



An Empirical Study on the Coordinated Development of Coal Resource-based Cities in Shanxi Province—— Based on the entropy right DPSIR—TOPSIS Evaluation Model

Jiaqi Li¹, Keren He^{2*}

¹ School of Business, Macau university of science and technology, Macau, China

²School of Education, Kun Ming city college, Yunnan Province, China

*Corresponding author: 1244298767@qq.com

Abstract. Shanxi Province is the largest coal producing province in China, because most of the urban development is highly dependent on mineral resources, it is also a typical coal resource-based city. This study takes 8 resource-based cities in Shanxi as the main research object to explore the economic, environmental and social development level and differentiation law of coal resource-based cities. At the same time, the DPSIR conceptual model is combined with TOPSIS method based on entropy weight to conduct an empirical study on the coordinated development of resource-based cities in Shanxi. It is concluded that the coal industry in Shanxi has a certain ability of sustainable development, so it is necessary to adjust the industrial structure of coal resource-based cities, and the environment and resource efficiency are the main negative factors affecting the coordinated development of the coal industry in Shanxi.

Keywords: coal resource-based cities, coordinated development, green transformation, Shanxi Province

1 Introduction

In the development goals of the 14th Five-Year Plan for National Economic and Social Development and the Outline of the 2035 Vision Goals and the Fifth Plenary Session of the 19th Central Committee of the Party, the goals of "continuous improvement of the ecological environment" and "fundamental improvement of the ecological environment" were respectively proposed. On December 11, 2023, the Central Economic Work Conference proposed to actively and steadily promote carbon peak, carbon neutrality, and accelerate the creation of a green and low-carbon supply chain. Coal resources provide a strong guarantee for China's economic development, but large-scale resource exploitation has brought a series of problems such as economic decline, rising unemployment rate and deteriorating air quality, which seriously hinder its sustainable development. Sachs & Warner (2001)[1], after proposing the concept of "resource curse", further verified that abundant natural resources hinder economic growth by crowding

© The Author(s) 2024

H. Cheng et al. (eds.), *Proceedings of the 2024 4th International Conference on Enterprise Management and Economic Development (ICEMED 2024)*, Advances in Economics, Business and Management Research 295, https://doi.org/10.2991/978-94-6463-506-5_60

out activities that promote economic growth. Li Xue, Qiu Fangdao, & Fang Lin. (2020) [2] Since the "Twelfth Five-Year Plan" was put forward, with the attention paid to environmental issues at home and abroad, the implementation of end-treatment measures such as energy conservation, emission reduction, desulfurization and denitrification, and environmental measures such as comprehensive treatment of air pollution, the impact of industrial development on the environment has been decreasing continuously. At the same time, the industrial structure is moving towards high-end, and the environmental efficiency is continuously and steadily improving. The improvement of environmental efficiency has a positive impact on the improvement of high-quality industrial development level of renewable resource-based cities, which is mainly manifested in that regional industrial development can maximize industrial added value with minimal environmental impact.

In 2007, Regulations on Promoting Green Transformation of Taiyuan City defined green transformation as the transformation of development mode to sustainable development with ecological civilization construction as the leading, circular economy as the basis, and green management as the guarantee, so as to achieve resource conservation, environmental protection, ecological balance, and harmonious development of human, nature and society. Most of the existing literatures overlap with the definition. Li et al. (2018)[3] believes that coordinated development is the best choice for the development of coal resources, environment, economy and society. As far as the influencing factors are concerned, economic factors, resource factors and environmental factors are the three main factors that affect the coordinated development of Shanxi Province. Moreover, the different interests of different stakeholders in terms of economic, resource and environmental values have a direct impact on the implementation of coordinated development policies.

Liu Shan-Shan, Wu Wen-Jie, & Wang Zhi-Qiang. (2023)[4] proposed that factors such as social and economic development, rapid urbanization development, improvement of people's living standards and increase of population growth rate are the long-term driving forces to promote urban green development and stimulate population aggregation. Increasing energy consumption, production and household pollution emissions and land occupation have a direct pressure impact on urban green development. Yu Li E. (2022)[5] proposed that in the past decade, faced with the pressure of economic downturn, environmental protection and carbon emission reduction, each coal-resource exhausted city has sought a path of green transformation, and different cities have chosen different green transformation modes, namely: To distinguish the primary and secondary, focus on the appropriate green transformation model, adopt different green transformation models at different times, take the lead of the government, actively attract the participation of enterprises, build a reasonable evaluation index system, and carry out quantitative selection of the green transformation model. Qin, J., & Guo, L. (2023)[6] put forward that the realization of green and low-carbon economic growth is an inevitable trend of urban green and low-carbon circular development, as well as an inherent requirement for achieving the goal of carbon peaking and carbon neutrality.

Based on the above conclusions from the research on the coordinated development of resource-based cities, this study takes urban green transformation as a concept, and

proposes to enhance the advantages of economic quality by types, improve urban functions and grades, and explore the formation of a transformation and development model that relies more on innovation and new momentum according to the differences in resource security capabilities and sustainable development capabilities of different types of coal resource-based cities.

