

A Policy-based Analysis of Marine Environmental Management Evolution of the Bohai Sea

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Abstract: In view of the serious damage to the marine environment of the Bohai Sea, the Chinese government has put forward a series of policies to manage the marine environment. However, to the authors' best knowledge, few existing researches make use of these policies to scientifically and quantitatively analyze the changes of marine environmental management of the Bohai Sea. Therefore, combined with the marine environmental management policies of the Bohai Sea from 1982 to 2020, this paper counts the frequencies of key words in these policy texts which could reflect the policy objectives to analyze the changes of marine environmental management objectives and the results show that with the continuous development, the marine environmental management of Bohai Sea has increased the restoration of the damaged marine environment on the basis of preventing the disruption of marine environment. Meanwhile, on the other hand, this paper contrasts the specific management contents involved in the marine environmental management plans of the Bohai Sea since the 21st century issued by the Chinese government and finds that more and more restoration schemes are developed. Then, based on the analysis results, the trend of the marine environmental management of the Bohai Sea in the future is predicted. Moreover, solutions to problems in current projects of marine environmental remediation and restoration by analyzing project implementing processes are explored as well. As a whole, the management of marine environment of the Bohai Sea is becoming more and more comprehensive, but there are still some problems such as complicated approval process and no unified evaluation standard.

1 INTRODUCTION

China is a country with a vast coverage of ocean area including the Bohai Sea, Yellow Sea, East China Sea and the South China Sea. Among them, as the only semi-enclosed inland sea, with an area of 77000 km² and an average depth of 18m (Li et al., 2018a) in China, the Bohai Sea is well-known with its rich marine resource (Zhang et al., 2009). The Bohai Rim, which composes Shandong Province, Liaoning Province, Hebei Province and Tianjin city, is the agricultural base and heavy industry base of China (Liu et al., 2015) (Figure 1). The Bohai Sea is located in the center of Northeast Asia economic circle (Qiu et al., 2018), which makes the Bohai Rim area one of the most densely populated and industrialized areas in China. (Gao et al., 2014; Liu et al., 2015). However, with the economy development of the Bohai Rim, a large number of industrial wastewater and

agricultural sewage are directly discharged into the Bohai Sea. As the Bohai Sea is a semi-enclosed marine area, the limited water exchange capacity has led to serious pollution of the marine environment (Lin et al., 2020; Wang & Wang, 2018). At the end of the 20th century, the fishery resources in the Bohai Sea were nearly exhausted, and the species richness and species diversity decreased continuously (Jin, 2003) (Figure 2).

In order to improve and restore the marine environmental quality of the Bohai Sea, the Chinese government has formulated a series of national marine environmental management policies and the sub-national policies only for Bohai Sea. In accordance with various policies including rules, regulations and plans, actions have been taken to improve the marine environment of the Bohai Sea, such as sewage treatment and sewage outlet inspection (Li, 2014).

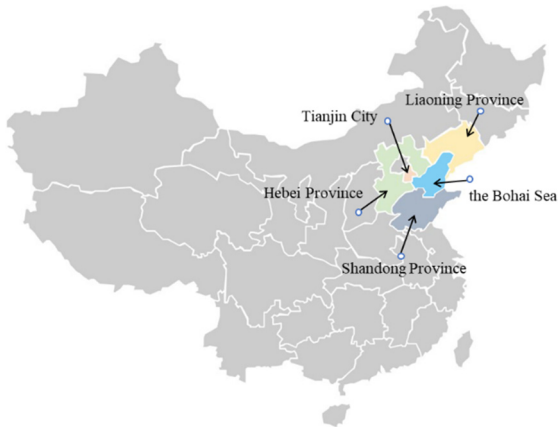


Figure 1: The location and surrounding of the Bohai Sea.

