Analysis on the Efficiency of Green Development Policy in Resource-Based Regions Under the Low Carbon Background
——Taking Qaidam Basin as an Example

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ABSTRACT
Based on the time series data of the green development policy of the Qaidam Basin in my country's resource-based region from 2011 to 2019, this paper uses the data envelopment analysis method to construct a super-efficient SBM-DDF model to measure and analyze the efficiency of the green development policy in this region. The research shows that: the efficiency of green development policies in the Qaidam Basin is around the optimal boundary, and the main influencing factors are too much investment in relevant policies, insufficient GDP growth rate and output, control the number of policies, actively adjust industrial transformation, and control government carbon emissions and atmospheric emissions. Pollution has become an important focus of green development in the Qaidam Basin in recent years.

Keywords: *SBM-DDF; Green Development Level; Policy Efficiency*

1. INTRODUCTION

In February 2021, the State Council issued the "Guiding Opinions on Accelerating the Establishment and Improvement of a Green, Low-Carbon and Circular Development Economic System", proposing multiple measures to promote green production, green circulation, green life and green consumption in the whole process. As China's "treasure basin", the Qaidam Basin contains a variety of mineral resources. It is the most dynamic area for economic and social development in Qinghai Province, supporting the economic and social development of Qinghai Province and protecting the Three Rivers Sources. In this context, analyzing and discussing the efficiency of green development policies is of great significance to promoting regional green development and ensuring the realization of low-carbon development.

2. LITERATURE REVIEW

Green development has become a hot issue in academic circles in recent years. Regarding the evaluation of green development efficiency in my country, most scholars have evaluated the green development efficiency of the study area through DEA, and found that there are differences in green development efficiency in different regions, and the problem of insufficient and unbalanced green development among cities in my country is still prominent [1-7]. Low-carbon pilot policies can stimulate the potential of regional green development, and the construction of low-carbon cities plays a significant role in improving the level of green development in the region [8].

Overall, the relationship between regional green development efficiency and carbon emissions has become a key area of green development research. However, from the perspective of research methods, most scholars use traditional DEA methods or SBM models to conduct regional green development efficiency research. According to the calculation, because the traditional directional distance has radial and directional characteristics of input and output, it will lead to the deviation of green policy efficiency from the actual value, which will affect the comparability of evaluation results. In view of this, this paper takes the Qaidam Basin as the research object, uses the non-radial and non-oriented SBM-DDF model to make up for the above shortcomings, and at the same time quantitatively

evaluates the efficiency of green development policies in the Qaidam Basin, and seeks for the economic transformation of resource-based regions. It provides a basis and reference for the development dilemma of the Qaidam Basin and resource-based cities across the country.

3. EVALUATION OF GREEN DEVELOPMENT POLICY EFFICIENCY IN QAIDAM BASIN

Combined with the current characteristics of the Qaidam Basin, it is concluded that the investment in the green development of the basin is mainly in three aspects: natural resource input, labor input and policy investment. The specific input indicators determined are: energy consumption per unit of GDP (X_1), number of green-related policies (X_2), labor input is the proportion of employed persons (X_3), green development index (X_4), and environmental protection expenditure per 10,000 yuan of GDP (X_5).

The selection of output indicators is mainly considered from the perspective of green and low carbon. Compared with general green output, it should cover relevant factors such as economic growth, industrial development and carbon emissions. Therefore, this paper uses the industrial structure advanced index (Y_1), GDP growth rate (Y_2), energy processing conversion rate (Y_3) and carbon productivity (Y_4) are the expected outputs of green development, government consumption carbon emissions (Z_1), household consumption carbon emissions (Z_2) and air pollution levels (Z_3) for unexpected output.

4. EVALUATION RESULTS OF GREEN DEVELOPMENT POLICY EFFECTS

In this paper, the SBM-DDF model [6] is used to evaluate the efficiency of green development policies in the Qaidam Basin. It is an improved model based on DEA, which overcomes the defects of angle and radial in the DEA model, and incorporates slack variables into the objective function, can clearly show the source of efficiency loss, that is, make a clearer definition of input and output.

