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Evaluation of High Quality Development of Marine Economy in Zhejiang Province Based on Entropy Weight TOPSIS Model

Jie Zhou [1,*] , Yutong Wang [2]

[1]School of Statistics and Applied Mathematics, Anhui University of Finance and Economics, Bengbu 233030, China;

[2]School of Law, Anhui University of Finance and Economics, Bengbu 233030, China.

*Corresponding author Email: JazzChou0909@163.com

Abstract: In order to evaluate the high-quality development of marine economy in Zhejiang Province and find out the key factors affecting the high-quality development, this paper selects 20 indicators from marine resources system, marine environment system and socio-economic system to construct the evaluation index system of high-quality development of marine economy, the entropy weight TOPSIS model is used to evaluate the marine economic development and the development of the three subsystems in Zhejiang Province from 2010 to 2017, then the coupling coordination degree model is used to describe the coordinated development of the three subsystems, and the obstacle factors affecting the high-quality development of marine economy in Zhejiang Province, marine resources, marine environment and socio-economic coordinated development are diagnosed through the obstacle degree model. The results show that the overall evaluation score of high-quality development index of marine economy in Zhejiang Province is not high, which is at the medium level; The coordination degree of 3 subsystems is low, and the coupling coordination degree is around the imbalance level; The main obstacle factors affecting the high-quality development of marine economy in Zhejiang Province are the throughput of coastal ports, the massive discharge of industrial wastewater, the output of marine chemical products, the total import and export volume and the total discharge of industrial waste gas. Based on the above conclusions, some suggestions on rational development of marine resources and protection of marine environment are put forward in order to improve the high-quality development level of marine economy in Zhejiang Province.

Keywords: High quality development of marine economy, entropy weight TOPSIS model, coupled co scheduling, obstacle model.

1. Introduction

With the rapid development of science and technology, human activities gradually enter the ocean from the land, marine resources have been vigorously developed, and marine economy has begun to become one of the new economic growth points. However, the problem of environmental protection in coastal areas has gradually emerged because of inappropriate development. In order to realize the overall planning of land and sea, we must first realize the stable economic development of coastal cities, the effective utilization of resources and the sustainable development of marine environment.

As one of the main key areas of marine economic development in China, Zhejiang Province has a sea area of 260000 square kilometers, which provides a broad space and rich resources for the development of marine industry in Zhejiang Province, including port resources, marine mineral resources, marine chemical resources, tourism resources and fishery resources[1]. In addition, Zhejiang Province has nearly 3000 islands with a coastline of 6696 kilometers, including 506 kilometers of port deep water line, ranking first in China. Therefore, the high-quality development of marine economy in Zhejiang Province is not only of great significance to the economic development of the province, but also has an important impact on the whole country. However, under such a broad prospect, Zhejiang Province is always facing problems such as dense population, shortage of resources and marine environmental pollution. The contradiction between population, resources and environment has become the key factor in the development of marine economy in Zhejiang Province. Therefore, to evaluate the high-quality development of marine economy in Zhejiang Province is helpful to analyze and regulate the relationship between marine resources, marine ecological environment and economic development in Zhejiang Province, and to promote the integrated development of marine economy in the Yangtze River Delta[2]. With the development of science and technology, since entering the 21st century, China's marine economy has also taken off rapidly, and its average annual growth rate is higher than the national average growth rate in the same period. However, the blind pursuit of economic indicators has led to a serious imbalance of marine ecological environment in coastal areas. Therefore, it is very important to analyze and evaluate the high-quality development of marine economy[3].

Aiming at the problems of air pollution, marine pollution and marine ecological environment damage in Zhejiang Province, this paper establishes an index system from the ternary system of marine resources, marine environment and social economy,

quantitatively evaluates the high-quality development of marine economy in Zhejiang Province by using entropy weight TOPSIS model, and then uses the coupling coordination degree model to analyze the marine resources system The three subsystems of marine environment system and socio-economic system are analyzed for coupling and coordination, the coordinated development of the ternary system of high-quality development of marine economy in Zhejiang Province is analyzed, and the obstacle degree model is used to diagnose the obstacle factors affecting the coordinated development of marine resources, marine environment and socio-economy in high-quality development of marine economy in Zhejiang Province, It provides a basis for the government to take targeted measures to promote coordinated development.

