Construction and empirical study of the evaluation index system for high-quality development of marine economy in Guangdong Province based on five new development concepts

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Abstract. The ocean is a strategic place for high-quality development. In-depth evaluation of the quality of Marine economic development is of great guiding significance for implementing the five new development concepts and promoting the sustainable and healthy development of Marine economy. On the basis of introducing the connotation of high-quality development of Marine economy and the five new development concepts, it tried to construct an evaluation index system for the high-quality development of the Marine economy that includes 12 evaluation dimensions and 12 indicators. The results show that: from the overall level of high-quality development of Marine economy, the high-quality development of Marine economy in Guangdong province shows a steady upward trend. The index weight of green development is the largest, which has the greatest impact on the high-quality development of Guangdong's Marine economy. Based on the implementation of the five development concepts, the paper puts forward the countermeasures and suggestions for the high-quality development of Marine economy in Guangdong province.

1. Introduction

In the 21st century, with the development of Marine industry, the ocean has become more and more important for the survival and development of human society. The development level of the Marine economy is an important manifestation of the ability to develop, utilize, control and protect the ocean. "High-quality development of Marine economy" is a new concept that has emerged in recent years, there are not many domestic studies on "high-quality development of the marine economy". Ding lili elaborated the connotation of high-quality development of Marine economy from the three dimensions of "object-concept-level"[1]. Lu Yayun and others believe that the high-quality development of the marine economy refers to the sustainable development that can meet people's needs for a better life in the impact and distribution of production activities related to marine development and the outcomes[2]. Zhao Hui and others studied the inherent essence of high-quality development of Tianjin's marine economy from five aspects: marine resource endowment, marine industrial structure, marine scientific and technological innovation, Open and shared oceans [3]. And use the analytic hierarchy process (AHP) to establish the high quality development index system
of Tianjin marine economy. Based on the "Five New Development Concepts", Yu Tianyu and others established the marine economic growth quality index system using principal component analysis, and evaluated the comprehensive level of marine economic growth quality in various regions [6]. Overall, the current research on the establishment of a high-quality evaluation index system for the marine economy is relatively simple. Moreover, there is no research on the high-quality development index system of marine economy specifically established for the characteristics of marine economic development in Guangdong Province. Guangdong is a large marine province, studying the evaluation system for the high-quality development of the marine economy in Guangdong Province is of great significance for studying the high-quality development of the national marine economy.

2. Construction of evaluation index system

2.1. The connotation of high quality

High-quality development is a development that can well meet the people's growing needs for a better life, and is a development that reflects the five new development concepts. Innovation has become the first driving force for development; coordination has become an endogenous characteristic of development; green has become a universal form of development; openness has become the only way for development; sharing has become the fundamental purpose of development.

2.2. Characteristics of Marine economic development in Guangdong

Guangdong is a large marine province with abundant marine resources. The sea area of Guangdong is 420,000 square kilometers, which is 2.3 times the land area, accounting for 14% of the national sea area; the mainland coastline is 4,114 kilometers, the largest in China. There are 1,431 islands and more than 510 bays, which are rich in Marine transportation, Marine life, Marine minerals and coastal tourism. Key Marine industries include Marine fishery, Marine engineering equipment manufacturing, Marine oil and gas, Marine biology, offshore wind power, as well as Marine transportation, coastal tourism and other Marine services.

2.3. High quality development index system of Marine economy in Guangdong province

Based on the five new development concepts, an evaluation index system of high quality development of Marine economy is constructed, which includes 12 evaluation dimensions and 12 specific indicators. As shown in Table 1.

Table 1. Indicator system of high-quality development of Marine economy in Guangdong province.

| Category     | Evaluation dimensions                        | The evaluation index                                      | Index attribute |
|--------------|----------------------------------------------|-----------------------------------------------------------|-----------------|
| Innovation   | Innovation investment                        | Funding for Marine scientific research                    | positive        |
|              | Basic conditions for research and development| Number of sea-related researchers                          | positive        |
|              | Innovation ability level                     | The number of academic papers related to sea              | positive        |
|              | The industrial structure                     | Proportion of marine tertiary industry                    | positive        |
|              | Integrated Marine management service level    | The proportion of added value of Marine technology management service industry | positive |
|              | Steady economic growth                       | Growth rate of Marine economy                             | positive        |
| Green        | Environmental protection                     | Number of wastewater and solid waste treatment projects   | positive        |
|              | Environmental pollution                      | Total amount of industrial wastewater and pollutants entering the sea | Reverse        |
3. Data processing and analysis

