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The Coupling Relationship between Marine Resource Carrying Capacity and Marine Economic Development Potential

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Abstract: The ocean is a fluid system, which is closely related to human economic activities. Marine resources(MR) provide a continuous supply of natural and non-natural resources of the ocean for human activities and livelihoods, which promotes the development of marine economic(ME) development potential, and also has a certain bearing capacity for waste generated by human social production and living activities, improving the human living environment. This paper studies the status quo of MR and the development of marine economy in the coastal economic zone of D province, and analyzes the coupling relationship between the carrying capacity of MR and the development potential of marine economy in D province from 2016 to 2020 according to the coupling degree calculation model. The results show that in 2019, the MR and marine economy of D province were at a moderately coordinated development level, with the highest degree of coupling coordination. In other years, the degree of coupling coordination is barely coordinated or out of balance, which shows that the province needs to pay attention to the coordinated development of MR and marine economy to promote The balance and stability of the marine ecosystem.

1. Introduction

The marine resource system supports the ME development system through the resource supply function, and the ME development system restricts the development of MR because of waste discharge, which reflects that the development between MR and marine economy must consider the relationship between the two coordination [1]. At present, we can promote the improvement of MR and environmental systems through scientific and technological progress.

The research on the carrying capacity of the marine economy and the development potential of

the marine economy has achieved good results. For example, some scholars pointed out that the current marine economy and marine resource carrying capacity are facing many problems, and tried to find an effective method to study the uncoordinated development between the two. Regional economic index, which proposes a standard for measuring marine ecosystems [2]. Some studies have pointed out that the development of marine economy in some provinces in my country is due to geographical factors, high incidence of marine disasters, large ME losses, and limited ME development. Therefore, the study proposes to accelerate the development of marine economy in the future to promote the construction of marine disaster prevention infrastructure is one of its primary tasks [3]. Relevant research shows that the ME development potential value of my country's coastal provinces is between 0 and 0.3, and my country's coastal areas are divided into three levels, namely, areas with strong ME development potential, areas with strong development potential and average development potential [4]. Although the research results are fruitful, it is worth noting that in order to realize the sustainable development of the marine economy, it is necessary to ensure that the MR have a high carrying capacity.

This paper first proposes a coupling degree and coupling coordination degree model for the coupling relationship that needs to be studied in this paper, and then takes D province as an example to analyze the factors affecting its ME development, and then analyzes the current situation of MR and marine economy in D province. The coupling relationship calculation formula obtains the coupling relationship between the carrying capacity of MR and the development potential of marine economy in D province.

2. Coupling Model and Analysis of Influencing Factors of Marine Economy

2.1. Coupling Degree and Coupling Coordination Degree

Whether the marine economy and MR are coordinated in the study area is measured by the coupling degree, and the imbalance of the coordination level is measured by the coupling coordination degree. First, the coupling degree is used to measure whether there is a coordination relationship between the marine economy and MR. On this basis , and further explore the coordination level of the two in order to better understand the degree of interaction between the marine economy and MR in this region [5-6]. Introduce the following formula for this:

$$H = \left\{ f(x)g(y) / \left[(f(x)+g(y)/2 \right]^2 \right\}^k \tag{1}$$

$$R = \sqrt{H \times G} \tag{2}$$

$$G = \alpha f(x) + \beta g(y) \tag{3}$$

Among them, H is the coupling degree, k is the adjustment coefficient. In order to make the measurement more convenient and effective, the value of k is defined as 2, R is the coupling coordination degree, G is the comprehensive evaluation index of marine economy and MR, and α is the development level of marine economy. , β is the carrying capacity of MR.

2.2. Constraining Factors of ME Development in D Province

Taking the coastal economic zone of D province as an example, this paper analyzes the factors that restrict the development of the marine economy in this province. Among the many coastal cities in my country, compared with other coastal cities, Province D is at a disadvantage in terms of scientific research and technology level and economic strength. At present, the development and

utilization of MR is still in a relatively backward state, with the characteristics of low level and repetition. , lack of sufficient motivation to improve the level of scientific research and technology [7-8]. The following two factors are the most important factors affecting the marine economy of D province.