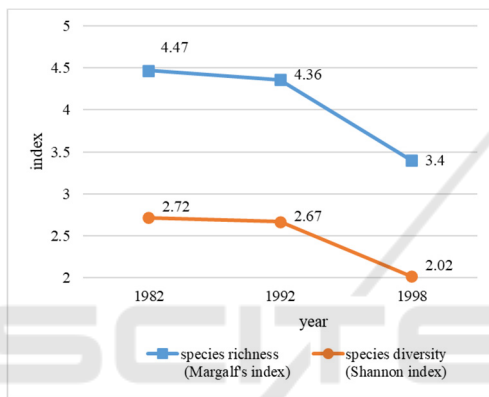


Figure 2: The changes of species richness and diversity.

From the founding of China in 1949 to the beginning of reform and opening up (A period of rapid economic development in China) in 1979, the Chinese government formulated marine policies mainly for the security of its territory and sovereignty, however, marine environmental problems were generally ignored (Zhang, 2016). In 1982, the Chinese government promulgated *the Marine Environment Protection Law of the People's Republic of China*, which is the first law on marine environmental management in China. Since then, China has successively issued a series of marine environmental management policies to improve the marine environmental quality.

Considering the timing of the promulgation of policies that have a significant impact on China's marine environmental management and the number of the policies issued in different years (Bai, 2019; Xu, 2018; Xu et al., 2016; Yu & Bi, 2019), the marine environmental management policies of the Bohai Sea from 1982 to 2020 can be divided into the following five phases.

1) The construction phase (1982-1985). In this phase, China began to promulgate regulations and policies related to marine environmental management in accordance with *the Marine Environment Protection Law of the People's Republic of China*, representing the beginning of the marine environmental management system of China.

2) The continuation phase (1996-2005). In this period of time, compared with marine environmental protection, the Chinese government paid more attention to the development of marine resources. As a result, the policies of the previous stage were basically continued.

3) The refinement phase (2006-2010). This phase is a period of continuous improvement of policy system. The administrative intensity of marine environmental protection policy is higher than that of marine resources development policy.

4) The diversification and consolidation phase (2011-2015). In this stage, the marine environmental management had been further strengthened, and the management methods had gradually diversified.

5) The innovation phase (since 2016). The government has paid more and more attention to the innovation of marine environmental management model, and began to emphasize the collaborative management of land and sea, and bring coastline into the scope of marine environmental management.

This paper firstly employed the word frequency analysis method to obtain the number of keywords in the Bohai Sea marine environmental management policy that could reflect the marine environmental management objectives in different phases, so as to analyze the changes of the objectives of Bohai Sea marine environmental management. Next, Since the policies issued in the 20th century for the marine environmental management of the Bohai Sea are mainly qualitative quotas, this paper analyzes the changes of specific management contents based on the quantitative management and control indicators specified in the management plan proposed since the 21st century. Finally, combined with the implementation of the current management plan, the problems existing in the current scheme has been discussed with the constructive suggestions to the authorities.

The structure of this paper is divided into six parts. The first part elaborates the way of dividing the marine environmental management policies of the Bohai Sea issued from 1982 to 2020 into different phases, and describes the structure and potential contribution of the paper. The second part reviews the relevant studies based on the marine environmental management policies of China. The third part deploys

the method of word frequency analysis to quantitatively count the keywords of policy content, and analyzes the change of management objectives. In the fourth part, through the parallel comparison of the quantitative control indicators in the marine environmental management plan of the Bohai Sea formulated since the 21st century, the changes of the specific management contents of the marine environment were analyzed. The fifth part discusses the change trend and existing problems of the marine environmental management of the Bohai Sea, and puts forward constructive suggestions to the authorities. Finally, the main conclusions of this paper are summarized in part six.

2 EXISTING RESEARCH ON MARINE ENVIRONMENTAL MANAGEMENT IN CHINA

In recent years, the Chinese government has laid more stresses on the importance of marine environmental pollution problem, and has issued a series of marine environmental management policies to manage this problem. Research related to these policies has also been conducted by scholars to analyze China's marine environmental management.