3.1. Evaluation method
This paper adopts the high quality development index system of Marine economy constructed above, the entropy method was used to empirically evaluate the development quality of Marine economy in Guangdong province from 2015 to 2017. The specific steps are as follows:

Dimensionless treatment. This system involves 3 years and 12 indexes, Let m denote the year and n denote the index, \( X_{ij} \) represents the measured value of the jth indicator in the ith year, \( 0 \leq i \leq 3, 0 \leq j \leq 12 \). For the positive index, formula (1) is used for dimensionless treatment, for the negative index, formula (2) is used for dimensionless treatment.

\[
X'_{ij} = \frac{X_{ij} - \min(X_{1j}, X_{2j}, ..., X_{nj})}{\max(X_{1j}, X_{2j}, ..., X_{nj}) - \min(X_{1j}, X_{2j}, ..., X_{nj})} \quad (1)
\]

\[
X'_{ij} = \frac{\max(X_{ij}, X_{2j}, ..., X_{nj}) - X_{ij}}{\max(X_{1j}, X_{2j}, ..., X_{nj}) - \min(X_{1j}, X_{2j}, ..., X_{nj})} \quad (2)
\]

Calculate the contribution of the ith year under the jth indicator. Which is the ratio of the index j in the ith year.

\[
P_{ij} = \frac{X'_{ij}}{\sum_{i=1}^{m} X'_{ij}} \quad (3)
\]

Calculate the entropy of the jth indicator. The entropy value is used to reflect the amount of information of the jth indicator.

\[
e_j = -\frac{1}{\ln m} \sum_{i=1}^{m} P_{ij} \ln P_{ij} \quad (4)
\]

The entropy weight method determines the index weight. The calculation formula of entropy weight is:

\[
W_j = \frac{1-e_j}{n \cdot \sum_{j=1}^{n} e_j} \quad (5)
\]

Calculate the composite score. Weighted sum of the non-dimensionalized values of different indicators in each year, get a composite score \( F_t \). The higher the score, the better the quality of Marine economic development that year\([4]\).

\[
F_t = \sum_{j=1}^{n} W_j X'_{ij} \quad (6)
\]

3.2. The empirical analysis
The index data of the evaluation system is derived from China Marine statistics yearbook, Statistical bulletin of China's Marine economy, and Statistical bulletin on Guangdong's national economic and social development. Some index data need to be processed through the relevant yearbook data.

3.2.1. Index weight analysis. According to the above calculation method, the weights of the indicators of high-quality development of Marine economy in Guangdong are shown in table 2.

| Table 2. Weight of indicators for high-quality development of Marine economy in Guangdong province. |
|---------------------------------------------------------------|
| First-level indicators | Weight | Secondary indicators | Weight |
|------------------------|---------|-----------------------|---------|
| Innovation             | 0.199   | Innovation investment | 0.069   |
|                        |         | Basic conditions for research and development | 0.07    |
|                        |         | Innovation ability level | 0.06    |
It can be seen from table 2 that in the indicator system of high-quality development of Marine economy in Guangdong province, the index weight of green development is 0.322, which is the largest of all indicators. It highlights the importance of the development concept of "green water and green mountains are gold and silver mountains" for the high-quality development of Guangdong's Marine economy. It also shows that green development has a great influence on the high-quality development of Marine economy in Guangdong province.

The weight of coordinated development is 0.201, Second only to green development. It shows that coordinated development has a great impact on the high-quality development of Marine economy in Guangdong province, the main reason is that the development level of Marine economy varies greatly among the cities under the jurisdiction of Guangdong province. The weight of innovation development is 0.199, It's not that different from the weight of coordinated development. It shows that innovation is the primary driving force for high-quality development, is the key to quality development. Open and Shared development have less weight, but they also hit 0.14 and 0.137, it shows that openness and sharing is also an essential connotation in the high-quality development of Marine economy in Guangdong province. High-quality development of the Marine economy can boost the employment of residents in coastal cities. At the same time, higher incomes and employment rates could also promote high-quality development of the Marine economy.

