. Although the level of development has fluctuated, it has generally shown an upward trend. This is due to the early infrastructure construction in Qiqihar. From 2008, Qiqihar Investment in urbanization is more about capital investment in infrastructure repair and maintenance. As for the ecological environment, the overall situation is continuously increasing, which shows that the region has strong ecological environmental protection and construction efforts, people have strong environmental protection consciousness, and environmental supervision capacity building efforts have achieved significant results. In summary, the level of urbanization of Qiqihar and the elements of the ecological environment system have been continuously improving, promoting each other and developing in harmony, this provides certain data support for the construction of new urbanization and ecological environment development in Qiqihar City.**

## Keywords

**Urbanization ; Ecological environment ; Qiqihar City.**

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## 1. Introduction

Urbanization, as an important carrier of China's economic development and the main driver of economic growth, has become a key support for economic structural adjustment and the promotion of coordinated development of industries and regions. Up to now, China's urbanization rate has reached 59.6%. Although China's urbanization construction started late, its growth and development have been rapid. The rapid development of China's urbanization level benefits from the rapid development of China's economy. However, while people get more economic benefits, the development and utilization of ecological resources will inevitably bring pressure and challenges to the ecological environment. The report of the 19th National Congress of the Communist Party of China stated that "respect for nature, conform to nature, and protect nature", "adhere to the harmonious coexistence of man and nature", and urbanization as a complex system may increase Ecology brings some pressure. If this kind of ecological environment pressure is not handled properly, it will become a hindrance factor restricting the development of urbanization to a certain extent. Therefore, fully implementing high-quality urbanization development levels while enjoying a high-quality ecological environment has become people's expectations for a better life.

Qiqihar, as a provincial sub-central city in Heilongjiang Province, is an important old industrial base and a commodity grain base in China. Under the background of the new urbanization construction

nationwide, the study of urbanization and the quality of the ecological environment and the coupling and coordination between the two are helpful to promote The coordinated growth of regional ecological resources and economy and society is of great significance. It not only becomes a need for academic research, but also a requirement for national economic and social development. This article selects Qiqihar City from 2008 to 2017 as the research object, selects evaluation indicators from the three aspects of population urbanization, economic urbanization and social urbanization, as well as two aspects of ecological environment state and ecological environmental pressure, and builds coordination and coordination between urbanization and ecosystem. Develop an evaluation model, introduce the comprehensive level evaluation model, coupling degree model and coupling coordination degree model of urbanization system and eco-environment system, and evaluate the coupling and evolution process and law of urbanization and eco-environment system in Qiqihar City in the past 10 years, so as to be able to couple the two Coordinate development and provide data support.

## 2. Research area and data source

Qiqihar City is located in the Songnen Plain in the southwest of Heilongjiang Province. It is located at 45 ° to 48 ° north latitude and 122 ° to 126 ° east longitude. The area is 43,000 square kilometers, of which the urban area is 4295 square kilometers. Qiqihar City is flat in area, with an average elevation of 146 meters, and is low-lying in the east and south. Qiqihar City has a moderate temperate continental monsoon climate. The characteristics of the four seasons are obvious: dry and windy in spring, hot and rainy in summer, short frost and early in autumn, long dry and cold in winter, and abundant natural resources. Rich natural resources provide the necessary resource support and strong ecological environment carrying capacity for the development of urbanization. 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 2008 to 2017 as the original data for this study. The data is mainly from the "Heilongjiang Statistical Yearbook (2009-2018)", 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 Qiqihar City, uses the frequency statistical method to complete the selection of primary indicators, and consults with experts to form an evaluation index for urbanization system and ecological environment system in Qiqihar City. 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)	0.10
		Total investment in fixed assets (excluding farmers) (10,000 yuan)	0.09
		Tertiary industry output value as a percentage of GDP	0.07
		Per capita disposable income of urban residents (yuan)	0.07

	Social urbanization	Total retail sales of social consumer goods per capita (yuan / person)	0.07
		Proportion of employees in the tertiary industry (%)	0.10
		Non-agricultural population as a percentage of total population (%)	0.11
		Number of beds per 10,000 people	0.06
		Urban road area per capita (m <sup>2</sup> )	0.09
		Urban population density (people / km <sup>2</sup> )	0.13
		Minimum number of urban residents living guarantee (person)	0.11
Ecosystem	Ecological resources	Water resources per capita (m <sup>3</sup> / person · year)	0.05
		Forest cover rate(%)	0.06
		Green coverage of built-up area (%)	0.06
		Park green area per capita (m <sup>2</sup> / person)	0.06
		Per capita arable land area (m <sup>2</sup> )	0.06
	Environmental pressure	Wastewater discharge (10,000 t / year)	0.12
		COD emissions (t / year)	0.14
		Ammonia nitrogen emissions (t / year)	0.12
		SO <sub>2</sub> emissions (t / year)	0.05
		NO <sub>x</sub> emissions (t / year)	0.14
		Smoke (powder) dust emission (t / year)	0.14

### 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.

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

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

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 Qiqihar City 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  $\omega_j$ :

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

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 Qiqihar City:

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

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 Qiqihar City 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 Qiqihar City:

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

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

In formulas (4) and (5), T is the comprehensive evaluation index of urbanization and ecological economy of Qiqihar City, which is used to reflect the overall development level of the two.  $\alpha$  and  $\beta$  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.

Table2 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 Qiqihar City 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 Qiqihar City ( Table 3 and Figure 1).