2. Model Building

All data in this paper are from *Zhejiang Statistical Yearbook*, *China Marine Statistical Yearbook*, *China Environmental Statistical* Yearbook and *China Statistical Yearbook from 2010 to 2017*.

Establishing a scientific, rich and targeted evaluation index system is very important to the evaluation of high-quality development of marine economy[4]. Based on the principles of scientificity, representativeness, generality and regional particularity, this paper constructs a scientific index selection process[5]. The specific process includes:

Establishing an alternative index database.

Screening indicators according to the characteristics of the evaluation area.

Combined with the availability of data and based on the analysis of historical data, the final index system is constructed.

In the evaluation of the high-quality development of marine economy, most of the index systems are still obtained by learning from the evaluation of the coordinated development of land economy and ecology[6]. Therefore, combined with the current situation of marine resources and ecological environment and the characteristics of economic development of coastal cities, this paper constructs the corresponding evaluation index system. For example, in terms of marine resources, sea area, coastline and marine industry output are selected as indicators to reflect the potential and development status of marine resources; In terms of marine environment, the proportion of class I or II seawater area and the massive discharge of industrial wastewater are selected as indicators to reflect the marine environment; In terms of social economy, the output value of marine industry and the proportion of tertiary industry of marine industry are selected as indicators to reflect the current situation of marine economic development[7].

This paper establishes a selectable index database from three systems: marine

resources, marine environment and social economy. Under the marine resources system, there are four secondary indicators: marine chemical mineral resources, marine space resources, marine resource supply capacity and water resources; Three secondary indicators of atmospheric environment, marine environment and land environment are set under the marine environment system; Under the socio-economic system, there are two secondary indicators: population index and economic index.

When establishing the selectable index database under the secondary index, we mainly consider the availability of data, select the index that can specifically reflect the current situation of Zhejiang Province and describe the highest frequency of each single element as the alternative index, and finally build the evaluation index system for the high-quality development of marine economy in Zhejiang Province, as shown in Table 1.

Table 1 Evaluation index system of high quality development of marine economy in Zhejiang Province

One grade index	Two grade index	Specific index	Unit	Index attribute
marine resources system	marine chemical and mineral resources	marine mining output A1	10 kilo-tons	+
		Output of marine chemical products A2	10 kilo-tons	+
	marine space resources	area of confirmed sea area A3	hm^2	+
		per capita shoreline retention A4	Km / 10 thousand people	+
	supply capacity of marine resources	coastal port throughput A5	10 kilo-tons	+
		mariculture area A6	Khm^2	+
	water resource	total water resources A7	100 million standard cubic meters	+
marine environmental system	atmospheric environment	average annual concentration of PM10 B8	10 kilo-tons	-
		average annual concentration of SO_2 B9	10 kilo-tons	-
		average annual concentration of NO_X B10	10 kilo-tons	-
	marine environment	industrial wastewater is discharged into massive B11	10 kilo-tons	-
		total industrial waste gas emission B12	100 million standard cubic meters	-
	terrestrial environment	area of Nature Reserve B13	Square kilometer	+
		forest coverage B14	%	+

socio economic system	population	population density C15	people / km2	-
		tourist reception C16	10 thousand person times	-
	economics	total imports and exports C17	Ten thousand yuan	+
		per capita GDP C18	yuan	+
		output value of tertiary industry C19	million yuan	+
		output value of marine industry C20	million yuan	+

In this paper, all indicators are divided into two categories. One is positive indicators, that is, the larger the value, the better; The other is negative indicators, that is, the smaller the value, the better. This paper has 13 positive indicators such as the output of marine mining and marine chemical products, 7 negative indicators such as the average annual concentration of PM10 and the average annual concentration of SO_2, a total of 20 influencing factors.

2.1 Entropy Weight TOPSIS Model.

In view of the characteristics of many data types, disorder and large amount of data of the evaluation indicators for the high-quality development of marine economy in Zhejiang Province, this paper uses the entropy weight TOPSIS model to evaluate the high-quality development of marine economy in Zhejiang Province[8]. Entropy weight method can effectively avoid the disadvantage of too strong subjectivity in quantitative analysis, while TOPSIS model can accurately evaluate the high-quality development of marine economy in Zhejiang Province in different years by quantitatively measuring the distance between different data and the optimal value, and then select the optimal solution from several limited schemes . Firstly, this paper uses the entropy weight method to determine the weight of each index, constructs the weighting matrix, and then uses TOPSIS model to evaluate and analyze the high-quality development of marine economy in Zhejiang Province.