(1) Unreasonable exploitation of MR

In the process of self-development of the ME zone of D province, due to the phenomenon of over-exploitation of MR, the marine ecological environment of D province has gradually deteriorated. A series of marine aquaculture activities have been carried out in the offshore area of D province, and the area of the wetland area has become smaller and smaller due to the encroachment, which has seriously damaged the ecological environment of the sea area [9]. At the same time, during the blind expansion of aquaculture, the discharged wastewater and slag could not be treated in time, which had a destructive impact on the marine ecology. In order to build the coastal port area, a lot of land reclamation and wharf construction were carried out. Although these actions provided the necessary basic conditions for the construction of the port area, they did sacrifice the marine ecology and caused sedimentation in the waterway. , thus seriously damaging the offshore environment [10-11]. Coupled with the serious phenomenon of unreasonable exploitation of MR, the MR and environment are faced with greater ecological pressure, which inhibits the healthy economic development of the economic zone [12].

(2) Marine environmental pollution problems

Due to its special geographical location, the ME zone of D province is in a semi-closed state. Compared with other sea areas, this sea area is relatively clean and has suffered less pollution in the past [13]. Moreover, this sea area has the characteristics of weak current speed and slow seawater exchange speed. It is because of these characteristics that once this sea area is polluted, the consequences are more serious than other sea areas, because the pollutants are difficult to spread, and the sea water itself The purification ability is relatively weak, which further aggravates the problem of seawater pollution [14]. With the rapid development of coastal cities in pursuit of industrialization, the development of the sea area has become more and more intensive, resulting in a sharp increase in pollution sources in seawater. Although some wastewater materials are treated and discharged, a large amount of pollutants are still discharged into the sea [15-16].

3. The State of MR and Marine Economy in D Province

3.1. Marine Resource Reserves

(1) Marine port resources

Table 1. Port throughput in the coastal economic zone of D province in 2020

	Cumulative total from January to December (10,000 tons)	Cumulative year-on-year growth (%)
Port 1	4728	6.32
Port 2	9356	2.78
Port 3	5427	11.45
Container	149.34	19.17

The coastline of the coastal economic zone of D province is tortuous, the harbor is deep and wide, and the conditions for building a port are very favorable, and it has the conditions for direct communication with major ports in the world. At present, the major ports in the region are developing well, and the cargo throughput is increasing year by year. As shown in Table 1, the throughput of the three major coastal ports in D province in 2020. Among them, the throughput of port 1 was 47.28 million tons, with a cumulative increase of 6.32% year-on-year in the 12 months

of the year. The throughput of port 2 was the largest at 93.56 million tons, with a cumulative increase of 2.78% year-on-year; the throughput of port 3 was 5,427 tons , the cumulative year-on-year increase of 11.45%, while the container volume in that year was 1.4934 million tons, a year-on-year increase of 19.17%. Along with a series of development opportunities, the port construction in the coastal economic zone of D province will be more perfect and the development space is huge.

(2) Marine ecological status

Table 2. Marine biodiversity in Province D in 2020

	Type	Average Biodiversity Index	Average uniformity
Phytoplankton	163	2.45	0.75
Zooplankton	98	1.93	0.62
Macrobenthos	124	1.47	0.69

As shown in Table 2, in 2020, D province has carried out monitoring of biodiversity and marine ecosystems in the surrounding waters. The main projects include phytoplankton, zooplankton and benthic organisms. It can be seen from the data in the table that there are 163 phytoplanktons with an average biodiversity index of 2.45 and an average evenness of 0.75; a total of 98 zooplanktons with an average biodiversity index of 1.93 and an average evenness of 0.62; benthic There are 124 organisms in total, with an average biodiversity index of 1.47 and an average evenness of 0.69.

