Coupling Analysis between Industrial Production and Resource-Environment Based on View of Ecological Civilization: a Case Study of Dongying City

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Abstract: Ecological civilization is a new stage in the development of human society, and it is the grand goal in 21st century. It is an important task for ecological civilization to promote the coupling level of industrial and resource-environment in the process of industrialization and urbanization. This paper builds the evaluation of index system and model. The coupled stages include low-grade coordination, moderate coordination, highly coordination and extreme coordination by analyzing the coupling coordination degree of Dongying city in 2000-2013.The main contents go as follows: The development of industrial and resource-environment was steadily rising, and the coupling coordination degree of industrial and resource-environment had largely improved; The development of industrial production and resource-environment was the lowest in 2002. It was the top of concave type, and the coupling coordination degree belonged to low-grade coordination in 2002; the comprehensive level of industrial production and resource-environment was transited to smooth by Environmental Bear Capacity and Location. The coupling coordination degree that belonged to highly coordination was 0.5.

Introduction

The experts has been addicted to researching the correlation of resource-environment and economic development. Wu Wenheng etc[1], proposed that the capability of resources and environment was further limited, which challenged the regions sustainable development, and we should choose the coordinated development pattern that involved the relationship between population and resource-environment. Hu Manfei etc[2], stressed that the effectiveness of the industrial structure development and resource-environment using exist closely contact, and interpreted the coupling of economic development and resource environmental bear capacity from the industrial structure; Ma Qiong etc[3], analyzed that the coordination of population, resources and environment have been fallen by using of the ecological footprint and moderate population model. Cao Zhi etc[4], showed the concept and assessment model of Eco-system-Service-based Ecological Carrying Capacity (ESECC) with"ecosystem-ecosystem services-the scale of population and economy (carrying capacity)"as its main line. Zhao Zhongchao[5], Zhao Xingguo[6], Zhao Wenliang[7], Xu Chenglong[8] etc, chose the indicator system and analyzed the coupling of economy and resource environment in the area. In a word, the research of this problem concentrates on two aspects. First, analyzing the coupling of industrial and resource-environment, we can set up a data model to explore the coupling of industry development and resource environment, Chen Xiaohong[9], Liu Yaobin[10] etc, explored the interactive mechanisms for the coordination and

vulnerability between regional urban and eco-environment based on the panel and serial statistical data; Second, analyzing the coupling of industrial and resource-environment, we can evaluate the degree of coordination and analyze the countermeasures, Liu Yunzhong[11], Cheng Jinhua[12], discussed the situation of industrialization to advice with the management methods.

Dongying as the central of Yellow River Delta, locate in the northeast of Shandong Province with 7923 km^2 in area and 2.08 million in population. From the reform and open policies, there are some problems about environment because of the development of industrial. For example, the pollution of water resources and atmosphere, the waste of mineral resources, the unreasonable utilization of land resources, and so on. Ecological civilization construction have been become the theme of time, and Dongying seriously need to change the development mode. In the past few years, since "High-efficiency Ecological Economic Zone in Yellow River Delta" and "Blue-yellow Economic Development Zone" was approved, Dongying have been regarded as the core city in the Development Plan. Based on researching the situation of Dongying city, it is necessary to improve the coupling development between industrial and resource environment in the whole Economic Zone.

Research method

Determine index weight by entropy method

In order to avoid error for subjective, the paper chose the entropy method to determine index weight. The steps for method is as follows:

r_{ij} set up the number of j-th index of the sample i (i=1,2,...m; j=1,2,...n), then m is said the number of sample and n is said the number of index.

$$p_{ij} = r_{ij} \Big/ \sum_{i=1}^{m} r_{ij} . \quad (1)$$

$$e_j = -k \sum_{i=1}^{m} p_{ij} \cdot \ln p_{ij} . \quad (2)$$

$$w_j = (1-e_j) \Big/ \sum_{j=1}^{n} (1-e_j) . \quad (3)$$

① To make the standardization of data, calculate the share of Dir items i of the index value j indicators; (Eq. 1)