(1) Determine target sequence. The original data matrix is constructed from 20 marine economic high-quality development evaluation indicators from 2010 to 2017. Due to different data dimensions, it is necessary to standardize the original data matrix.

Positive indicators:

$$x_{ij} = \frac{X_{ij} - \min\left(X_{ij}\right)}{\max\left(X_{ij}\right) - \min\left(X_{ij}\right)}, \tag{1}$$

Negative indicator:

$$x_{ij} = \frac{\max\left(X_{ij}\right) - X_{ij}}{\max\left(X_{ij}\right) - \min\left(X_{ij}\right)}, \tag{2}$$

Where: X_{ij} is the initial value of the NO. i index in the NO. j year; x_{ij} is the standardized value of the NO. i index in the NO. j year; i is the number of evaluation indicators, $i = 1, 2, \cdots, m$; j is the number of evaluation years, $j = 1, 2, \cdots, n$. The standardized matrix A is obtained after formula calculation:

$$A = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix}. \tag{3}$$

Entropy weight method to calculate weight. The entropy weight method can effectively take into account the variation degree of the evaluation index and objectively reflect its importance. The calculation formula of entropy weight is:

$$w_i = \frac{1 - e_i}{m - \sum_{i=1}^{m} e_i}, \tag{4}$$

Where: w_i is the index weight of high-quality development of marine economy; e_i is information entropy. The lower the entropy, the more orderly the system is, and the higher the entropy, the more chaotic or dispersed the system is.

$$e_i = -\frac{1}{\ln n} \sum_{j=1}^{n} f_{ij} \ln f_{ij} = 0 \tag{5}$$

Where $f_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}}$, if $f_{ij} = 0$, then $\lim_{f_{ij} \to 0} f_{ij} \ln f_{ij} = 0$.

Build TOPSIS Model. In order to increase the objectivity of the matrix, this paper creates a standardized evaluation and analysis matrix Y for the high-quality development of marine economy according to the weight w_i determined by the entropy weight method:

$$Y = \left|\gamma_{ij}\right|_{m \times n} = \left|w_i \times x_{ij}\right|_{m \times n}. \tag{6}$$

Determining Positive and Negative Ideal Solutions. Positive ideal solution Y^+ is the optimal solution of each index in the analysis of high-quality development of marine economy, which is the maximum value of the NO. i index in the evaluation data in NO. j year ; negative ideal solution Y^- is the worst solution of each index in the analysis of high-quality development of marine economy, and it is the minimum value of the NO. i index in the evaluation data in NO. j year. The specific calculation formula is:

$$Y^{+}=\max\left\{\gamma_{ij}\right\}, \tag{7}$$

$$Y^{-}=\min\left\{\gamma_{ij}\right\}. \tag{8}$$

Calculate Distance. In this paper, Euclidean distance is used to calculate the distance from each index of high-quality development of marine economy to positive and negative ideal solutions. Let D_j^{+} represent the distance between the NO.i index and y_i^{+}, and D_j^{-} represent the distance between the NO.i index and y_i^{-}. The specific calculation formula is:

$$D_j^{+}=\sqrt{\sum_{i=1}^{m}\left(y_i^{+}-\gamma_{ij}\right)^2}, \tag{9}$$

$$D_j^{-}=\sqrt{\sum_{i=1}^{m}\left(y_i^{-}-\gamma_{ij}\right)^2}. \tag{10}$$

Calculate the comprehensive evaluation index of high-quality development of marine economy. C_j is the comprehensive evaluation index of high-quality development of marine economy in NO. j year, and the value range is $[0,1]$. When $C_j=0$, it indicates that the high-quality development of marine economy in this region is the worst; When $C_j=1$, it shows that the high-quality development of marine economy in this region is the best.