3.2. Status Quo of ME Development

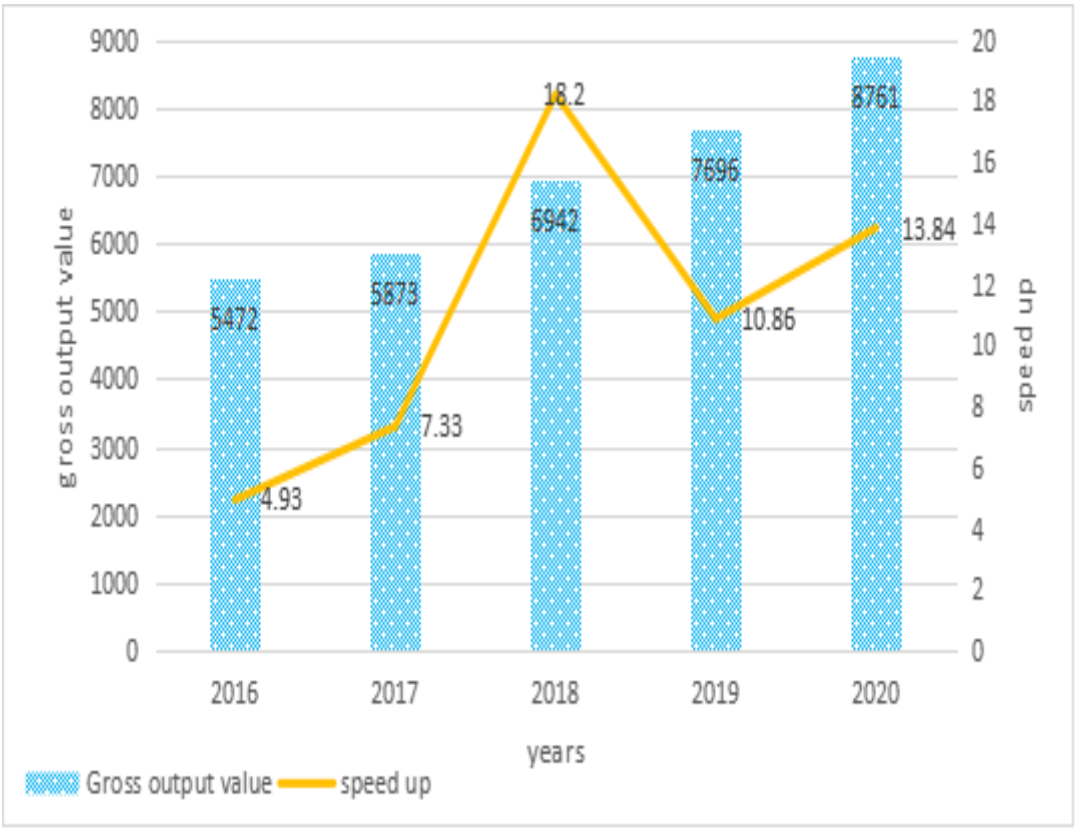

Figure 1. The state of gross marine product in province D

As shown in Figure 1, from 2016 to 2020, my country's total marine production has increased by 3.289 trillion yuan, and the total increase is large, which shows that the marine economy of D province has achieved considerable development in the past five years, and the growth rate has generally increased. trend. The growth rate of the marine economy fluctuated significantly. In 2017, the growth rate of the marine economy was 7.33%, compared with 18.20% in 2018, and the growth rate increased by 2.48 times. By 2019, the growth rate of the marine economy will drop to 10.86%, and it will increase to 13.84% in 2020. The largest growth rate is in 2018.

4. Empirical Results and Evaluation of Coupling Relationships

4.1. Analysis of Coupling Results

Table 3. Coupling development types of marine resource carrying capacity and ME development

Coupling relationship	Scope
Severely disordered	[0,0.2)
Slight maladjustment	[0.2,0.4)
Barely coordinated	[0.4,0.6)
Moderate coordination	[0.6,0.8)
Well coordinated	[0.8,1]

As shown in Table 3, it is the type of coupling and coordinated development of MR carrying capacity and marine economy. When the coupling degree is between [0, 0.2), it means that the MR carrying capacity and marine economy are seriously out of balance. When the coupling degree is between [0.2, 0.4) is in a state of slight imbalance, when the coupling degree is between [0.4, 0.6), it means that the marine resource carrying capacity and the marine economy are barely in coordinated development, and when the coupling degree is between [0.6, 0.8) in a moderately coordinated development state, when the coupling degree is between [0.8, 1], it is in a well-coordinated development state.