② It is said to calculate the entropy of j indicator, and k= $1/\ln m$; (Eq. 2)

③ It is said to calculate the weight of j indicator; (Eq. 3)

Comprehensive evaluation index between industrial production and resource-environment

Based on comprehensive evaluation index system between industrial production and resource-environment, the paper build comprehensive evaluation index between industrial production and resource-environment. $a_1, a_2, a_3, ..., a_n$ is said comprehensive evaluation index of the industrial production, and $b_1, b_2, b_3, ..., b_n$ is said comprehensive evaluation index of the resource-environment.

$$A = \sum_{i=1}^{n} g_i a_i . \quad (4)$$

$$B = \sum_{j=1}^{n} h_j b_j . \quad (5)$$

A and B is said the comprehensive evaluation index between industrial production and resource-environment. a_i is the i-th index in comprehensive evaluation index system of industrial production. b_j is the j-th index in comprehensive evaluation index system of resource-environment. g_i and h_j is the weight between a_i and b_j.

Coupling coordination degree model between industrial production and resource-environment

Then the comprehensive evaluation index of two subsystems is obtained according to the weights of index; the model of coupling coordination degree is built adopting deviation principle finally. The model go as follows:

$$E=\sqrt{FT}\ . \tag{6}$$

Then E is said the coupling coordination degree; T is said the comprehensive evaluation index between industrial production and resource-environment. F is said the coupling degree between industrial production and resource-environment. The expression for F and T is follows:

$$F=2\left\{\frac{A\cdot B}{(A+B)^2}\right\}^{1/2}. \tag{7}$$

$$T=\alpha\cdot A+\beta\cdot B. \tag{8}$$

The range of the F is between 0 and 1; The coupling coordination degree is proportional to the F. A and B is said comprehensive evaluation index between industrial production and resource-environment. Since the research region is Dongying city and consider the coordination between industrial production and resource-environment in the amost of region, the paper made sure that α and β is 0.4 and 0.6.

Table 1 The coupling stage between industrial production and resource-environment

Coupling stage		Classification standard
I	low-grade coordination	0.0≤E＜0.4
II	moderate coordination	0.4≤E＜0.5
III	highly coordination	0.5≤E＜0.8
IV	extreme coordination	0.8≤E＜1.0

Result analyses between industrial production and resource-environment in Dongying city

Build evaluation index system and deal with date

According to the principle of evaluation indicators, the paper builds index subsystems between industrial production and resource-environment. There are 12 for index(Table 2).

Table 2 Evaluation index subsystem between industrial production and resource-environment in Dongying city

Subsystem	Basic index	Index	Weight
Industrial production	Industrial scale	A_1 GDP（Ten thousand yuan）	0.1218
		A_2 Per capita GDP （Ten thousand yuan/person）	0.1111
		A_3 Added value of industrial （Ten thousand yuan）	0.1210
	Industrial structure	A_4 Industrial added value proportion of GDP（%）	0.1022
		A_5 The proportion of secondary industry（%）	0.0702
resource-environment	Resource condition	B_1 Total urban water production（Ten thousand cubic meters）	0.0696
		B_2 Per capita arable land （hm^2/person）	0.0562
		B_3 Built-up area（km^2）	0.0487
		B_4 Forest coverage rate（%）	0.0530
	Environme-ntal pressure	B_5 Unit of industrial output wastewater emissions （Tons per yuan）	0.0988
		B_6 Unit emissions of industrial output （Tons per yuan）	0.052
		B_7 Unit of industrial output solid waste emissions（Tons per yuan）	0.0954

Analysis between comprehensive level and coupling coordination degree in Dongying

Analyze comprehensive level of the subsystems

The paper made a trend line chart(Fig. 1) by researching index system and weight between industrial production and resource-environment.

As you can see from Figure 1, the comprehensive level of industrial production had two phases: ①The trend was concave in 2000-2005. It was the lowest in 2002 during the Tenth Five Year Plan. ②It showed the state of slow growth in 2006-2013.

