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A Study on the Implementation effect of the Marine Ecological Civilization Policy in the Three Major Bay Areas of China: take relevant provinces and cities in the Bay Area as examples

Hailan W
Guangdong University of Foreign Studies
Higher Education Mega Center
Panyu District, Guangzhou,China 510006
Email: 872853048@qq.com
China

ABSTRACT

The implementation effect evaluation of marine ecological civilization policy is a necessary means to manage and supervise the construction of marine ecological civilization. The evaluation work needs to design a targeted effect evaluation index system for the implementation effect of marine ecological civilization policy. Based on collecting the comprehensive data of the sea areas of relevant provinces and cities in the three Bay regions of China from 2012 to 2016, Compared with the changes in marine ecological quality before and after the implementation of the policy in 2015, analyzing the comprehensive index of the Bay Area and the effect of the policy implementation, this research puts forward relevant suggestions for the improvement of China's marine ecological civilization construction system and the continuous implementation of the ecological civilization construction policy.

Keywords: marine ecological civilization, policy evaluation, marine ecological quality, three major Bay Areas

1. Introduction

In July 2015, the former State Oceanic Administration issued the Implementation Plan for Marine Ecological Civilization Construction of the State Oceanic Administration (2015-2020), which plans to add 40 new national marine ecological civilization construction demonstration zones by 2020, providing a roadmap and timetable for marine ecological civilization construction during the 13th Five-Year Plan period. The 18th National Congress of the Communist Party of China proposed to tie the construction of ecological civilization with the construction of the political, economic, cultural, and social four civilizations, forming a "five-sphere integrated" scientific development layout, and making it clear that ecological civilization is an integral part of the overall social civilization. The report of the 19th CPC National Congress on "ecological progress" has been mentioned 12 times, making new conclusions on ecological progress. China has opened a new era of ecological progress.

China's three major bay areas include the Guangdong-Hong Kong-Macao Greater Bay Area, the Hangzhou Bay Area, and the Bohai Greater Bay Area. Guangdong is close to Hong Kong and Macao. The dense population, rapid transportation development, overall capital flow, and close economic links make the Guangdong-Hong Kong-Macao Greater Bay Area have an important strategic position in the overall development of the country. Zhejiang is rich in marine resources and has a large number of fisheries. Hangzhou and Guangzhou are both old central cities in the region. Hangzhou Bay Area has a strong manufacturing base, complete types, stronger brand advantages, and technical level than other regions, and has certain competitive advantages. As a municipality directly under the central government, Tianjin is the center of the Bohai Greater Bay Area, with the advantages of international and domestic competitive modern service industry and advanced manufacturing industry. The city cluster with Liaoning as the center is located in the iron and steel chemical manufacturing base and the center of the international shipping trade, connected by sea and land, and has a superior geographical position.

Therefore, this paper by collecting 2012-2016 from three bay area mainly related provinces and cities of the comprehensive data, contrasts marine ecological quality before and after the policy implementation, analyzes the policy implementation effect and influence, on the improvement of the system of marine ecological civilization construction and continuous implementation of ecological civilization construction policy to put forward relevant suggestions.

2. Materials and Methods

Building marine power, and building beautiful oceans, should be in marine ecological environment protection and resource conservation as the main line, on the marine ecological civilization system and the capacity construction, with major projects and projects as the gripper, implement the comprehensive marine management, promote marine ecological environment quality gradually improve and the efficient utilization of marine resources. On this basis, for the targeted evaluation of marine ecological civilization policy in coastal provinces and cities implementation effect of research purpose, and given the policy effect has a large lag, this paper selects 2012-2016 three bay seven provincial data on the key indicators of marine ecological

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civilization policy, analyzes the relative short of marine ecological civilization construction work, to provide Suggestions for the policy subsequent implementation and improvement.

2.1. The Construction of the evaluation index system

In addition to the comprehensive evaluation of the policy effect of marine ecological civilization construction at the national level, this paper also constructs a policy effect evaluation index system of seven provinces and cities in the three major Bay areas (Table 1). The first level is the implementation effect of marine ecological civilization construction policies in 7 provinces and cities, the second level is the element layer, including marine ecology, marine economy, marine science and technology, and marine supervision, and the third level is the index layer, including 13 indicators.

Table1. Evaluation index system of policy effect of marine ecological civilization construction in 7 provinces and cities in The Three Major Bay Area.

