Measuring Quality Development of Innovation Ecosystem in Yellow River Basin

Kaidi huang[1*]

[1]College of Management, Tianjin University of Technology, Tianjin, 300384, China

Abstract. Promoting ecological environmental protection and high-quality development in the Yellow River Basin is an important measure and an inevitable choice to achieve sustainable social development. Based on the data of 48 prefecture-level cities in the Yellow River Basin during 2003-2018, a high-quality development evaluation system was constructed to measure the high-quality development of the innovation ecosystem in the Yellow River Basin. The results of the study show that the Yellow River Basin ecosystem has a high quality development level, with a distribution pattern of "middlestream disadvantage, downstream advantage, and upstream stability".

1 Introduction

China's social development has entered a new period, which is mainly manifested by the shift of China's economy from high-speed development to high-quality development. The rapid economic development has effectively solved the problem of the contradiction between the growing material and cultural needs of the people and the backward social productivity, but the environmental derivative problems brought by it have become an obstacle to the further development of the country. How to effectively measure ecological development and achieve high-quality social development has become the key to solving current problems.

As a strategic support belt for China's economic development in the new era, the Yellow River Basin's innovative ecological development plays a significant role in promoting China's high-quality economic development. Since there are obvious differences in the effectiveness of environmental governance, infrastructure construction, and innovation resource investment among different regions, it is of great practical importance to measure the innovation ecosystem objectively and effectively [1], to manage each region differently, and to help the Yellow River Basin develop with high quality.

2 Research area overview

Yellow River Basin as China's important ecological barrier and economic zone, in China's socio-economic development of nuclear and regional ecological civilization construction has a pivotal role [2]. The Yellow River Basin, as an ecological and economic twin core built on the Yellow River, has a long and winding urban coverage, starting from Qinghai in the west and reaching the Bohai Sea in the east, through 9 provinces and regions including Gansu, Ningxia and Henan, and 7 major urban clusters, spanning different stages of China's urban development, which has important strategic value in academic research and urban construction [3].

Because of this, the ecological environmental protection and high-quality development of the Yellow River Basin has been highly valued by the state and has been elevated to a major strategy. As the economic development of the Yellow River Basin has a high dependence on the ecosystem construction, the inferior development of the ecosystem such as resource constraints, environmental pollution, and deformed industrial structure will eventually restrict the regional economy of the Yellow River Basin. Addressing the construction of the Yellow River Basin Ecosystem Prime System and identifying the elements of high quality development of the ecosystem has become a pressing issue at present.

3 Indicator system construction

3.1 Indicator System Design and Screening

The essence of ecosystem construction is to enhance the carrying capacity of the environment and protect the green and recyclable development capacity of the region, while high-quality development aims to effectively reduce non-essential losses in the economic system and achieve the sustainability of social growth [4]. From the social contradiction, high-quality development embodies the concept of efficient and sustainable development, which covers political, economic, cultural, social and ecological civilization construction in the field, and corresponds to the five major development concepts of

*Corresponding author's e-mail: 13622113125@163.com

innovation, coordination, green, openness and sharing in the national strategic development [5].

In view of this, based on the understanding of the connotation of high-quality development of the innovation ecosystem in the Yellow River Basin, the evaluation system of high-quality development indicators of the innovation ecosystem in the Yellow River Basin covering 31 indicators is constructed in accordance with the principles of objectivity, comprehensiveness and systematization from five dimensions: ecological innovation, ecological coordination, green development, system opening and resource sharing.

This paper aims to reveal the innovation ecosystem indicators of cities under the seven urban agglomerations in the Yellow River Basin, so the selected indicators have the ability to objectively reflect the high-quality development of innovation ecosystems. Eco-innovation is mainly measured by science and technology innovation investment, innovation environment creation, innovation foundation construction and other related elements; Ecological coordination focuses on the role of social needs and industrial transformation; Green development covers energy consumption, resource recycling, pollution control and other aspects; System opening mainly considers economic factor effects, including population income, regional development, etc. Resource sharing into green resource sharing, education resource sharing, etc.. Specific indicators are detailed in Table 1.

text of your paper should be formatted as follows:

Table 1 Innovation ecosystem quality development index evaluation system

Target layer	Guideline layer	Indicator layer	Properties
Innovation Ecosystem Quality Development Index	Innovation Capability	Number of academic research practitioners	Positive
		Science Business Expenses	Positive
		Budget balance	Positive
		Internet users	Positive
		Students in higher education	Positive
	coordination Capacity	Number of registered unemployed in urban areas	Backwards
		The proportion of employees in the secondary industry	Positive
		Increase rate of tertiary sector as a percentage of GDP	Positive
		Urban road freight volume	Positive
		Population	Positive
	Greening Capability	Landscape coverage in built-up areas	Positive
		Amount of LPG used by households	Backwards
		Total gas supply	Backwards
		Water Supply	Backwards
		Electricity supply	Backwards
		Harmless disposal rate of domestic waste	Positive
		Domestic sewage treatment rate	Positive
		Industrial sulfur dioxide emissions	Backwards
		Industrial fume emissions	Backwards
	Openness Capabilities	Average wage of employees in employment	Positive
		Year-end balance of urban and rural residents' savings	Positive
		Actual foreign investment	Positive
		Total retail sales of social consumer goods	Positive
		Profit of enterprises on the scale	Positive
		Gross Regional Product	Positive
	Shared Capabilities	Number of cabs	Positive
		Paved road area	Positive
		Total number of books in public library collections	Positive
		Ten thousand people share the garden green area	Positive
		Number of cell phone users	Positive
		Number of medical workers	Positive

3.2 Data Acquisition

This paper collects various data indicators of the Yellow River Basin from 2003 to 2018 through the China City Yearbook, the database of Beida Faber and the information platform of Tianwei Cha as the main sources of data. To ensure the consistency of the data and avoid errors due to cross-regional data, the data sample was restricted to cities above prefecture level in the seven major urban agglomerations in the Yellow River Basin. Seven major city groups in the Yellow River Basin, including Shandong Peninsula City Group, Central Plains City Group, Jinzhong City Group, Guanzhong Plain City Group, Ningxia along the Yellow River City Group, Hubao-Egyu City Group and Lanxi City Group. Due to the high degree of integration of cities within the urban agglomerations and the close relationship between urban agglomerations and urban clusters due to the water-dependent proximity of the Yellow River basin, this can, to a certain extent, alleviate the errors in variables due to economic differences and resource allocation.

4 Measurement methods and analysis of results

4.1 Measurements

The assessment of high-quality development of innovation ecosystems in the Yellow River Basin involves multiple categories of indicators, and the determination of the weights of various indicators is somewhat subjective. The entropy method, as an objective evaluation method, determines the index weight coefficients based on the size of the information provided by the observations of each index, and calculates the entropy weight of each index according to the degree of variation of each index and the information entropy, so as to arrive at a more objective index weight. The human-generated random errors are eliminated to some extent. Based on this, this paper selects the entropy value method to measure the level of high-quality development of innovation ecosystems in cities above prefecture level in the Yellow River basin from 2003-2018. The specific steps are as follows:

• Dimensionless processing of the data. Because of the differences in the magnitude and order of magnitude of each data, the original data need to be normalized by extreme difference normalization:

Positive indicator calculation method:

$$X_{ij} = \frac{X_{ij} - minX_j}{maxX_j - minX\_j}$$

Negative indicator calculation method:

$$X_{ij} = \frac{maxX_j - X_{ij}}{maxX_j - minX\_j}$$

• Construction of the original index data matrix:

$$X = \{X_{ij}\}_{m*n} \quad p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}}$$

• Calculate the entropy value of the jth indicator:

$$e_j = 1/lnn$$

• Calculating the redundancy of information entropy:

$$d_j = 1 - e_j$$

• Calculate the weights of each indicator:

$$w_j = {d_j}\Big/{\sum_{j=1}^{m} d_j}$$

• Calculate the composite score for each year:

$$s_i = \sum_{j=1}^{m} w_j * p_{ij}$$

4.2 Measurement results

By measuring the level of high quality development of ecosystems in 48 prefecture-level cities in the Yellow River Basin, some of the data are shown in the table below. The level of quality development of the Yellow River Basin ecosystem varies more significantly spatially between cities.