The comprehensive level of resource-environment had three phases:①The trend was concave in 2000-2003, and it is a relatively large change process. ② The comprehensive level of resource-environment was characterized by transition from concave to fluctuant rising in 2004-2009.

③The trend was convex in 2010-2013.

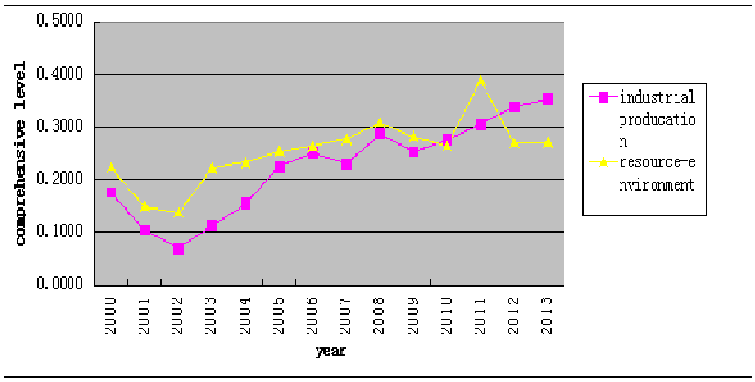

Fig. 1 The trend chart of comprehensive level involving industrial production and resource-environment in 2000-2013 of Dongying city

Analyze coupling coordination degree of the subsystems

The paper process data with the formula of coupling coordination degree. The coupling coordination degree of the whole Dongying city was analyzed by contrast, and the results was discussed. Finally the paper make the classification of the coupling stage(Fig. 2).

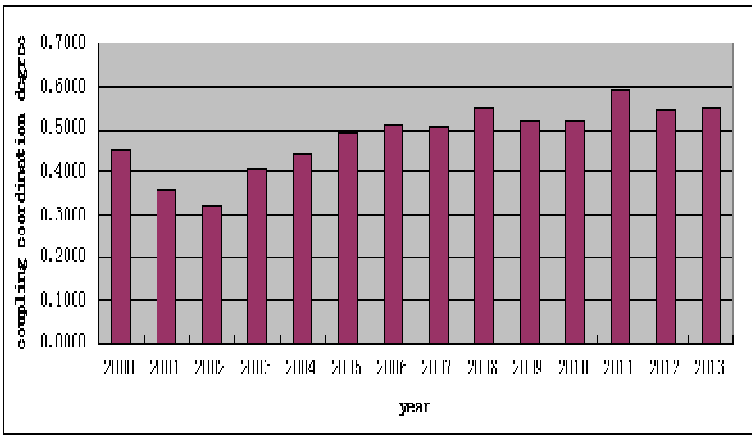

Fig. 2 The trend chart of coupling coordination degree involving industrial production and resource-environment in 2000-2013 of Dongying city

Overall from the whole city, the total coupling coordination degree of Dongying city was slow down, rapid development, slowing growth and leveling off. The coupling coordination degree was on the upswing overall. It was the lowest in 2002 and it was the highest in 2011. Finally, the coupling coordination degree currently stabilized at about 0.5 in highly coordination(Table 1). There was a certain degree of rise space.

Conclusion and discussion

Along with the course of industrialization and urbanization, ecological civilization becomes more important. The coupling mechanism between industrial development and resource-environment was analyzed. The related coupling elements included industrial scale, industrial structure, resource-environment, environmental bearing capacity, location, technology and policy. In the conclusion, ①overall from the whole city, the comprehensive level between industrial development and resource-environment was on the upswing in 2000-2013. The coupling degree between industrial development and resource-environment was characterized by transition from fluctuant rising to stabilizing. The coupling stage of the city was characteristic of highly coordination in 2013.

Then it was good at Ecological Civilization Construction. ② In 2002, the level of the comprehensive development of industrial production, the overall level of resources and environment and changes in the coupling coordination tend to agree, which are in a transition phase of "concave" period of development, and coupled in a low level of coordination stage.

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