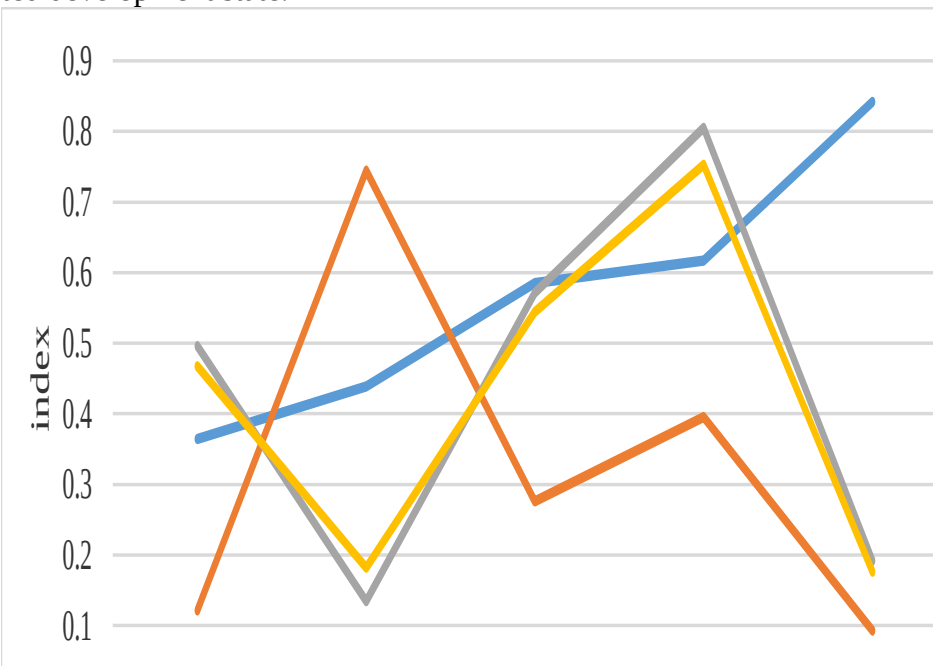

Figure 2. Coupling and coordinated development of MR carrying capacity and marine economy in D province

According to the data in Figure 2, from 2016 to 2020, the comprehensive index of MR carrying capacity of D province has increased year by year, which shows that the MR of D province have maintained a steady growth trend, while the comprehensive index of ME development has been showing a fluctuating trend. In 2017, the comprehensive index of ME development in Province D was the highest, reaching 0.745, an increase of 0.624 compared with 2016. In the following years, the index has been low and dropped to 0.093 in 2020, which shows that the marine economy of Province D The level of economic development is extremely unstable, and the stability of ME development has been greatly challenged. By analyzing the coupling degree and coupling coordination degree of MR carrying capacity and marine economy in D province from 2016 to 2020, combined with the coupling and coordinated development types classified in Table 3. We can see that in 2019, the coupling degree and coupling coordination degree of MR and marine economy in D province were the highest, which were 0.805 and 0.753, respectively, reaching a moderately coordinated development level, followed by 2016 and 2018. coordinated development. In 2017 and 2020, the coupling coordination degree of MR and ME development in D province was 0.182 and 0.176, respectively, which belonged to the type of serious imbalance. In 2016, the development level of marine economy was too low, and the carrying capacity of MR was average; in 2017, the marine economy of D province has achieved rapid development, and the carrying capacity of MR has also improved, indicating that the rapid development of marine economy has driven MR to have a However, in the past two years, the marine ecological environment of D province has been greatly damaged, which also shows that emergency work such as disaster prevention and early warning and post-disaster reconstruction in the province needs to be strengthened. On the whole, in the past five years, the coupling degree of MR carrying capacity and marine economy in D province has not reached a well-coordinated level of development.

4.2. Coupling Analysis of Marine Economy and MR

The development of marine economy has had a negative impact on MR. First, the rapid development of marine economy has brought pressure to resources and environment. The development of marine economy often depends on the progress of science and technology, which increases the utilization of MR and people often overuse them, which will make the deteriorating marine environment worse [17]; in addition, with the development of marine economy development, there will be more industrial pollution and damage to the marine environment, which is not suitable for its healthy development [18]. Secondly, developing the marine economy will provide a lot of financial and technical support for the development and management of the marine environment, and the marine ecosystem will become a part of the marine resource management plan. With the new understanding of the ocean, the state pays more attention to the development of the marine economy and marine ecosystem in the ME planning. Today, when material life is already abundant, people begin to pay attention to the protection of the ocean. At this time, the funds raised by the development of the marine industry will be returned to the ocean and put into the work of improving the marine environment [19]. Funds raised by the marine industry can play a role in protecting the marine environment through the creation of marine resource conservation organizations, as well as by changing the way the marine environment is managed with greater funding. However, in this matter, we must understand the harm caused by "development first and management later" to the marine environment. Just because the marine economy can promote the governance of MR and the environment, we should not wantonly exploit MR. It is not advisable to manage the marine environment at a certain level, because most of the MR in the marine environment are non-renewable and cannot be recovered once they are damaged to a certain extent.

Therefore, we must treat it correctly. The dialectical relationship between marine economy and MR, in order to coordinate the development of the two.

5. Conclusion

The research in this paper shows that the comprehensive index of ME development in province D was the highest in 2017, and it has shown a downward trend since then, indicating that the development potential of marine economy in province D has declined, while the carrying capacity of MR in province D has shown an upward trend. Rational development of MR in D province can stimulate the development of its marine economy, but at the same time, attention must be paid to the coupling and coordination of MR and marine economy in order to ensure the stability of marine ecological environment in D province and the sustainable development of marine economy.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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