$$C_j=\frac{D_j^{-}}{D_j^{+}+D_j^{-}}. \tag{11}$$

2.2 Coupling Coordination Degree Model.

The degree of coupling and coordination describes the degree of interaction between two or more systems, and the degree of coupling and coordination determines the development of the system; Based on the capacity coupling coefficient model, this paper constructs the coupling coordination degree model of marine resources, marine environment and social economy for the high-quality development of marine economy in Zhejiang Province[9]. The formula is as follows:

$$E=\left\{\frac{f(x)\times g(y)\times h(z)}{\left[\frac{\left(f(x)+g(y)+h(z)\right)}{3}\right]^3}\right\}^{1/3} \tag{12}$$

$$T=\alpha f(x)+\beta g(y)+\delta h(z) \tag{13}$$

$$H=E\times T \tag{14}$$

Where: E is the coupling degree; $f(x)$、$g(y)$ and $h(z)$ are the comprehensive evaluation values of marine resources, marine environment and socio-economic subsystems, also known as development index; T is the comprehensive development index of the three subsystems; α、β and δ are the adjustment coefficients of marine resources, marine environment and socio-economic subsystems respectively. This paper considers that marine resources, marine environment and socio-economic subsystems are equally important, so $\alpha=\beta=\delta=\frac{1}{3}$； H is the coordination degree, indicating the coordinated development degree of the three subsystems.

2.3 Obstacle Model.

The obstacle degree model is used to diagnose the obstacle factors affecting the high-quality development of marine economy in Zhejiang Province, marine resources, marine environment and socio-economic coordinated development, which is conducive to the government to take targeted measures to promote coordinated development[10]. The specific calculation steps are as follows:

$$w_i = r_i \times w_\mu \tag{15}$$

$$P_j = 1 - X_{ij}^{'} \tag{16}$$

$$A_{ij} = \frac{P_j \times \omega_j}{\sum_{j=1}^{20}\left(P_j \times \omega_j\right)} \times 100\% \tag{17}$$

Where: R_j is the factor contribution; r_j is the weight value of the NO. j index; w_i is the weight value of the indicator layer where the NO. i indicator is located; P_j is index deviation; $X_{ij}^{'}$ is the standardized value of the NO. j index; A_{ij} is the obstacle degree.

3. Model Solution

3.1 Evaluation and Analysis of High-Quality Development of Marine Economy.

Use formula (1) and formula (2) to standardize the original data and construct the standardization matrix, then use formula (4) to determine the weight of each index and construct the weighting matrix at the same time. Combined with the weighting matrix, the evaluation index of high-quality development of marine economy in Zhejiang Province from 2010 to 2017 is calculated according to equations (6) ~ (11), as shown in Table 2.

Table 2 Evaluation results of high-quality development of marine economy in Zhejiang Province from 2010 to 2017

Particular year	Marine resources system development index	Marine environmental system development index	Socio economic system development index	High quality development index of marine economy
2010	0.612	0.223	0.545	0.419
2011	0.444	0.242	0.559	0.339
2012	0.707	0.294	0.516	0.370
2013	0.376	0.319	0.483	0.278
2014	0.509	0.329	0.456	0.324
2015	0.549	0.387	0.548	0.367
2016	0.461	0.553	0.491	0.437
2017	0.402	0.800	0.478	0.638

As can be seen from Fig. 1, the high-quality development of marine economy in Zhejiang Province from 2010 to 2017 generally showed a development trend of "decline rise decline rise". Specifically:

(1) From 2010 to 2011, the high-quality development index of marine economy in Zhejiang Province showed a downward trend. During this period, the development of marine economy in Zhejiang Province was sluggish and the output of marine chemical minerals increased, but the area of sea area and the total amount of water resources confirmed decreased. With the vigorous development of marine resources, the emission of precipitation pollutants and population density increased under the quality of atmospheric environment, As a result, the high-quality development index of marine economy decreased by 19.1%.

(2) From 2011 to 2012, the high-quality development index of marine economy in Zhejiang Province showed an upward trend. During this period, the output of marine chemical products increased significantly, the throughput of coastal ports continued to grow steadily, and the area of authorized sea area also increased significantly, but it is still lower than the level in 2010. The total import and export volume, per capita GDP, output value of tertiary industry and output value of marine industry increased steadily "12th Five Year Plan" During this period, the Zhejiang provincial government attached great importance to marine environmental protection. The average annual concentration of PM10 and the discharge of industrial wastewater into large quantities decreased significantly. However, during this period, the contradiction between marine resources and environment and socio-economic development in Zhejiang Province was particularly prominent. Under the condition of high per capita GDP, the proportion of

tertiary industry and the output value growth rate of marine industry, the number of tourist reception doubled, which put pressure on the environment Force has a great impact.

(3) From 2012 to 2013, the high-quality development index of marine economy in Zhejiang Province showed a downward trend, the output of marine mining industry decreased significantly, and the area of the sea area for the confirmation of rights also decreased significantly. Although the output of marine chemical products, the throughput of coastal ports, per capita GDP, the output value of tertiary industry and the output value of marine industry increased steadily year by year, the increasing population density and the number of tourists still gave rise to Zhejiang The high-quality development of marine economy in Zhejiang Province has caused great pressure.