Target layer	Elements layer	Index layer
Implementation effect of marine ecological civilization construction policies in seven provinces and cities in The Three Major Bay Area	·Marine ecology	·Marine biodiversity ·Number of newly built national marine nature reserves ·The total amount of industrial wastewater directly discharged into the sea
	·Marine economy	·Marine GDP accounts for GDP of coastal areas ·The proportion of the tertiary industry in the marine GDP ·Coastal marine cargo transport volume ·Number of marine employment personnel
	·Marine science and technology	·Number of marine scientific research institutions ·Employees of marine scientific research institutions ·Total funding revenue of marine scientific research institutions ·Number of applied research projects in marine scientific research institutions
	·Marine regulation	·Sea area use fee ·Number of ocean observation stations

2.1.1. Marine ecology

Marine biodiversity refers to a variety of living organisms (animals, plants, microorganisms) within a certain marine range to form a stable ecological complex. This index can reflect the number of marine species. As a key means of marine ecological restoration and marine environment remediation, the national marine nature reserve is of great significance for maintaining the healthy development of marine ecology. The total amount of industrial wastewater directly discharged into the sea refers to the amount of wastewater directly discharged into the sea through the coastal discharge outlet of the enterprise. The control of the pollutants directly discharged into the sea is conducive to the improvement of the coastal marine water quality and ecological environment.

2.1.2. Marine economy

The proportion of marine GDP in the GDP of coastal areas directly reflects the value and development potential of the marine economy. The proportion of the tertiary industry of marine GDP can be seen from the optimization degree of the industrial structure of the marine economy. The number of coastal marine cargo transported and the number of marine workers respectively reflect the contribution of marine cargo and marine human resources to the economy.

2.1.3. Marine science and technology

The number of marine research institutions constitutes the basis for the development of marine science and technology. The total income of marine research institutions and the number of applied research projects of marine research institutions reflect the level of investment and development level in marine science and technology.

2.1.4. Marine regulation

The use fee of the sea areas refers to the right fee collected by the state from the units and individuals to grant the right to use the sea areas as the owner of the sea areas. This index reflects the optimal allocation of the sea area resources. The number of marine observation stations can reflect the level of marine ecological environment supervision to a certain extent.

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2.2. Index weight determination method

The entropy method refers to using the concept of entropy in physics to determine the weight of each index through the degree of difference between the initial values of multiple indicators, namely, the information entropy. This paper uses the extreme value processing method to process the raw data, and determine the weight coefficient of each index in each element layer respectively. The specific steps are as follows.

2.2.1. Normalization

Suppose transforming m evaluation metrics, the raw data matrix of n evaluated objects by normalization $(A = (a_{ij})m \times n)$ as $R = (r_{ij})m \times n$.

For the positive indicators, the normalization formula is: $r_{ij} = \frac{a_{ij} - \min_j\{a_{ij}\}}{\max_j\{a_{ij}\} - \min_j\{a_{ij}\}}$ (i=1,2,…n, j=1,2…,m)

For negative indicators, the normalization formula is: $r_{ij} = \frac{\max_j\{a_{ij}\} - a_{ij}}{\max_j\{a_{ij}\} - \min_j\{a_{ij}\}}$ (i=1,2,…n, j=1,2…,m)

2.2.2. Defining entropy

The entropy value of the i-term index is $h_i = -k\sum_{j=1}^{n} P_{ij} \ln P_{ij}$. In the formula, $P_{ij} = r_{ij} / \sum_{j=1}^{n} r_{ij}$. Inside, $k = 1/\ln n$(when $P_{ij} = 0$, $P_{ij}\ln P_{ij}$=0).

2.2.3. Defining entropy weights

The entropy weight of the i th index $w_i = \frac{1-h_i}{m-\sum_{i=1}^{m} h_i} (0 \le w_i \le 1, \sum_i^m w_i = 1)$.

2.2.4. Calculate the composite index

$g_i = 100 * \sum_{j=1}^{n} r_{ij} w_{ij}$, w_{ij} is dimensionless data.

2.2.5. For the partial missing values

In this paper, the linear interpolation was completed by using the Stata statistical software. Among them, the index of industrial wastewater into the sea is a negative indicator, and other indicators are positive indicators.

2.3. Data collection

The original data of this study are mainly derived from China Marine Statistical Yearbook from 2012 to 2016, the China Environmental Yearbook, Bulletin of China Marine Environment Status, Provinces and Statistical Bulletin of National Economic and Social Development, etc. By collecting the indicators of 13 evaluation items in this period, the overall development level, each dimension level, relative level, and their fluctuation of coastal provinces and cities were observed, to analyze the changes in marine ecological environment quality in specific provinces and cities before and after the implementation of the policy in 2015.