2 Literature Review

Ma Jing, Tian Xiaoyu, & Chen Huaichao. (2021)[7] Based on the coupling and coordination mechanism of scientific and technological innovation and sustainable development system of coal industry and the principles of scientificity, systematization and operability, the evaluation index system of the two systems of scientific and technological innovation and sustainable development of coal industry is constructed, and the coupling and coordination degree model is used to evaluate the coupling and coordination status of scientific and technological innovation and sustainable development of coal industry in Shanxi Province It provides theoretical basis and suggestions for further promoting the scientific and technological innovation and development of coal industry in Shanxi Province and improving the level of sustainable development in Shanxi Province. Sun Yu (2021)[8] proposed that there are certain differences in the transformation and development level and development balance among resource-based cities in different resource types, development stages and provinces. The transformation and development level of petroleum and metallurgical resource-based cities is higher than that of coal resource-based cities. In order to better analyze the differences in transformation and development level and development balance of resource-based cities in different regions, It is found that the overall level of transformation and development of resource-based cities is low, and the difference of equilibrium in different development stages is manifested as growth stage > regeneration stage > maturity stage > decline stage.

Guo Lingling (2016)[9] defined the concept of urban green transformation, and proposed that the per capita mineral resource ownership, per capita GDP, urban registered unemployment rate, soot emission and comprehensive air pollution index were the main factors affecting the effect of green transformation. Coal resource-based cities are affected by long-term inertia and path dependence, it is difficult to achieve a large transformation effect in a short period of time, and there are still many problems in their own development. Dou R Y. Liu X M. (2016)[10] analyzed the coupling and coordinated development level of the binary and term-based systems of economy, resources and environment, and concluded that the environmental subsystem and the economic subsystem had a reverse development trend, while the economic subsystem and the resource subsystem showed a similar development trend. The transformation of resource-based areas must give priority to the implementation of supply-side reform. Shanxi Province should choose intensive and low-energy emerging industries on the basis of improving energy efficiency. Zhang Haixia (2021)[11] finds that when energy and resource consumption declines, the level of economic development will decline, which is reflected in the relatively large proportion of the secondary industry in terms

of industrial structure. He proposes that accelerating the implementation of policies such as urban infrastructure, emerging industries and talent introduction can effectively avoid the "resource curse" of urban development. And the construction of "economic development, innovation level, people's livelihood, ecological environment, sustainable development" 5 dimensions of 21 indicators of the evaluation system.

According to the existing literature, the content dimension and specific scope of the coordinated development of resource-based cities have not been clearly defined at present. Most of the relevant studies build evaluation systems from the three aspects of environment, society and economy, ignoring the causal relationship among indicators to a certain extent, and failing to correlate different indicators into an organic whole. Therefore, this study plans to combine DPSIR conceptual model with TOPSISI method based on entropy weight to conduct empirical research on the coordinated development of resource-based cities.

3 Research Design

3.1 Research Object

Based on the data of 8 typical coal resource-based cities in Datong, Linfen, Gujiao, Xinzhou, Jinzhong, Luliang, Huozhou and Xiaoyi in Shanxi Province, this study aims to study the coordination of various elements in the development of these coal resource-based cities. By deeply exploring the degree and law of coordinated economic and social development of coal resource-based cities, the paper provides the assessment basis and transformation path suggestions for the green transformation of mature, declining and regenerative cities in coal resource-based cities

3.2 Data Source

This research plan selects 8 typical coal resource-based cities in Shanxi Province as research objects, which are covered by three types of mature, declining and regenerative cities in the National Sustainable Development Plan for Resource-Based Cities (2013-2020). The research data mainly come from China Statistical Yearbook, China Urban Statistical Yearbook and Shanxi Provincial Statistical Yearbook for 2012-2022, in which the environmental system indicators such as air quality compliance rate come from Shanxi Provincial Ecological Environment Status Bulletin published by Shanxi Provincial Department of Ecology and Environment over the years. Social and economic system indicators such as per capita GDP come from the statistical bulletin of national economic and social development published by the municipal people's government network.

3.3 Research Method

This study takes 8 cities in Shanxi Province as the evaluation unit, based on the evaluation index of the coordinated development of urban economy, environment and

society, adopts DPSIR conceptual model and entropy weight TOPSIS method to construct the evaluation model of the coordinated development of coal resource-based cities for empirical research, and explores the economic, environmental and social development level and differentiation law of coal resource-based cities. The specific analysis is as follows:

(1) Methods for determining evaluation indicators of urban economic, environmental and social coordinated development

Starting from the coordination of development factors of coal resource-based cities, based on the principles of objectivity, representativeness and accessibility of data, this paper comprehensively evaluates 25 indicators of economic, social and environmental aspects from 2012-2022 by integrating relevant literatures of domestic and foreign scholars, so as to determine the impact of various factors on the coordinated development of coal resource-based cities.