(Wang & Liu, 2012) and (Xu et al., 2014) classified the marine policies of China according to four standards, including levels, management objectives, fields and subjects, to analyze the problems existing in the marine policy system of China and put forward suggestions. According to the marine environmental management policies issued by the Chinese government from 1979 to 2015, (Xu et al., 2016) used quantitative analysis and content analysis to study the tendency of the marine environmental policy system of China and the proportion of different policy tools used in marine environmental management. (Zhang, 2016) digested the contents of the *Government Work Report of China* from 1954 to 2015, so as to analyze the change of the proportion of marine policy in all aspects of government policy and the change of the focus of marine management policy. (Xu, 2018) considered the marine environmental management policies issued by the government from 1982 to 2015, and used content analysis and word frequency analysis to investigate the changes in the concept and structure of the policy. (Yu & Bi, 2019) divided the marine environmental management policies issued by the Chinese government from 1982 to 2020 into multiple stages, and used mathematical methods to analyze the

evolution process of the policies, such as co-word analysis and word frequency analysis. (Ma & Zhao, 2019) divided the legal history of the marine environmental protection of China from 1949 to 2019 into three stages, defined the characteristics of each stage, and prospected the legal development in the future. (Wang & Mao, 2019) analyzed the change of the government's emphasis on marine environmental management by using content analysis method and social network analysis method according to the marine environmental policies issued by the government from 1983 to 2016. (SONG et al., 2019) established an evaluation system of marine environmental management effect, which includes three aspects: institutional setting and management, legal system and state of the marine environment. The results indicated that the legal system of marine environmental management in China is still in a backward position. (Yu & Yu, 2021) used the NVivo software to analyze the qualitative data of coastal ecological policy documents and found that ecology is a priority factor in policy-making. In addition, it is also found that more attention is paid to the process of policy implementation instead of evaluation and feedback. (Yu & Cui, 2021) divided the policy evolution of marine litter governance in China into three stages based on the important time points of promulgating policies and extracted the keywords and calculated their frequencies of each stage, which are used to analyze and compare the characteristics and performances of policies of different stages.

From the aforementioned review, it can be found that, based on China's marine environmental management policies, most of the existing studies are still solely focusing on the policy system, such as establishment and development, instead of analyzing the objectives and specific contents of marine environmental management. Therefore, in view of the impact of management policies on the change of management objectives and specific management contents, this paper makes a trial with series of analysis and discussion to propose a theoretical basis for clarifying the evolution process of the marine environmental management of the Bohai Sea.

3 THE CHANGE OF MARINE ENVIRONMENTAL MANAGEMENT OBJECTIVES IN THE BOHAI SEA

Since the Chinese government promulgated the *Marine Environment Protection Law of the People's*

Republic of China in 1982, a series of marine environmental management policies have been promulgated in succession, which have become important tools for marine environmental management. This paper selects 102 policies issued from 1982 to 2020, including national marine environmental management policies and sub-national policies only for the Bohai Sea, to analyze the changes of marine environmental management objectives of the Bohai Sea. As described in Part I, the period 1982-2020 is divided into five phases, and each policy is classified into specific phases according to the year in which it was enacted.

Based on the key words proposed by (Xu, 2018) and (Yu & Bi, 2019), which can reflect the core contents of China's marine environmental management policies, and the research requirements, this paper selects 8 key words that can reflect the objectives of marine environmental management in the Bohai Sea. The 8 keywords are "Pollution", "Environment", "Protection", "Ecological", "Prevention", "Renovation", "Restoration" and "Reclamation".

This paper uses the word frequency software of ROST CM6 developed by Wuhan University to count the frequency of 8 key words appearing in each phase. Meanwhile, the growth rates of each keyword in different phases relative to the previous phase are calculated and the upper and lower growth rates of each keyword has been calculated (Figure 3).

