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Quantitative Research on Intensive Utilization of Marine Resources Based on Information Entropy

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Abstract: In recent years, in order to pursue economic benefits, the development of marine resources(MR) in my country is in a disordered state. People mistakenly believe that MR are endless, high-intensity and uncontrolled development, although once brought huge economic benefits to coastal cities, However, with the continuous improvement of the development intensity of MR, people found that the economic benefits did not increase accordingly, but gradually decreased, and even the phenomenon of more and more losses occurred. In order to solve the above problems, this paper takes the MR of K province as an example, conducts an in-depth study on the development and utilization of three MR in K province from 2016 to 2021, and uses information entropy to classify the degree of intensive utilization of MR. The results show that the best years for intensive utilization of marine mineral resources are 2018 and 2020, and the years with the highest degree of intensive utilization of marine fishery resources and marine salt resources are 2018 and 2019, respectively.

1. Introduction

For my country, the marine economy should implement the concept of sustainable development. For a long time, due to our emphasis on the pursuit of marine economic benefits and the pursuit of output at all costs, we have neglected the scientific and effective development and utilization of MR, resulting in serious damage to marine ecosystems, and MR decline [1]. The intensive utilization of MR is the way to coordinate the development of marine economy and marine environment.

The research on the intensive utilization of MR at home and abroad has achieved good results. Foreign research perspectives on the intensive utilization of marine fishery resources are relatively broad. For example, a scholar combines the marginal analysis method in economic knowledge with the fishery biological model to construct a grey relational evaluation system for the intensification of marine fishery resources. The amount of fish is to meet the interests of both parties. Although the evaluation system is reasonable to a certain extent, the evaluation system is relatively simple and does not take into account the seasonal effects of fishing [2]. Based on the data of coastal provinces

and cities in recent years, some domestic scholars have analyzed and studied the efficiency level of my country's offshore fishing through the calculation results of the DEA model. It calls on the government to carry out clear, planned and continuous management of marine fishery resources [3-4]. To sum up, the current domestic and foreign scholars' research methods on the intensive utilization of MR mainly use the DEA model and the gray correlation coefficient to conduct quantitative and qualitative research on MR in all aspects. Nevertheless, the research on marine resource intensification at home and abroad has not yet formed a complete theoretical system, that is, the research on MR lacks systematicness.

This paper first puts forward the concept of information entropy from the perspective of information, then analyzes the natural and economic characteristics of MR, then analyzes the current situation of intensive utilization of three MR in K province, and finally evaluates the three types of marine resource intensive use in K province through information entropy The degree of chemical utilization and suggestions for improving the intensive utilization of MR are given.

2. Introduction of Information Entropy and Characteristics of MR

2.1. Information Entropy

Before introducing the concept and formula of information entropy, first understand the concept of self-information, which is of great help to the understanding of various entropy in the future. From a statistical point of view, self-information can be expressed as the amount of information brought about by the occurrence of a random event [5]. The probability of an event occurring determines the size of self-information. From the point of view of probability theory, if the probability of an event occurring is small, then in reality, if it actually occurs, we can call it “explosive” to a certain extent. News" [6-7]. The self-information has a strict mathematical expression. If the probability of a random event occurring is pi, then the self-information of the random event can be calculated by formula (1).

$$F(p_i) = -\log(p_i) \tag{1}$$

where log represents the base 2 logarithm. The minimum self-information is 0, and the value cannot be negative. The greater the probability of a random event, the smaller the self-information of the event.

Compared with self-information, information entropy has more statistical characteristics, and information entropy is the sum of various self-information in random distribution [8]. Information entropy defines the amount of information about information that a set of data can carry [9]. Given a probability distribution of random variable X, its Shannon entropy is defined as formula (2).

$$H(p) = -\sum_{i=1}^{n} p_i \log_2 p_i \tag{2}$$

H(p) measures the uncertainty of the probability distribution and is the expected value of the amount of information generated by all possible events. If H(p) is larger, the uncertainty of the probability distribution p will be higher, otherwise, the smaller it will be. When the probability distribution is uniform, the entropy value will reach the maximum, and $0 \leqslant H(p) \leqslant \log n$[10].

2.2. Characteristics of MR

(1) Natural characteristics of MR

Due to the differences in the location and geographical location of the ocean, MR have natural differences [11]. The natural differences in MR will continue to expand under the background of the continuous expansion of the scope of human use of the ocean and the continuous improvement of productivity levels. Under the conditions of rational and scientific development and utilization, MR can be continuously utilized for economic development [12].