3. Results and Discussions

Through the calculation, the comprehensive index of the implementation effect of the marine ecological civilization construction policies in 2012-2016 among the 7 provinces and cities in the Three Major Bay Areas of China is obtained, as shown in Table 2.

Table 2. Comprehensive Index of marine Ecological Civilization Construction in the 7 provinces and cities in The Three Major Bay Area

Year	Liaoning	Hebei	Tianjin	Shandong	Shanghai	Zhejiang	Guangdong	Index mean
2012	0.211	0.075	0.212	0.447	0.313	0.331	0.633	0.317
2013	0.224	0.062	0.201	0.459	0.315	0.349	0.609	0.317
2014	0.234	0.056	0.215	0.541	0.32	0.35	0.658	0.339
2015	0.289	0.066	0.219	0.552	0.335	0.355	0.718	0.362
2016	0.318	0.067	0.19	0.536	0.313	0.357	0.701	0.355

As can be seen from Table 2, the comprehensive index in most regions fluctuated and increased in the past five years, while the comprehensive index in Liaoning and Zhejiang has increased year by year. The comprehensive index has a great impact on the evaluation results. To further clarify the policy effect, this paper analyzes the results from three perspectives.

3.1. Analysis of the time evolution of the overall water average value of the policy effect

As can be seen from Figure 1, the average score of the comprehensive index of marine ecological civilization construction in the seven provinces and cities in the three Bay Area gradually increased from 0.317 in 2012 to 0.362 in 2015,

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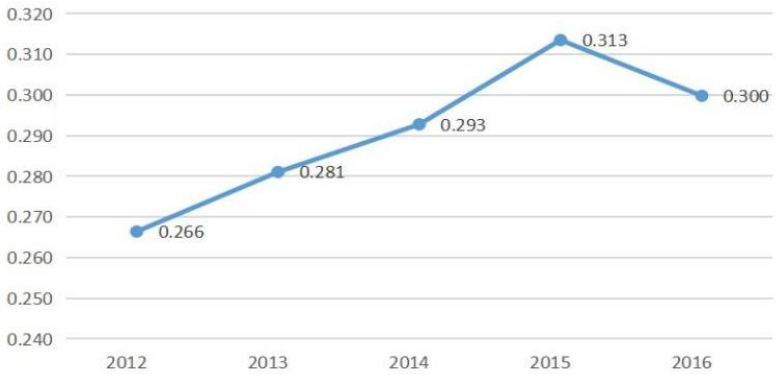
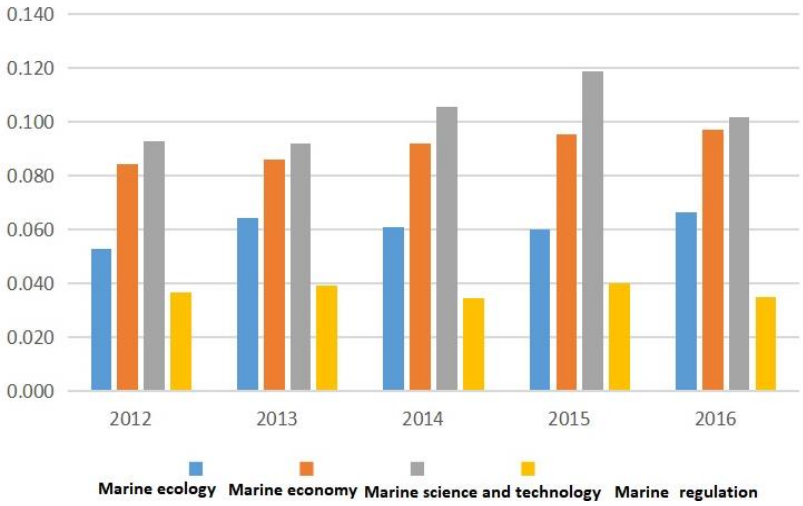
indicating that the investment of all provinces and cities in the construction of marine ecological civilization is constantly increasing. After the implementation of the policy in 2015, the average composite index score fell, but the official data was not available only until 2016. In the element layer dimension, seven provinces and cities in the marine economy showed good growth, marine ecological performance fluctuations, marine science and technology in 2015 after the highest average score fell, marine regulation average score steady fluctuation (Figure 2).

Figure 1. The average change of the comprehensive index of marine ecological civilization construction in seven provinces and cities in the three Bay Area.



Data source: China marine Statistical Yearbook

Figure 2. The mean change of each dimensions of marine ecological civilization construction in 11 coastal provinces and cities.