As shown in Figure 3, along with the advance of marine environmental management of the Bohai Sea, the key words "Pollution", "Environment" and "Protection" appear frequently. The rising trend of those key words indicates that protecting marine environment and reducing pollution of the Bohai Sea are always the objectives of China's marine environmental management. For example, *Marine Environment Protection Law of the People's Republic of China* (1982), *Some Opinions on Further*

Strengthening Marine Ecological Protection and Construction (2009), and *Regulations on Prevention and Control of Marine Environmental Pollution by Ships* (2017) are mainly focus on strictly controlling the discharge of pollutants into the sea and protecting the marine environment.

The frequency of the key word "Ecological" is relatively low in the policies issued in the first phase (1982-1995), but it increases rapidly in the following phases. In the two phases of 2011-2015 and 2016-2020, the frequency of "Ecology" is close to or even more than that of "Pollution", "Environment" and "Protection", which indicates that in the 21st century, the scope of marine environmental management objectives in the Bohai Sea has been further expanded on the basis of controlling the discharge of pollutants into the sea. For example, *the 13th Five-year Plan for Ecological and Environment Protection* (2016) and *Opinions of the State Oceanic Administration on Further Strengthening the Protection of the Ecological and Environment in the Bohai Sea* (2017) all call for strictly controlling the discharge of pollutants into the sea and for strengthening protection of the marine ecological.

The frequency of the keyword "Prevention" shows a growth rate of greater than zero in each phase compared with the previous phase, indicating that the Chinese government has always taken preventing further damage to the marine environment as the objective of marine environmental management in the Bohai Sea. It should be noted that before 2005, the frequency of "Remediation", "Restoration" and "Reclamation" was very low, but since then, the frequency of these three keywords shows a positive growth trend. This shows that the objective of marine environment management of the Bohai Sea emphasizes the restoration of the damaged marine environment on the basis of preventing the disruption of marine environment.

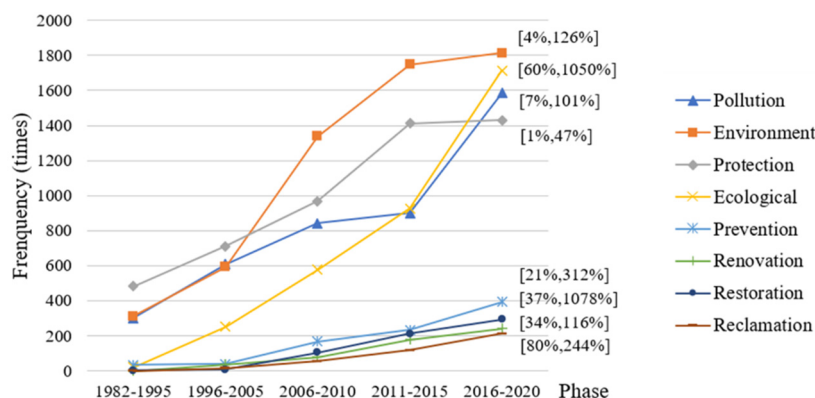


Figure 3: The frequency and growth rate of keywords of the Bohai Sea marine environmental management policy.

4 THE CHANGE OF MARINE ENVIRONMENTAL MANAGEMENT CONTENTS IN THE BOHAI SEA

In the 20th century, most marine environmental management policies of the Bohai Sea are merely focused on the setup of the management objectives, the specific management contents are ignored. Since the 21st century, the Chinese government has formulated a series of plans with specific contents and scale for the marine environmental management of the Bohai Sea in order to protect the marine environment more effectively. By sorting out the management contents and corresponding quantitative indicators stipulated in these management plans, this part analyzes the changes of specific marine environmental management contents of the Bohai Sea in the past 20 years.

