Measurement and Analysis of the Level of Green Economy Development in the Yellow River Basin

JI Tonghui, DU Ying*

School of Economics and Finance, Xi'an International Studies University, Xi'an, Shannxi, 710128, China

duyingxjtu@aliyun.com

*Corresponding Author

Abstract: The green economic development level of 100 prefecture-level cities in the Yellow River basin from 2010 to 2019 was measured under the framework of DPSIR model. The results show that: (1) the overall level of green economy development in the Yellow River basin is good, but regional differences still exist, and the overall clustering trend is "medium-high level - high level - medium-high level". (2) Most cities belonging to Gansu Province, Henan Province and Sichuan Province have improved their green economy development level. (3) Lanzhou City has been able to maintain a high level steadily while improving its overall level, which cannot be separated from the city's emphasis on talent training.

1. Introduction

The State Council issued on October 8, 2021, *the Yellow River Basin Ecological Protection and High-Quality Development Planning Outline*, highlighting the importance of protecting the Yellow River Basin to maintain China's ecological security, the Yellow River Basin is an important area for population activities, but also a key area for economic development, promoting the development of the Yellow River Basin green economy has far-reaching significance. However, the Yellow River Basin is still facing problems such as low quality of economic development, severe green environment situation and unbalanced regional development. How to improve the level of green economy in the Yellow River Basin?

In order to solve the above problems, firstly, we need to start from the root cause and find out the influencing factors about the level of green economy development, and the current research mainly focuses on industrial structure[1-2], urbanization level[3-4] scientific and technological progress level[5-6], education level[7] etc. The research results at home and abroad have great significance for this paper. However, on the one hand, the method of measuring the level of green economic development in the research process still needs to be improved. Unlike the previous subjective weighting method, this paper adopts the objective weighting method of principal component analysis. On the other hand, there is a lack of research systems aiming at the ecological quality development of the Yellow River Basin.

To sum up, this paper takes 100 prefecture-level cities in 9 provinces of the Yellow River Basin as the research objects, constructs a better evaluation index system under the framework of DPSIR, and uses principal component analysis to assign objective weights to them to find out the changing trends and characteristics of the level of green economic development in the Yellow River Basin, so as to provide reference for promoting the high-quality ecological economic development in the Yellow River Basin.

2. Research Methodology and Sample Data

2.1 Methodology for Measuring the Development Level of Green Economy in the Yellow River Basin

In this paper, we refer to the framework of DPSIR model to construct an index system for evaluating the level of green economic development in the Yellow River Basin. Based on the PSR model, the EEA (European Environment Agency) first proposed the DPSIR conceptual model in 1993 and gradually started to use it. The PSR model can describe and evaluate the relationship between human activities and the environment, natural resources system dramatic interaction in a more comprehensive way, and its inner logic is as follows: the environment and natural state The system dynamic process can be summarized as three links: "pressure-state-response". Based on the PSR model, the DPSIR model considers the driving factors that cause people's activities and considers the impact of people's responses, expanding and deepening the original model framework to capture the interaction between people and nature and the environment in a more comprehensive way.
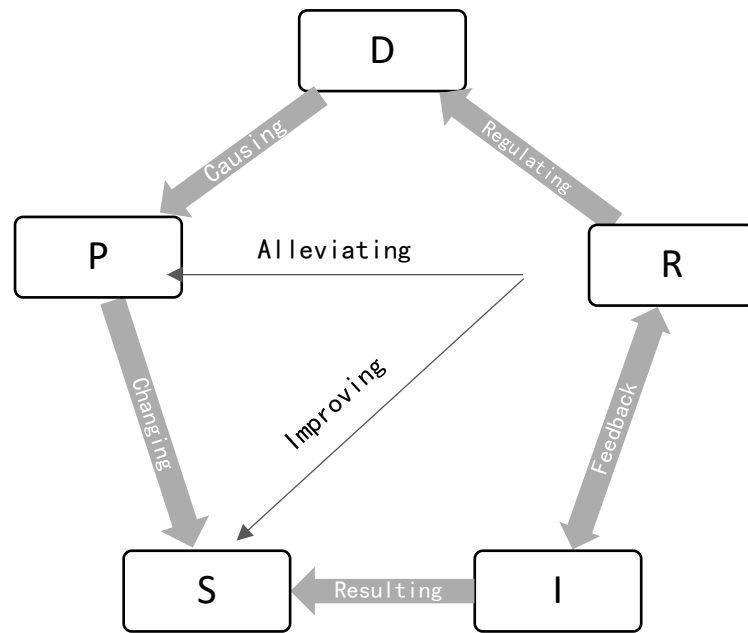

Fig.1 Dpsir Model Framework

Considering the complexity and systemic nature of the level of green economic development in the Yellow River Basin, this paper draws on the research results of Yanchun Xing et al[16]to select indicators from five aspects, respectively, and establishes the indicator system as shown in Table 1, considering the integrity and authority of the data.