(4) From 2013 to 2017, the high-quality development index of marine economy in Zhejiang Province showed a steady growth trend. During this period, the growth rate of marine mineral and chemical output in Zhejiang Province slowed down, the development of resources with great impact on the environment was controlled, the discharge of PM10, SO2, NO_X and industrial wastewater was controlled, the effect was good, the discharge decreased significantly year by year, the marine environment was protected, and the marine economy was high-quality development is relatively stable and increasing.

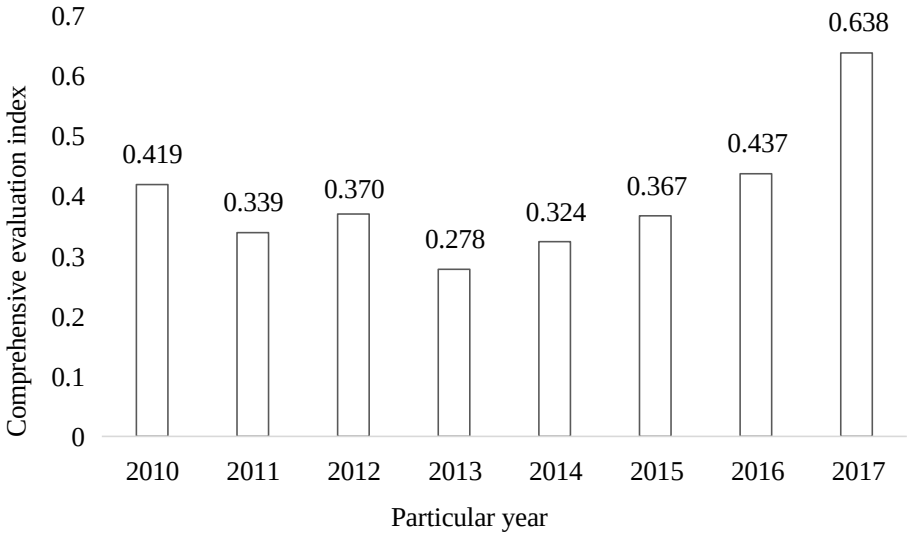

Fig.1 Evaluation results of high-quality development of marine economy in Zhejiang Province

3.2 Analysis on Coupled and Coordinated Development of Marine Economy.

The coupling coordination degree model is used to calculate the coupling degree and coordination degree of marine resources, marine environment, society and economy in Zhejiang Province (Table 3). It can be seen from table 4 that the coupling degree of marine resources, marine environment and socio-economic in Zhejiang Province

has been stable at about 0.95 in the past 8 years, which is in a high-level coupling stage, indicating that there is a close interdependence and interaction between the development of marine resources, marine environment and socio-economic subsystems in Zhejiang Province, but the low coordination index leads to low coupling and coordination scheduling in each year, For example, in 2013, the coupling degree of marine resources, marine environment and socio-economic in Zhejiang Province was 0.985, but the comprehensive development index was only 0.393, resulting in a low degree of coordination, which was only 0.387. Therefore, a high level of coupling does not represent a high level of comprehensive development index and a high level of coordination.

Table 3 Analysis results of coupled and coordinated development of ternary system of marine economy in Zhejiang Province

Particular year	Coupling value C	Comprehensive development index value T	Coordination value D	Coupling coordination degree
2010	0.914	0.460	0.421	on the verge of disorder
2011	0.944	0.415	0.392	mild disorder
2012	0.940	0.506	0.475	on the verge of disorder
2013	0.985	0.393	0.387	mild disorder
2014	0.984	0.431	0.424	verge of disorder
2015	0.987	0.495	0.488	verge of disorder
2016	0.997	0.502	0.500	barely coordination
2017	0.957	0.560	0.536	barely coordination