In terms of development index scores, there are quantitative differences in quality development scores among different cities. By categorizing cities with high quality development level of urban ecosystem and similar geographical distance, the cities in the Yellow River Basin can be divided into areas of strength, smoothness and weakness of high quality development of ecosystem. The overall spatial pattern is characterized by a distribution of "midstream disadvantage, downstream advantage and upstream stability". From a temporal perspective, the overall trend of high-quality development of the Yellow River Basin ecosystem is "high speed in the middle reaches, low speed in the upper reaches, and decline in the lower reaches".

As an important strategic node of China's industrial layout, urban agglomerations are characterized by a high concentration of resource elements and are also the basic unit for measuring regional development. To simplify the operation, the core cities of urban clusters are used to represent the seven major urban clusters in the Yellow River Basin. The level of urban ecology in different regions varies significantly, with the Central Plains urban agglomeration and Shandong Peninsula urban agglomeration with Zhengzhou, Qingdao and Jinan as the core having relatively high levels of ecosystem construction, the Guanzhong Plain urban agglomeration and Jinzhong urban agglomeration with Xi'an and Taiyuan as the core having the second highest level, while the Ningxia Yanhuang urban agglomeration, Lanxi urban agglomeration and Hubao-Egyu urban agglomeration with Yinchuan, Lanzhou and Hohhot as the core have relatively poor levels of urban ecosystem construction. The level of urban ecosystem construction is poor.

Table 2 Urban Innovation Ecosystem Quality Development Index

Sorting	City	Index 2003	City	Index 2009	City	Index 2018
1	Qingdao	0.094759	Xi'an	0.075525	Xi'an	0.10006
2	Xi'an	0.07848	Zhengzhou	0.070836	Zhengzhou	0.080868
3	Jinan	0.073473	Qingdao	0.068052	Qingdao	0.072702
…						
16	Xinxiang	0.017263	Yinchuan	0.01828	Yinchuan	0.019097
17	Pingdingshan	0.014968	Xinxiang	0.017927	Baotou	0.017991
18	Jiaozuo	0.01381	Linfen	0.015884	Yulin	0.01642
……						
46	Hebi	0.005542	Pingliang	0.005133	Tongchuan	0.004626
47	Shangluo	0.003639	Shangluo	0.004826	Sahngluo	0.004029
48	Dingxi	0.003506	Dingxi	0.003775	Dingxi	0.003677

5 Conclusions

This paper interprets the meaning of high-quality development of innovation ecosystems from the perspective of high-quality economic development, and evaluates cities in the Yellow River Basin by constructing evaluation indicators for high-quality development of innovation ecosystems. The study shows that the index of high quality development of the innovation ecosystem in the Yellow River Basin is not spatially balanced, showing a high level of quality development in the eastern coastal region with a higher regional concentration, and a lower level of quality development in the western interior. This is highly correlated with the level of economic development between regions. Compared to cities in the western interior, the eastern coastal cities have a higher level of economic development, complete infrastructure and relatively better policies, and therefore show a higher level of innovation ecosystems. To this end, the government's regulatory role needs to be brought into play, with resources tilted towards underdeveloped regions, and through financial subsidies, policy support, and government-enterprise synergy, to continuously strengthen regional development and thus achieve high-quality development of the Yellow River Basin's overall innovation ecosystem.

In the process of enhancing the quality development of urban innovation ecosystems, local governments should make full use of the synergy of multiple elements on the innovation ecosystem and play the macroscopic scheduling role of the government in resource allocation, so that the development of the regional innovation ecology can be efficiently enhanced.

References

1. Mengdi Liu, Ronald Shadbegian, Bing Zhang. Does environmental regulation affect labor demand in China? Evidence from the textile printing and dyeing industry[J]. Journal of Environmental Economics and Management, 2017, 86: 277-294.
2. Charles R. Shipan and Craig Volden. Policy Diffusion: Seven Lessons for Scholars and Practitioners[J]. Public Administration Review, 2012, 72(6): 788-796.
3. Gouldson A, Hills P, Welford R. Ecological modernisation and policy learning in Hong Kong[J]. Geoforum, 2008, 39(1):319-330.
4. R.P. Sapkota, P.D. Stahl, K. Rijal. Restoration governance: An integrated approach towards sustainably restoring degraded ecosystems[J] Environmental Development, 2018,27: 83-94
5. Wallace E Oates. An Essay on Fiscal Federalism[J]. Journal of Economic Literature, 1999, 37(3): 1120-1149.