Table 1 Indicator System for Assessing the Level of Green Economic Development in the Yellow River Basin

Target Layer	Standard Layer	Indicator Layer
The level of green economy development in the Yellow River Basin	Driving forces	GDP per capita
		Natural Growth Rate
		Total number of patents granted
	Pressures	Population density
		Carbon Emission Intensity
	States	Share of Secondary Industry in GDP
		The proportion of tertiary industry in GDP
	Impacts	Number of private and individual employees in urban areas
		Degree of greening coverage in built-up areas
	Responses	Harmless treatment rate of domestic waste
		Comprehensive utilization rate of general industrial solid waste
		Centralized treatment rate of sewage treatment plants

2.2 Data Description

2.2.1 Sample Selection and Data Sources

To ensure the completeness and authority of the data, annual data of a total of 100 prefecture-level municipalities in 9 provinces along the Yellow River Basin from 2010-2019 were selected for this paper. The data were obtained from the annual national economic and social development statistical bulletin of each city, the annual statistical yearbook of each city, the bulletin of the seventh national census of each city and the China Carbon Emission Database.

2.2.2 System Construction

According to the indicators of industrial agglomeration and the index system constructed in the previous paper, descriptive statistics were conducted on the sample data, and the results were as follows:

Table 2 Descriptive Statistics Results

Variables	Minimum value	Maximum value	Mean value	Standard deviation
GDP per capita	2.17	256877	45286.7373	31025.9815
Natural Growth Rate	-6.66	38.8	4.474	3.6103
Number of patents granted	11.00	57448	2215.129	5369.79475
Population Density	5.05	2675	410.3934	356.78467
Ratio of Secondary Industry to GDP	15.58	87.45	49.7576	9.05583
Ratio of tertiary industry to GDP	10.47	65.36	32.7382	9.57099
Number of private and self-employed workers in urban areas	10202.00	6296321	402275.577	548035.357
Harmless treatment rate of domestic waste	22.45	102.2	86.1468	24.76961
Comprehensive utilization rate of general industrial solid waste	1.81	106.45	54.6161	40.53544
Centralized treatment rate of sewage treatment plants	18.30	100	75.8514	32.82959
Greening coverage rate of built-up areas	0.59	95.25	37.0378	9.7245
Carbon emission intensity	3.16	108.48	24.0723	22.24697

3. Empirical Results

3.1 Assessment of the Level of Green Economy Development in the Yellow River Basin

In order to more clearly and intuitively see the changes of regional green economy development in these 10 years, the mean-standard deviation method was used to classify the level of green economy development of each prefecture-level city by referring to the analysis method of Qiao Rui et al[22], and the specific scoring criteria.

Taking 2011, 2015 and 2019 as examples, we use arcgis to make a distribution map of green economic development level. As we can see, the overall level of green economic development in the Yellow River Basin is improving as time advances, but the differences between regions do not narrow down, and gradually present a "medium-high-high-middle-high" clustering state on the map. In general, the level of green economy development in the Yellow River Basin shows a trend of high in the east and low in the west, high in the south and low in the north.