In 2010, the coupling degree of marine resources, marine environment and socio-economic in Zhejiang Province was 0.914, the comprehensive development index was 0.460, the coordination degree was 0.421, and the coupling coordination degree was close to imbalance; In 2011, the value of marine resources marine environment socio-economic coupling degree in Zhejiang Province increased to 0.944, while the comprehensive development index decreased by 9.8%, resulting in a decrease of 6.9% in coordination degree and a slight imbalance in coordination degree; In 2012, the value of marine resources marine environment socio-economic coupling degree in Zhejiang Province decreased slightly, and the comprehensive development index

increased by 21.9%, so the value of coordination degree also increased by 21.2%; In 2013, the coupling degree of marine resources, marine environment and socio-economic in Zhejiang Province increased slightly, but the comprehensive development index decreased significantly, resulting in a decrease in the degree of coordination and a slight imbalance; From 2014 to 2017, the coupling degree of marine resources, marine environment and socio-economic in Zhejiang Province was relatively stable, and the comprehensive development index increased year by year. Therefore, the degree of coordination also increased year by year, and the degree of coordination increased to barely coordination. With the proposal of relevant policies in recent years, the development of marine resources marine environment socio-economic system tends to be balanced, and the degree of marine resources marine environment socio-economic coupling system shows an upward trend.

3.3 Analysis on Key Factors of High-Quality Development of Marine Economy. Using the obstacle degree diagnosis model, calculate the obstacle degree value of each subsystem in each year (Fig. 2) and the top 5 obstacle factors in each year (Table 5). It can be seen from Figure 3 that the three subsystems have great differences in coordinated development. From 2010 to 2012, the obstacle degree values of the three subsystems fluctuated. On the whole, the obstacle degree of the marine environment subsystem was large, while the obstacle degree of the socio-economic subsystem was small. With the implementation of the marine environment protection policy and the increase of the protection of the marine environment, the obstacle degree of the marine environment system gradually decreased, and with the influx of a large number of people and tourists, The obstacle degree of the socio-economic system fluctuates. From 2013 to 2017, with the continuous development of marine resources and the implementation of the policy of high-quality development of marine economy, the output development of marine resources was limited to ensure the sustainable development of marine resources. Therefore, the obstacle degree of marine resources system showed an upward trend, the marine environment was vigorously protected, and the obstacle degree of marine environment system decreased significantly, However, the obstacle degree of social and economic system is still at a high level. It can be seen that the socio-economic subsystem has always been an important factor restricting the high-quality development of marine economy in Zhejiang Province. The key to realizing the high-quality development of marine economy in Zhejiang Province in the near future is to give consideration to the development of marine resources and socio-economic subsystem, and focus on improving the development level of marine resources subsystem and socio-economic subsystem.

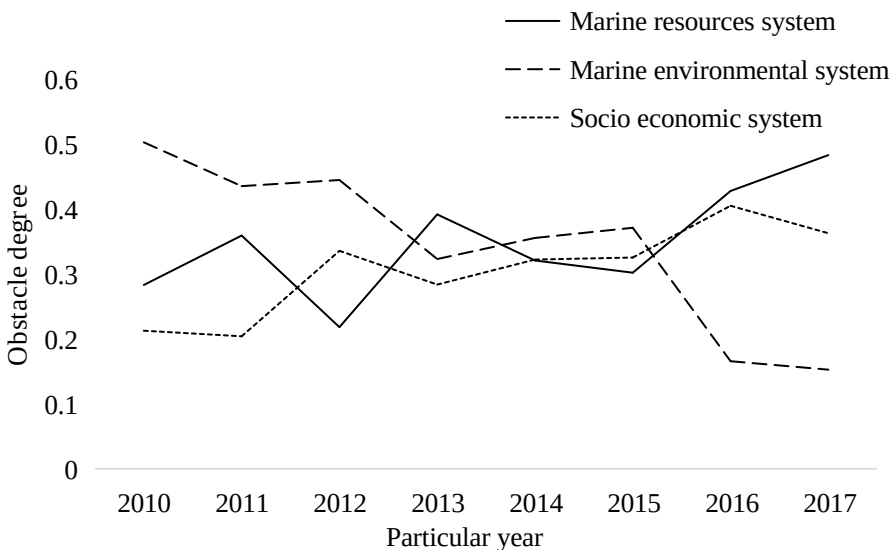

Fig. 2 Changes of systematic obstacles to the coordinated development of marine resources, marine environment and social economy in Zhejiang Province

According to the index obstacle degree (Table 4), the obstacle factors affecting the high-quality development of marine economy in Zhejiang Province are not fixed, and the main obstacle factors are different every year. According to the analysis of system obstacle degree, the top 4 obstacle factors in the study are divided into two stages according to 2010-2012 and 2013-2017, and the indicators with a frequency of more than 10% are counted as the main obstacle factors in the two stages (Table 5). It can be seen from table 5 that from 2010 to 2012, the main obstacle factors affecting the high-quality development of marine economy in Zhejiang Province were the output of marine chemical products and the discharge of industrial wastewater into large quantities; From 2013 to 2017, the main obstacle factors affecting the high-quality development of marine economy in Zhejiang Province were marine mining output, population density, total industrial waste gas emission, total tourism reception, marine mining output and water resources output.