Based on the SBM-DDF model, the 2011-2019 time series in Qaidam area was used as the decision-making unit to construct the technological frontier. Suppose x represents N inputs for each evaluation unit, $x = (x_1 \cdots x_N) \in R_N^*$; y denotes M expected outputs, $y = (y_1 \cdots y_M) \in R_M^*$, b denotes K undesired outputs output, $b = (b_1 \cdots b_K) \in R_K^*$; then (x^t, y^t, b^t) is the input-output data of the Qaidam Basin in period t, (g^x, g^y, g^b) is the direction vector, (s_n^x, s_m^y, s_k^b) is the relaxation vector of input and output. Then, the non-radial, non-guided slack-based directional distance function (SBM-DDF) in the Qaidam area is defined as follows:

$$\rho S_v^t(x^t, y^t, b^t g^x, g^y, g^b) = \frac{1}{3} max\left[\frac{1}{N}\sum_{n=1}^{N}\frac{S_n^x}{g_n^x} + \frac{1}{M}\sum_{m=1}^{M}\frac{S_m^y}{g_m^y} + \frac{1}{K}\sum_{k=1}^{K}\frac{S_k^b}{g_k^b}\right] \quad (1)$$

$$s.t\lambda Y - S_m^y = y_m^t, \tilde{m}; \lambda B + S_k^b = b_k^t, \tilde{k}; \lambda X + S_n^x = x_n^t, \tilde{n}; \quad (2)$$

$$\boldsymbol{\lambda} \geq 0, \boldsymbol{\lambda l} = \mathbf{1}; S_n^x \geq 0, S_m^y \geq 0, S_k^b \geq 0 \quad (3)$$

In order to comprehensively study the dynamic changes of green development efficiency in the Qaidam Basin, MaxDEA8.22 software is used for calculation. Before the software runs, the main specific settings of the model are that all input and output variables are set to "non-radial"; Set to "non-oriented" to calculate the green development efficiency value (without considering undesired output) and green policy efficiency value (with undesired output considered) in 2011-2019. The calculated result represents the green policy efficiency level of each evaluation unit. When the result is less than 1, it means that the Qaidam Basin is at an inefficient level in that year. The expected output or expected output is at an optimal level, that is, there are basically no problems such as excessive input, pollution discharge, and insufficient output. The specific results are shown in Table 1 and Table 2.

It can be found from Table 1 that during the period from 2011 to 2019 in the Qaidam Basin, the average green development efficiency without considering undesired outputs was 1.0603, and the average green policy efficiency when undesired outputs were considered was 1.0564. The policy efficiency decreased slightly, which shows that after considering the undesired output, the excessive resource input, carbon emission and the increase in air pollution caused the green policy efficiency in the Qaidam Basin to decrease slightly. Overall, the green development efficiency and green policy efficiency values in the Qaidam Basin from 2011 to 2019 were both greater than 1, indicating that the green development in this region was at a relatively good level in terms of input, expected output and undesired output. The degree of input, undesired output, insufficient expected output, etc. is low. Although the green development efficiency and green policy efficiency in the Qaidam Basin are at the optimal efficiency from 2011 to 2019, it does not mean that the green development and green policy in the region have absolutely good environmental regulation conditions, shows the development of the region in this year. In the process, green development and green policy have been given the top priority, with better green performance.

For the efficiency value shown in the year of green development efficiency considering the undesired output, through the projection of the production frontier, we can not only understand the use of its factor inputs, but also analyze the reasons for the change of its efficiency value, and determine its effect. The degree of attribute value

improvement and the ideal value of input and output, the results are shown in Table 2.

Table2 shows the performance of green development policy efficiency in slack variables from the perspectives of redundant input and insufficient output. The slack variables of input and undesired output are negative, the slack variable of expected output is positive, and MaxDEA The positive and negative of the slack variable in the middle represent the direction of improvement, that is, the positive sign represents an increase, and the negative sign represents a decrease.

From Table 1, it can be seen that the efficiency of green development policies in 2012, 2013, 2014, and 2019 was lower than the average. From the in-depth analysis of Table 2, it can be seen that in the above years, there were mainly too many policies and more investment in green development, etc. The reasons are insufficient carbon productivity and high levels of air pollution.