The cities that can maintain a high level of green economy development are mainly concentrated in Shandong Province. This is related to the unique geographical location and rich natural resources of Shandong Province[23], the high population density ensures a rich source of labor, and as an economic province with strong scientific and technological innovation strength, so the cities with high level of green economic development are mainly concentrated in Shandong Province.
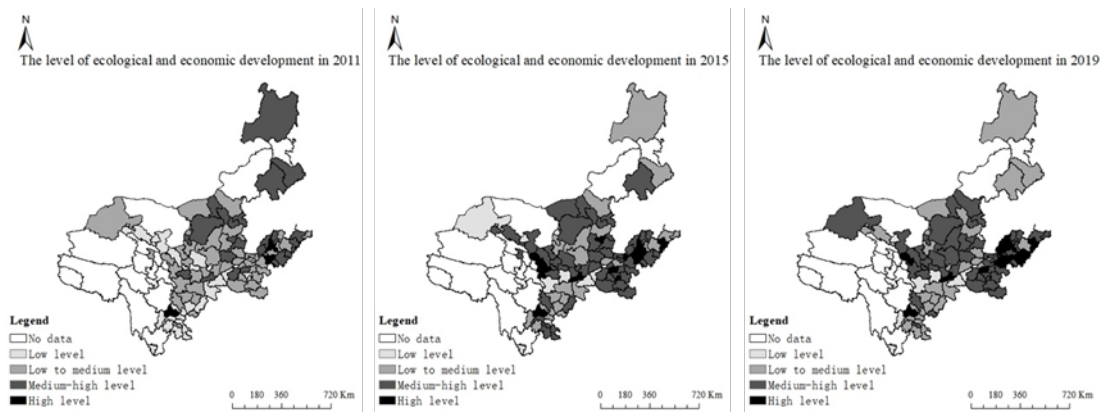
Fig.2 Changes in the Development of the Green Economy in the Yellow River Basin

With every four years across the level of change as the standard of greater fluctuations, further analysis of the green economy development level fluctuations of the city. (1) From the results of change, it can be found that throughout the 18 cities, while fluctuating, the green economy development level of each city are in the direction of a higher level, 2019 and 2011 level compared to all have a certain degree of improvement Among them, the cities belonging to Gansu Province, Henan Province and Shandong Province all reached a medium-high or high level grade in 2019, and the cities belonging to Shaanxi Province and Sichuan Province both reached a medium-low level grade, and the cities belonging to Gansu Province accounted for nearly half of these 18 cities and were in the first place, while the cities belonging to Sichuan Province and Henan Province were tied for the second place. (2) In terms of the change process, Dingxi, Lanzhou, Luohe, Puyang and Tai'an rise from low or medium-low levels to high levels in the first four years, with Lanzhou maintaining a high level in the next four years. In contrast, the other four cities dropped to medium-high levels in the second four years.

Most of the cities in Gansu, Henan and Sichuan Provinces have achieved such a large increase in the level of green economy development, and Lanzhou City was able to stabilize at a high level on this basis without the following efforts: (1) Strengthening the supervision and management of emission rights. 21 January 2015, Gansu Province gradually launched a pilot project on the paid use and trading of emission rights, laying the foundation for further strengthening the supervision and management of emission rights. Henan Province has also started to gradually carry out the paid use of emission rights since April 1, 2016, using market-based means to promote environmental protection. *The 12th Five-Year Plan for Energy Conservation and Emission Reduction*, released in 2012, summarizes the achievements of the 11th Five-Year Plan while focusing on the current problems and specifying the reduction targets for each indicator. Henan Province, the energy-saving targets for 2015 to make specific instructions to enhance sustainable development. (3) Promote economic transformation and upgrading. Sichuan Province puts green development in the first place and insists on not sacrificing ecology, focusing the core of its work on economic transformation, and upgrading, especially the development of environmental industries with low-carbon and energy-saving as the main theme, and encouraging the flourishing of eco-friendly and resource-friendly new industries. (4) Focus on talent training. Lanzhou City has built a policy framework for economic and technical talents in the city since 2018, promoting the development of green and ecological industries, cultivating fertile ground for innovation-driven strategies, and making steady progress on the road to green economic development.

4. Conclusions

This paper measures the level of green economy development in the Yellow River Basin under the DPSIR model using principal component analysis and summarizes the trends and characteristics of changes in the past decade. The specific conclusions are as follows:(1) The level of green economy development in the Yellow River Basin is generally good, but there are large differences among regions. (2) Most cities belonging to Gansu Province, Henan Province and Sichuan Province

have improved their green economy development level. (3) Lanzhou City has been able to maintain a high level steadily while improving its overall level, which cannot be separated from the city's emphasis on talent training.

References

[1] Li B, Su Jiaxuan. Is industrial restructuring beneficial to the development of green economy? --An empirical study based on spatial econometric model[J]. Green Economy,2016, 306(06):32-37.