Table 4 The main obstacle factors of the coordinated development of marine resources, marine environment and social economy in Zhejiang Province

Particular year	Index ranking							
	1		2		3		4	
	factor	Obstacle degree	factor	Obstacle degree	factor	Obstacle degree	factor	Obstacle degree
2010	A2	0.3884	B11	0.2847	C17	0.2694	B8	0.2544
2011	B11	0.3267	A2	0.3089	A7	0.3063	B14	0.2408
2012	B10	0.1817	A5	0.1745	C18	0.1728	B9	0.1677
2013	A1	0.2786	A7	0.2247	C15	0.2069	A3	0.1855

2014	C15	0.2586	A1	0.2291	B8	0.1925	B12	0.1722
2015	C16	0.1757	C19	0.1686	B12	0.1680	A6	0.1653
2016	C19	0.2174	C16	0.2124	C20	0.2029	A4	0.2000
2017	A6	0.3700	B12	0.3292	C19	0.2803	C16	0.2550

Table 5 The frequency of the main obstacles to the coordinated development of marine resources, marine environment and social economy in Zhejiang Province

Particular year	2010-2012		2013-2017					
Obstacle factor	A2	B11	B12	C16	C19	A1	C15	A6
Frequency of occurrence	16.7%	16.7%	15..0%	15.0%	15.0%	10.0%	10.0%	10.0%

To sum up, the obstacle degree of each subsystem and the obstacle degree formula of a single index are constantly changing with the actual situation. Therefore, the formulation of policies for the coordinated development of marine resources, marine environment and socio-economic system should also size up the situation and adapt to the time, and timely adjust the policies and countermeasures according to the changes of system obstacle degree and index obstacle degree, so as to make the policies and Countermeasures adapt to the development changes, Targeted measures shall be taken.

4. Conclusion

Aiming at the high-quality development of marine economy in Zhejiang Province, this paper first uses the entropy weight TOPSIS model to evaluate the high-quality development of marine economy in Zhejiang Province from 2010 to 2017, then analyzes the coupling coordination of the ternary system of marine economy, marine resources, marine environment and socio-economy in Zhejiang Province through the coupling coordination degree model, and finally based on the development level of the ternary system, Through the obstacle degree model, this paper analyzes the coupling coordination degree of the ternary system of high-quality development of marine economy in Zhejiang Province and the obstacle factors restricting the coordinated development. The results show that:

(1) The high-quality development index of marine economy in Zhejiang Province is between 0.238-0.638. The overall evaluation score of the high-quality development index of marine economy is not high, which is at the medium level, but changes with the development of marine resources marine environment socio-economic system.

(2) The early vigorous development of marine resources resulted in high marine resources development index, but at the same time, it led to serious marine pollution and low marine environment development index. With the implementation of relevant policies for high-quality development of marine economy during the 12th Five Year Plan period, the marine environment protection was strengthened, so the marine environment development index increased significantly.

(3) The coupling degree of the marine resources, marine environment and socio-economic ternary system in Zhejiang Province is at a high level. There is a close interdependence and interaction between the development of the three subsystems, but the coordination degree of the three subsystems is low. The coupling and coordination degree of the marine economy, marine resources, marine environment and socio-economic system in Zhejiang Province was around the imbalance level from 2010 to 2017, With the improvement of marine environment development index, marine economic development is gradually balanced, and its coupling and coordination degree has risen to barely coordination.

(4) The obstacle factors affecting the high-quality development of marine economy in Zhejiang province change with the actual development of each year. Among them, the main obstacle factors affecting the high-quality development of marine economy in Zhejiang Province from 2010 to 2012 are the throughput of coastal ports, the massive discharge of industrial wastewater, the output of marine chemical products and the total import and export volume, The main obstacle factors affecting the high-quality development of marine economy in Zhejiang Province from 2013 to 2017 are marine mining output, per capita coastline ownership, total industrial waste gas emission, total tourism reception and tertiary industry output value.

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