In 2001, for dealing with the serious pollution problem in Bohai Sea, the Chinese government formulated the *Clean Bohai Sea Program* (CBSP) to strengthen the marine environment management of the Bohai Sea. The CBSP is the earliest regional marine environmental management plan at the national level in China (Tong et al., 2014), which stipulates that the management plan will be implemented in three five-year stages from 2001 to 2015 and the specific management content of the first-stage is to reduce the discharge of pollutants into the sea. Specifically, by 2005, compared with 2000, the discharges of phosphorus, ammonia nitrogen, COD, and oil into the Bohai Sea should be dropped by 20%, 20%, 10%, and 20%, respectively. However, an investigation in 2006 showed that there were still serious problems in the ecological environment of the Bohai Sea, with the total amount of land-sourced pollutants into the sea remaining high and the wetland area shrinking. The CBSP failed after only five years of implementation (Li et al., 2018b)

In 2007, the Chinese government formulated the *Bohai Sea Environmental Protection General Plan* with a coverage of two stages: 2008~2012 and 2013~2020. The management contents of the first stage plan include reducing the discharge of pollutants into the sea. The discharges of COD, ammonia nitrogen, and total phosphorus should be reduced from 1.5 million tons to 1.2 million tons, 110 thousand tons to 90 thousand tons, and 105 thousand tons to 9 thousand tons respectively. In addition, the restoration of marine ecological environment has been supplemented to the management contents, including the restoration of 210 thousand hectares of

wetland area and the increase of 460 thousand hectares of shelterbelt area. The management contents of the second stage of the plan are roughly the same as that of the first stage, with quantitative indicators include reducing COD into the sea to 800 thousand tons and increasing the area of shelterbelt by 210 thousand hectares by 2020. In 2013, the Chinese government proposed the implementation of *The Blue Bay* project to restore the marine ecological environment of seriously polluted bays across the country, including several bays of Panjin City, Jinzhou City and Qinhuangdao City in the Bohai Rim. *The Blue Bay* project is proposed at the second stage of the *Bohai Sea Environmental Protection General Plan*, so this paper regards the implementation of the Blue Bay project as a supplement to the restoration of the marine ecological environment included in the management contents of the second stage of the *Bohai Sea Environmental Protection General Plan*, including restoration schemes of damaged shoreline restoration, dredging and the removal of offshore structures.

When the implementation of the *Bohai Sea Environmental Protection General Plan* entered its final stage in 2018, unfortunately, the ecological environment of important estuaries, bays and marine ecosystems in the Bohai Sea is still in a sub-health or unhealthy state. Hence, the Chinese government formulated an *Action Plan for The Comprehensive Management of the Bohai Sea* to speed up the solution of the prominent ecological and environmental problems in the Bohai Sea. The management contents of the plan include reducing the discharge of pollutants into the sea and restoring the marine ecological environment. By the end of 2020, the proportion of coastal seawater with good quality should reach over 75% by reducing land-sourced pollutants into the sea and the natural shoreline rate, the restored wetland area and shoreline length should be greater than 35%, 6,900 hectares and 70 km respectively by means of restoration schemes such as sand filling, dredging and the removal of offshore structures.

By comparing the management contents of the above marine environmental management plans of the Bohai Sea, one uniform management code can be summarized: reducing the discharge of pollutants into the sea. Importantly, the restoration of the marine ecological environment has also been emphasized gradually with restoration schemes developed (Table 1).

Table 1: Restoration schemes covered by different management plan.

Restoration schemes management plan	Wetland restoration	Vegetation restoration	Shoreline restoration	Dredging	Offshore structures removed	Sand filling
<i>the Clean Bohai Sea Program</i> (2001)	/	/	/	/	/	/
<i>The Bohai Sea Environmental Protection General Plan-the first stage</i> (2007)	⊙	⊙	/	/	/	/
<i>The Bohai Sea Environmental Protection General Plan-the second stage</i> (2013)	⊙	⊙	⊙	⊙	⊙	/
<i>the Action Plan for The Comprehensive Management of the Bohai Sea</i> (2018)	⊙	⊙	⊙	⊙	⊙	⊙

“/” is not covered in the management plan, “⊙” is covered in the management plan.