[2] Meng Wansheng, Shao Fangqin. The impact of environmental regulation and industrial structure on green economic growth efficiency in the Yellow River Basin[J]. Water Resources Conservation,2020,36(06):24-30.

[3] Ren Yangjun, Wang Chuanxu. An empirical study on the impact of urbanization on regional green economic efficiency in China[J]. Technology Economics,2017, 360(12):72-78+98.

[4] Yu W, Zhang P. Urbanization process, spatial spillover and green economic efficiency growth-a spatial econometric study based on provincial units from 2002-2012[J]. Exploration of Economic Issues,2016, 402(01):77-82.

[5] Li Linhan,Tian Weimin. Financial deepening, science and technology innovation and green economy[J]. Finance and Economics,2020, 512(03):68-75.

[6] Yang Yuzhen,Song Wensong,Li Shan. Research on the impact of ecological science and technology innovation capacity on green economic growth--an analysis based on provincial panel data[J]. Guangxi Social Science,2019, 287(05):72-79.

[7] Cai W. B., Huang J. S., Yuan X. How much does educational human capital contribute to green economic development? --An analysis of threshold characteristics based on industrial structure change[J]. Journal of East China Normal University (Education Science Edition),2020, 162(10):34-47.

[8] Qian Qiming, Liu Xiaochen. Regional differences in green economic efficiency and influencing factors in China[J]. China Population-Resources and Environment, 2013, 155(07):104-109.

[9] Zhang Juntao, Zhu Yue,You Bin. The impact of collaborative industrial agglomeration on green development of urban economy[J]. Urban Issues,2021(02):66-74+94.

[10] Jackson J, Murphy P. Clusters in regional tourism An Australian case [J]. Annals of Tourism research, 2006, 33(4): 1018-1035.

[11] Antonioli D, Borghesi S, Mazzanti M. Are regional systems greening the economy? Local spillovers, green innovations and firms' economic performances[J]. economic performances[J]. Economics of Innovation and New Technology, 2016, 25(7): 692-713.

[12] Liu and Dong, Zhang Guijing. The impact of collaborative industrial agglomeration on high-quality economic development[J]. Science and technology progress and countermeasures,, ():1-8.

[13] Zhang Youguo. The impact of changes in economic development on carbon emission intensity in China[J]. Economic Research, 2010, 45(4): 120-133.

[14] Xing Yanchun, Guo Yanfei, Wang Lin. Dynamic measurement of ecological environment quality in China[J]. Statistics and Decision Making,2021, 567(03):81-84.

[15] Han F, Qin J, Gong SH. Does the agglomeration of productive services promote the optimization of energy use structure? --An empirical analysis based on dynamic spatial Durbin model[J]. Journal of Nanjing Audit University, 2018, 15(4): 81-93.

[16] Zhang Hu,Han Aihua,Yang Qinglong. Analysis of spatial effects of synergistic agglomeration between manufacturing and productive service industries in China[J]. Quantitative Economic and

Technical Economics Research, 2017, 34(2): 3-20.

[17] Elhorst J P. Matlab software for spatial panels[J]. International Regional Science Review, 2014, 37(3): 389-405.

[18] LeSage J, Pace R K. Introduction to spatial econometrics [M]. Chapman and Hall/CRC, 2009.

[19] Gao Xincai, Cao Haoyu. Evaluation of industrial development and policies in Northwest China in the past 70 years: a low-carbon economy perspective [J]. Journal of Lanzhou University: Social Science Edition, 2019, 47(5):11-23.

[20] Zheng Guanqun,Xu Yan,An Lei. Manufacturing industry agglomeration and firm innovation--Porter externality test based on market share perspective[J]. Nankai Economic Research,2021, 219(03):239-256.

[21] Liu and Dong. Study on the siphon effect of domestic market size and innovation factor agglomeration[J]. Science and Technology Management, 2013, 382(07):104-112.

[22] Zhao Xin,Ren Jun. Research on regional differences and spatial spillover effects of green economic development in ethnic regions: the case of Inner Mongolia Autonomous Region[J]. Taxation and Economy, 2020, 231(04):33-39.

[23] Qiao R, Dong F, An T L. Evaluation of green development level in the Yellow River Basin and analysis of obstacles[J]. Statistics and Decision Making,2021,(23):72-76.