Table 3 Coupling evaluation results of urbanization and ecological environment

YEAR	U	G	C	D	Coordinated Development Type
2008	0.47	0.03	0.50	0.60	Basic coordination
2009	0.57	0.05	0.52	0.63	Primary coordination
2010	0.58	0.07	0.63	0.67	Primary coordination
2011	0.48	0.18	0.88	0.74	Moderate coordination
2012	0.49	0.21	0.92	0.75	Moderate coordination
2013	0.71	0.52	0.99	0.84	Well coordination
2014	0.45	0.74	0.97	0.87	Well coordinated
2015	0.53	0.82	0.98	0.91	Quality coordination
2016	0.59	0.87	0.98	0.92	Quality coordination
2017	0.83	0.91	0.99	0.96	Quality coordination

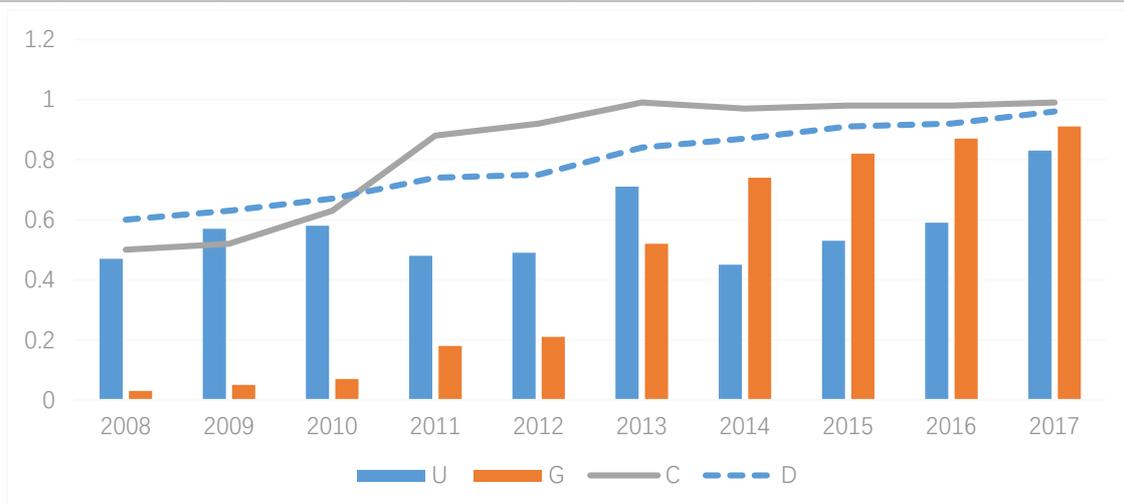


Figure 1 Coupling trend of urbanization and ecological environment system

In the past 10 years, the overall level of urbanization in Qiqihar has been at a high level. Although the level of development has fluctuated, it has generally shown an upward trend. This is due to the early infrastructure construction in Qiqihar. From 2008, Qiqihar Investment in urbanization is more about capital investment in infrastructure repair and maintenance. With regard to the ecological environment, we can see that the overall situation is continuously rising. First, the rich natural resources provide better ecological environment quality for the region. Second, the Qiqihar City's ecological environment index is continuously improving from 2008 to 2017. The quality of the ecological environment has been greatly improved, which shows that the region has strengthened ecological environmental protection and construction efforts, vigorously promoted the policy of returning farmland to forests, and actively carried out environmental pollution control, and through publicity and education, people's awareness of environmental protection has been continuously strengthened, and environmental supervision capabilities Construction, the effect is remarkable. In addition, the eco-environment index reached a higher level between 2016 and 2017, which may be

due to the green development concept put forward by the Fifth Plenary Session of the 18th Central Committee, a series of major arrangements and deployments for ecological civilization and environmental protection, and the quality of the ecological environment. The overall improvement is included in the goal system of building a well-off society in an all-round way. In 2016, the Heilongjiang Provincial Government issued the "Thirteenth Five-Year Plan" for Ecological Environmental Protection in Heilongjiang Province, and various measures provided a strong impetus for environmental protection and construction. This shows that ecological environment construction is a long-term construction project.

As shown in Figure 1, the coupling degree and coordinated development degree of Qiqihar's urbanization level and the coordinated development of the ecological environment showed a fluctuating upward trend from 2008 to 2017. The comprehensive evaluation index of urbanization and comprehensive evaluation index of ecological environment of Qiqihar City before 2013 is higher than the comprehensive ecological development level, which indicates that the development of ecological environment is a constraint, and the coordinated development of urbanization level and ecological environment of Qiqihar City; From 2014 to 2017, the level of ecological environment development continued to rise, surpassing the comprehensive quality level of urbanization, indicating that with the development of ecology, the quality of urbanization hinders the degree of coordination between the two. From the data in Table 3, it can be seen that Qiqihar's urbanization level and the degree of coupling of the ecological environment system have undergone changes from basic coordination to Quality coordination. This shows that in the past 10 years, the level of urbanization of Qiqihar and the elements of the ecological environment system have been continuously improving, promoting each other and developing in harmony.

## 5. Conclusion

Based on the urbanization level of Qiqihar City and the current status of ecological environment development, by establishing a relationship between various variables, after standardizing all indicators and determining the weight by entropy weighting method, the coupled development model is used to analyze the urbanization level and ecology of Qiqihar Environmental coupling development. Conclusions after data analysis in Qiqihar: This shows that in the past 10 years, the level of urbanization of Qiqihar and the elements of the ecological environment system have been continuously improving, promoting each other and developing in harmony, this provides certain data support for the construction of new urbanization and ecological environment development in Qiqihar City.

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