Data source: China marine Statistical Yearbook

3.2. Analysis of the change of the policy effect relative to the average water value

The relative level of marine ecological civilization construction in the seven provinces and cities of the three Bay Area includes 13 indicators, including marine biodiversity and the proportion of marine GDP in the GDP of coastal areas. The figure below shows the average score of each indicator of the seven provinces and cities each year.

It can be seen that in addition to the "Total industrial waste direct discharge into the sea", the negative index, "The new national marine nature reserve quantity" "Marine GDP proportion of coastal GDP" "Gross marine tertiary industry proportion" "Coastal marine cargo transport" "Marine employment number" "Marine research institutions", a total of six indicators performance is on the rise. Among them, the number of new national marine nature reserves increased the most significantly, up 151 percent year on year in 2016. The average scores of "Number of marine research institutions" Employees of marine research institutions" "Total income of marine research institutions" "Sea use to fund" and "the number of marine stations of coastal observation stations" all rose first and then decreased (Figure 3).

It can be seen that in terms of specific indicators, the overall performance of the marine economy has been good in five years, the marine industrial structure has been continuously optimized, and the economic contribution has been increasing.

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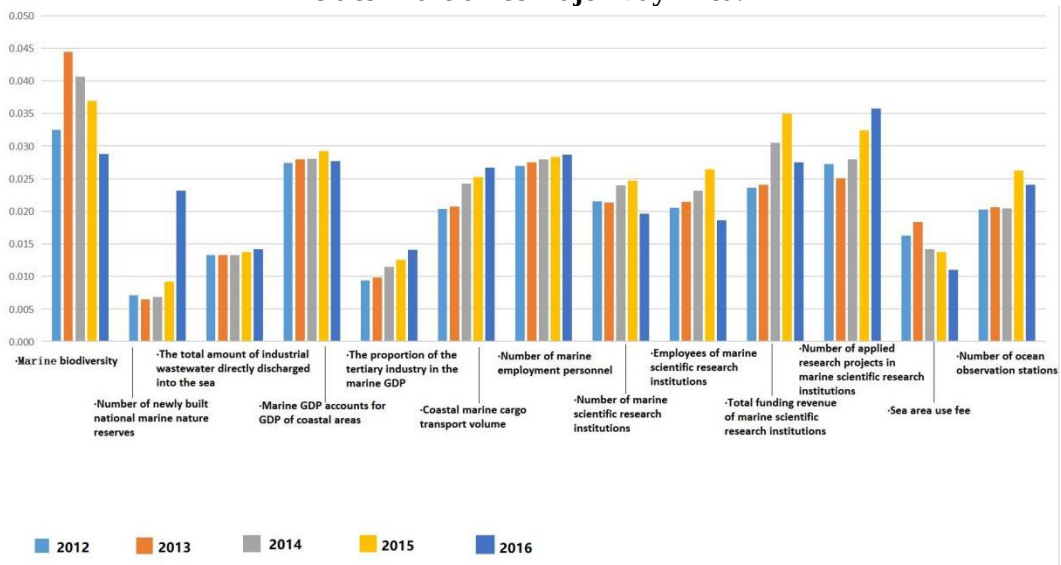
Figure 3. Changes in the average water value of marine ecological civilization construction in the seven provinces and cities in the three major Bay Area.



Data source: China Marine Statistical Yearbook

3.3. Regional analysis of the mean change of each dimension of the policy effect

From a vertical perspective, Guangdong has the highest level in marine ecology and marine economic construction, with an absolute leading position from 2012-2016. The level gap between Hebei, Guangxi, and the other four provinces and cities is not obvious. Shandong did its best in marine technology but was overtaken by Guangdong after 2015. In terms of marine supervision, Zhejiang has been ranked first for four consecutive years and was slightly lower than Shandong in 2016.

From a horizontal perspective, from 2012 to 2016, the average value of Shandong's index in marine ecology, marine economy, and marine regulation continued to rise. The average index of indexes in Guangxi and Zhejiang marine economy increased steadily, while the average index in the seven provinces and cities in marine science and technology showed a fluctuating trend. The average index in Tianjin and Zhejiang gradually rose to decline after 2015 (Table 3).