(2) DPSIR conceptual model is combined with TOPSISI method based on entropy weight

The DPSIR conceptual model is that the driving force of the system leads to pressure, and the pressure forces some states of the system to change, and the changes in the state have an impact on the system, and these impacts prompt human beings to make direct or indirect responses. The model can not only cover social, economic and environmental factors, but also describe the complex causal relationship between systems. At the same time, using entropy to determine the weight value can reduce subjectivity, obtain the optimal weight according to the actual data of each sample, effectively avoid human influence factors, and get closer to the objective facts.

4 Conclusion

The level of green transformation in Shanxi Province is gradually improving, but the overall effect is at a general level, and the situation of green transformation is still not optimistic. From the perspective of each subsystem, the values of pressure, state and response system all fluctuate up, but the values of driving force system fluctuate down. At the same time, there are also problems such as Engel coefficient and high urban registered unemployment rate, uncoordinated industrial structure, and serious environmental pollution. Therefore, it is proposed that the first is to attract external investment and develop the private economy, and on the basis of improving the basic conditions of factor agglomeration, find and reconstruct the driving force of long-term and healthy economic and social development, and improve the per capita economic level. The second is to strengthen the transfer training of coal surplus labor force. As coal companies shut down production, a large number of surplus labor will be released. It is necessary to strengthen the skills training of the labor force in the coal industry, promote the re-employment of the surplus labor force in coal enterprises, and provide sufficient labor force for the development of emerging industries while reducing the unemployment rate. Second, industrial transformation is a long way to go. It is necessary to continue to change the concept, strengthen the awareness of market competition and crisis, improve the efficiency and efficiency of resource utilization, strictly control high energy

consumption, eliminate high energy consumption and low efficiency industries, change the mode of regional economic growth, and actively promote the green development of industries. At the same time, we should pay attention to urban environmental protection, improve the ability to improve environmental quality, strictly enforce environmental law, and increase environmental remediation efforts, especially strengthen air environmental governance, strictly control pollution emissions, and shut down and remediate heavily polluting and harmful industries. We will introduce relevant local laws and regulations on environmental governance.

References

1. Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European Economic Review*, 45(4), 827–838. [https://doi.org/10.1016/S0014-2921\(01\)00125-8](https://doi.org/10.1016/S0014-2921(01)00125-8)
2. Li Xue, Qiu Fangdao, & Fang Lin. (2020). Evaluation of high-quality industrial development level in renewable resource-based cities: A case study of Xuzhou City. *Resources development and the market*, 36 (7), 716-720. <https://doi.org/10.3969/j.issn.1005-8141.2020.07.008>
3. Li, L., Lei, Y., Wu, S., He, C., & Yan, D. (2018). Study on the coordinated development of economy, environment and resource in coal-based areas in Shanxi Province in China: Based on the multi-objective optimization model. *Resources Policy*, 55, 80–86. <https://doi.org/10.1016/j.resourpol.2017.10.017>
4. Liu Shan-Shan, Wu Wen-Jie, & Wang Zhi-Qiang. (2023). Measurement of green development level of Urumqi City: Based on DPSIR-TOPSIS model and its influencing factors. *Journal of Earth Sciences and Environment*, 45(4), 857–868. <https://doi.org/10.19814/j.jese.2022.12027>
5. Yu Li E. (2022). Evaluation of green transformation model of coal-resource depleted cities based on AHP. *Journal of Zaozhuang University*, 39(5), 70–77. <https://doi.org/10.3969/j.issn.1004-7077.2022.05.011>
6. Qin, J., & Guo, L. (2023). Study on the coordinated development of economy, environment and society of green transformation of coal resource-based cities in Henan Province. *Henan Ligong Daxue Xuebao. Ziran Kexue Ban = Journal of Henan Polytechnic University. Natural Science*, 42(5), 93-. <https://doi.org/10.16186/j.cnki.1673-9787.2022110033>
7. Ma Jing, Tian Xiaoyu, & Chen Huaichao. (2021). Research on the coupling and coordination relationship between technological innovation and sustainable development of coal industry in Shanxi Province. *Chinese coal*, 47(5), 20–26. <https://doi.org/10.3969/j.issn.1006-530X.2021.05.004>
8. Sun Y. (2021). Research on transformation and development of resource-based cities in Northeast China based on five development concepts. *Coal classic Economic research*.
9. Xiao Guirong, Zhao Yanjun, Guo Lingling. (2016). Evaluation and demonstration of urban green transformation based on DPSIR-TOPSIS: A case study of Taiyuan City. *Journal of Technical Economics*, 35(12), 82-89. <https://doi.org/10.3969/j.issn.1002-980X.2016.12.010>
10. Dou R Y. Liu X M. (2016). Dynamic relationship between energy consumption and economic growth in China's typical resource-based regions. *China's population, resources and environment*, 26 (12), 164-170. <https://doi.org/10.3969/j.issn.1002-2104.2016.12.022>
11. Zhang Haixia. (2021). Evaluation of transformation and development of coal resource cities based on AHP. *Coal Economic Research*, 41(8), 6.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