5 RESULT AND DISCUSSION

5.1 Evolution Trend of Marine Environmental Management in the Bohai Sea

According to the analysis of the change of objectives and contents of marine environmental management in the Bohai Sea, it is recognized that before 2005, the key words related to restoration are rarely mentioned in the marine environmental management policies of the Bohai Sea, but since 2005, relevant keywords have been mentioned repeatedly with a rising trend. In addition, by analyzing the specific management contents of the marine environmental management plan of the Bohai Sea in the past 20 years, it can be found that the restoration schemes corresponding to the marine ecological environment restoration are becoming more and more comprehensive. However, it is worth noting that in the *General Plan for Environmental Protection of the Bohai Sea* issued in 2007, the specific contents of marine environmental restoration of the Bohai Sea are proposed for the first time, so far just 13 years. Naturally, the mature marine environmental restoration system of the Bohai Sea has not been formed. Therefore, it can be predicted that marine environmental management of the Bohai Sea in the future will continue to focus on reducing the discharge of pollutants into the sea and restoring the marine ecological environment, and

gradually form a mature marine environment restoration system of the Bohai Sea.

5.2 Existing Problems and Countermeasures in the Marine Environmental Restoration of the Bohai Sea

The recent management plan for marine environmental restoration of the Bohai Sea is the Action Plan for The Comprehensive Management of the Bohai Sea, which was promulgated by the Chinese government in December 2018 and finished by December 2020. The plan involves 64 marine environmental restoration projects. This paper firstly summarizes the process of 26 related projects and finds out the existing problems, then analyzes the possible causes of these problems, and finally proposes exploratory solutions.

The process of marine environmental restoration project of the Bohai Sea generally includes eight steps: review, approval, preliminary work, preliminary design, environmental impact assessment, construction, completion acceptance and project acceptance. In August 2019, all the 26 projects passed the review. However, by March 2020, 7 of the 26 projects are in the approval step, 3 projects in the preliminary design step, 13 projects in the environmental impact assessment step, and only one projects in the construction step. It can be seen that overall progress is slow and the projects are

concentrated in the environmental impact assessment step.

The main causes of these problems may include:

(a) The process of the project is cumbersome, requiring a complex approval process for each step and each step should be executed in strictly sequential order;

(b) The lack of unified standards for environmental impact assessment of marine environmental restoration projects in China makes it difficult to pass the environmental impact assessment step.

In view of the existing problems in marine environmental restoration of the Bohai Sea, this paper suggests that, on the one hand, the process of marine environmental restoration project should be simplified, such as reducing the number of approval steps or taking place simultaneously. On the other hand, the environmental impact assessment standards for marine environmental restoration projects should be promulgated as soon as possible.

6 CONCLUSIONS

Dealing with the deficiencies in the academic research on marine environmental management of the Bohai sea, with a special focus on the marine environmental management policy content, this paper tried to exploring the existing problems in marine environmental restoration of the Bohai sea based on the detail investigation of the objective and content changes of marine environmental management in Bohai sea since 1982. Future marine environmental management direction of the Bohai sea has also been predicted with exploratory solutions proposed in this paper.

From 1982 to 2020, great changes have taken place in the marine environmental management of the Bohai Sea. The management objective has changed from targeted pollution control to comprehensive ecological management, and the management content has increased the marine environmental restoration on the basis of reducing the discharge of pollutants into the sea. In addition, the marine environmental restoration schemes are becoming more and more comprehensive. From the simple vegetation restoration, various schemes such as coastal restoration, dredging, and offshore structure removal have been gradually added. It is expected that marine environmental management of the Bohai Sea in the future will continue to take into account the reduction of the pollutants into the sea and the restoration of marine ecological environment. The marine

environmental restoration project will further simplify the process and promulgate the environmental impact assessment standards as soon as possible, which are currently the key issues to be addressed in China. Study in the policy evolution of environmental management scheme in China can also provide importance hints and directions for other developing countries, which are now suffering from the environmental problems caused by the regional economic developments.

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