In-depth analysis can be seen that the redundancy rate of relevant policies in terms of investment is the highest, reaching 33.3%, and the redundancy rate has risen significantly in 2018-2019, reaching a peak of 99% in 2013, and the amount of environmental protection expenditure per 10,000 yuan of GDP is redundant. The surplus rate is the lowest at 2%, while the employment shortage has always existed from 2011 to 2019, only 0 in 2013; in terms of expected output, the GDP growth rate is the highest, and at the same time, the corresponding policy redundancy Under the condition that the expected output is insufficient, the undesired output appears as the output redundancy, which further indicates that the green development policy efficiency of the Qaidam Basin is an effective value from 2011 to 2019. From Table 2, it can be seen that the degree of insufficiency of energy processing conversion rate is the lowest, and the carbon emission redundancy rate of household consumption is the lowest, indicating that the focus of improving the efficiency of green development policies in the basin is not to improve the conversion rate of energy processing, but to increase GDP growth through regional industrial transformation. Rate. In 2019, the redundancy rate of air pollution levels in undesired outputs was as high as 214%, becoming a major factor restricting the efficiency of green development policies.

Table 1. Efficiency level of green development policies in the Qaidam Basin

Years	Efficiency level of green development without considering undesired outputs	Green Policy Efficiency Level Considering Undesirable Outputs
2011	1.0716	1.062
2012	1.0356	1.0095
2013	1.005	1.0205
2014	1.0299	1.0218
2015	1.0131	1.0684
2016	1.0615	1.1102
2017	1.0783	1.0604
2018	1.0517	1.1498
2019	1.1965	1.0053
Mean	1.0603	1.0564

Table 2. Input-output Slack in green development policy efficiency in the Qaidam Basin from 2011 to 2019

Years	Input Slack variable					Onput Slack variable						
						Expected Output				Undesired Output		
	X_1	X_2	X_3	X_4	X_5	Y_1	Y_2	Y_3	Y_4	Z_1	Z_2	Z_3
2011	-0.199	0	-0.061	0	0	0	1.011	0	0.141	-0.159	0	-0.548
2012	0	0	-0.014	-0.061	0	0.029	0	0	0.068	-0.085	-0.002	-0.583
2013	0	-0.99	0	-0.045	0	0	0	0.001	0	0	0	-0.028
2014	-0.102	-0.7	-0.013	0	-0.002	0.033	0	0.002	0	-0.007	-0.005	0
2015	0	0	-0.117	0	-0.01	0.056	0	0.001	0	0	-0.002	0

2016	0	-0.342	-0.03	0	0	0.137	4.606	0	0	0	0	0
2017	-0.051	0	-0.193	-0.094	0	0.028	1.844	0.002	0	0	-0.006	-0.996
2018	0	-0.537	-0.006	-0.086	0	0.06	3.984	0	0.06	-0.017	0	0
2019	0	-0.425	-0.09	-0.058	-0.006	0	0	0	0.03	-0.78	-0.027	-2.14
Mean	-0.039	-0.333	-0.058	-0.038	-0.002	0.038	1.272	0.001	0.033	-0.116	-0.005	-0.477

5. CONCLUSION

Overall, the efficiency of green policies in the Qaidam Basin is around the optimal boundary. From the perspective of investment, the over-investment in the number of relevant policies is the main factor, accounting for 33%; from the perspective of output, the industrial structure is not sufficiently advanced, Insufficient GDP growth rate after 2016 and consumption carbon emissions and air pollution are the main reasons affecting the efficiency of green policies in the Qaidam Basin.

However, the efficiency of green policy decreased slightly after considering the undesired output, reflecting the influence of resource input and pollutant discharge on policy efficiency. Through the analysis of input and output slack variables, it is found that the resource input redundancy rate in the Qaidam Basin is high, the GDP growth rate and the industrial structure advanced index in the expected output are still insufficient, and government consumption carbon emissions and air pollution Material is the main factor affecting the efficiency of green policy.

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