Table 3. The average index of each dimension of marine ecological civilization construction in the seven provinces and cities in the three Bay Area

Elements layer	Province	2012	2013	2014	2015	2016
·Marine ecology	Hebei	0.024	0.026	0.019	0.019	0.019
	Tianjin	0.039	0.041	0.02	0.02	0.022
	Shanghai	0.047	0.156	0.047	0.038	0.018
	Liaoning	0.029	0.042	0.041	0.025	0.109
	Zhejiang	0.032	0.019	0.033	0.026	0.042
	Shandong	0.085	0.099	0.156	0.157	0.164
	Guangdong	0.231	0.218	0.22	0.22	0.214
·Marine economy	Hebei	0.011	0.008	0.013	0.015	0.018
	Tianjin	0.061	0.066	0.084	0.085	0.076
	Shanghai	0.043	0.076	0.051	0.053	0.129
	Liaoning	0.116	0.121	0.131	0.131	0.07
	Zhejiang	0.144	0.149	0.155	0.162	0.171
	Shandong	0.098	0.099	0.106	0.109	0.112
	Guangdong	0.159	0.157	0.176	0.175	0.18
·Marine science and technology	Hebei	0.018	0.013	0.012	0.013	0.013
	Tianjin	0.074	0.075	0.087	0.095	0.077
	Shanghai	0.132	0	0.166	0.18	0.149
	Liaoning	0.072	0.07	0.08	0.172	0.106
	Zhejiang	0.082	0.083	0.086	0.092	0.08
	Shandong	0.21	0.198	0.215	0.218	0.189
	Guangdong	0.181	0.18	0.211	0.269	0.254
·Marine regulation	Hebei	0.017	0.016	0.012	0.018	0.017
	Tianjin	0.036	0.041	0.024	0.019	0.015
	Shanghai	0.021	0.034	0.028	0.036	0.016
	Liaoning	0.045	0.043	0.038	0.007	0.033
	Zhejiang	0.073	0.098	0.076	0.075	0.064
	Shandong	0.053	0.063	0.063	0.068	0.071
	Guangdong	0.063	0.054	0.05	0.055	0.053

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Overall, the composite indexes of Guangdong, Shandong, and Zhejiang have been among the top three for five consecutive years, while Hebei is at the bottom. The average value of the composite index of the other four provinces and cities such as Shanghai has changed very little, and it has remained in the range of 0.132 to 0.354 within 5 years (Figure 4 to 8).

Figure 4. The comprehensive index of Marine ecological civilization construction in seven provinces and cities in the Three Major Bay Area in 2012.

Data source: China Marine Statistical Yearbook

Figure 5. The comprehensive index of marine ecological civilization construction in seven provinces and cities in the Three Major Bay Area in 2013.

Data source: China Marine Statistical Yearbook

Figure 6. The comprehensive index of marine ecological civilization construction in seven provinces and cities in the Three Major Bay Area in 2014.

Data source: China Marine Statistical Yearbook

Figure 7. The comprehensive index of Marine ecological civilization construction in seven provinces and cities in the Three Major Bay Area in 2015.

Data source: China Marine Statistical Yearbook

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Figure 8. The comprehensive index of Marine ecological civilization construction in seven provinces and cities in the Three Major Bay Area in 2016.

Data source: China Marine Statistical Yearbook

4. Conclusions

Building a marine ecological civilization is a long-term and systematic social project. It is not simple ecological protection or pollution control, but a process of creating a new cultural and ethical form different from the traditional civilization and gradually integrating it into all aspects of society. In this process, to realize the all-around transformation of development thinking, development path, and development mode, to achieve the coordinated development state of "harmony between man and the ocean". Building a marine ecological civilization is an urgent requirement for realizing the sustainable development of marine undertakings and an important basis for building China into a maritime power.

A comprehensive understanding and understanding of the mechanism of marine ecological civilization construction is the premise of its construction. Although there is some research on the construction and evaluation of marine ecological civilization, a complete theoretical system has not been formed, and there are also some limitations in the application process. This research combines the characteristics of the existing evaluation index system, fully considering the systematic indicators and data availability, based on the theory of "five one" to build a new evaluation index system, that has strong operability, can for the next coastal marine ecological civilization construction and research to provide a reference.

Based on the analysis of the existing studies, it is necessary to focus on the following aspects: first, improve the theoretical system, make in-depth discussions on construction paths, management mechanisms, evaluation, and impact analysis, carry out empirical research, and provide theoretical guidance for the construction of marine ecological civilization. Second, improve the evaluation mechanism for marine ecological civilization, establish and improve the hierarchical assessment and tracking evaluation mechanism, have a more objective and in-depth understanding of the development level of marine ecological civilization in coastal areas, and promote the construction and development of marine ecological civilization. Finally, we should give full play to the demonstration effect of the marine ecological civilization demonstration zones, while actively exploring the path of marine ecological civilization construction, and further promoting the integration of the demonstration areas and coastal areas, to drive the local marine ecological civilization construction to the maximum extent.

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