3.2.2. Comprehensive score analysis. The comprehensive scores of Marine economic development in each year calculated by the entropy method are shown in table 3.

Table 3. Comprehensive scores of high-quality development of Marine economy in Guangdong province from 2015 to 2017.

|        | Innovation | Coordinate | Green | Openness | Sharing | High-quality development |
|--------|------------|------------|-------|----------|---------|-------------------------|
| 2015   | 0.077      | 0.078      | 0.125 | 0.054    | 0.053   | 0.3878                  |
| 2016   | 0.0957     | 0.0967     | 0.155 | 0.067    | 0.066   | 0.4812                  |
| 2017   | 0.0977     | 0.0987     | 0.158 | 0.0687   | 0.0673  | 0.4912                  |

As can be seen from table 2, the high-quality development index of Marine economy in Guangdong province shows a slow increasing trend. On the whole, the development indexes of the five indicators all showed a steady growth trend from 2015 to 2017. Among them, green development has the highest growth index. The development index of innovative development grew the fastest between 2015 and 2016, this is related to the increased investment in marine economic research in Guangdong Province. In 2015, the scientific research funding of Guangdong's Marine economy was 121,398 thousand yuan, it increased to 250,194 thousand yuan in 2016, the number of sea-related researchers also increased from 3,835 in 2015 to 5,434 in 2016. The index of open development and shared development shows steady growth, It fully reflects the nature of Guangdong as the frontier of reform and opening up.

4. Countermeasures and suggestions

According to the above research conclusions, combining with the characteristics of the development of Guangdong's Marine economy, the following policy recommendations are put forward:

4.1. Replace old growth drivers with new ones to improve the structure of the Marine industry.
Replacing old growth drivers with new ones is a process of upgrading the industrial structure\(^4\). Although the proportion of Marine economy tertiary industry in Guangdong province has been rising steadily, the overall industrial structure is still not good. It should focus on developing new growth drivers to adapt to the new economy, to make a continuous optimization of industrial structure. Reduce the differences in the level of marine economic development in the cities under their jurisdiction, to promote the development of areas that are relatively backward and the coordinated development of the provincial Marine economy.

4.2. **Innovate the green development model of marine economy.**

The index weight of green development takes the largest proportion in the index system of high-quality development of Marine economy in Guangdong. Therefore, it should attach importance to green development, strengthen marine environmental protection. Encourage the development of a green economy and low carbon economy. Vigorously develop low energy consumption and low emission marine industry. Promote energy saving and emission reduction in high energy consumption industries, strengthen the protection, repair and restoration of the Marine environment, eliminate industries that are low in efficiency, high in energy consumption, and high in pollution.

4.3. **Adhere to innovation-driven development, increase investment in scientific research.**

From the above analysis results, increasing investment in Marine research can lead to a significant increase in the innovative development index, promote the high-quality development of Guangdong's marine economy. Therefore, the investment in Marine scientific research and innovation should be increased, introduce marine science and technology innovative enterprises. Encourage and support enterprises to set up research and development centers, support core technology research in key areas.

5. **Conclusions**

Based on the construction of a high-quality evaluation index system for the development of the marine economy in Guangdong Province, using the relevant data of the marine economy in Guangdong Province from 2015 to 2017, and using the entropy method for analysis, the conclusion is as follows:

First, from the analysis of indicator weights, green development has the largest index weight, indicating that green development has a great influence on the high-quality development of the marine economy in Guangdong Province. The weight of coordinated development is second only to green development. The main reason is that the differences in the level of marine economic development in the cities under the jurisdiction of Guangdong are quite different.

Secondly, from the comprehensive score analysis, the Guangdong marine economic high-quality development index shows a slow increasing trend as a whole. Among them, the development index of green development is the highest, and the change of innovation development index is very sensitive to the changes of the investment in marine economic research. The index of open development and shared development also show a slow increasing trend.

There are many factors that affect the high-quality development of the marine economy. Due to the complexity of the influencing factors and the lack of data, a comprehensive index system reflecting the high-quality development of the marine economy in Guangdong Province cannot be established in the study. In the future, the comprehensiveness of the index system needs to be further studied.

**Acknowledgement**

This work is funded by Guangdong Province Special Fund Project for Promoting High-Quality Economic Development "Jiangmen Marine Economic Operation Monitoring and Evaluation System" (GDNRC [2020]069).

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