(2) Economic characteristics of MR

The development direction of MR has many aspects, such as the development of marine aquaculture, the construction of port terminals, and the development of marine tourism projects [13]. However, once the investment in the development and utilization of the ocean is huge, it is difficult to completely dismantle the marine engineering after the investment and construction. Such a long and detailed master plan is indispensable before the investment and development of MR. When determining the development direction of MR, it is necessary to carry out all-round research and multi-channel investigation and exploration to avoid the occurrence of repeated construction and building pollution in the future [14-15]. Compared with land-based buildings, buildings in the ocean not only require high investment, but also after the project is changed, the original waste cannot be completely removed and will be left in the original location, causing pollution or even abandonment of the entire sea area [16].

3. Status Quo of Intensive Utilization of MR in K Province

3.1. Intensive Utilization of Marine Mineral Resources

Marine mineral resources are inseparable from production and life, and a large amount of oil and gas energy is consumed every day. As an emerging marine industry, the development speed of marine mineral resources is quite amazing [17]. The development of marine mineral resources in K province is not outstanding, but it lays the foundation for K province's economic revitalization. The average daily consumption of marine mineral resources in K province from 2016 to 2021 is selected for analysis. The result is shown in Figure 1, the consumption of various marine mineral resources has increased. In 2021, the average daily consumption of crude oil is 303,000 tons, an increase of 2.30 times compared with 2016; the average daily consumption of coal is 1.17 million tons, an increase of 2.45 times compared with 2016; the average daily consumption of fuel oil is 36.8 10,000 tons, an increase of 3.96 times compared with 2016; the average daily consumption of gasoline was 242,000 tons, an increase of 5.62 times compared with 2016; the average daily consumption of kerosene was 156,000 tons, an increase of 2.73 times compared with 2016; The average daily consumption of LPG was 93,000 tons, an increase of 5.17 times compared with 2016. The development and utilization of marine mineral resources is increasing and the trend is obvious.

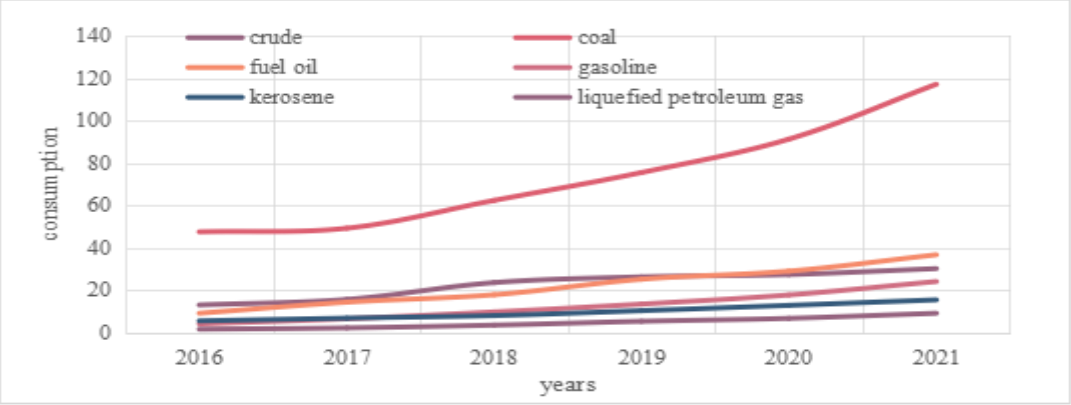

Figure 1. Average daily energy consumption by marine mineral resources in the province

3.2. Intensive Utilization of Marine Fishery Resources

Table 1. Development of fishery in K province

	2016	2017	2018	2019	2020	2021
Sea water products	324.8	353.2	366.4	437.8	536.9	662.7
Fishery output value	457.6	491.7	523.2	591.5	728.3	847.2

As shown in Table 1, marine fisheries in K province are developing rapidly. In 2016, the fishery output value of K province was 32.48 billion yuan, of which marine products were 32.48 billion yuan. From 2016 to 2018, the development of fishery in K province was relatively slow, and the annual increase in the output value of fishery and marine products was not large. In 2019, the output value of fishery in K province reached 59.15 billion yuan, and the output value of marine products was 43.78 billion yuan, an increase of 13.05% and 19.49% respectively over the same period. After 2019, the fishery in K province has developed rapidly. By 2020, the fishery output value will reach 72.83 billion yuan, and in 2.21 it will be 84.72 billion yuan; In 2021, the increase in fishery output value in K province will reach 16.33% compared with the previous year, and the marine products will increase by 23.43% compared with the previous year.

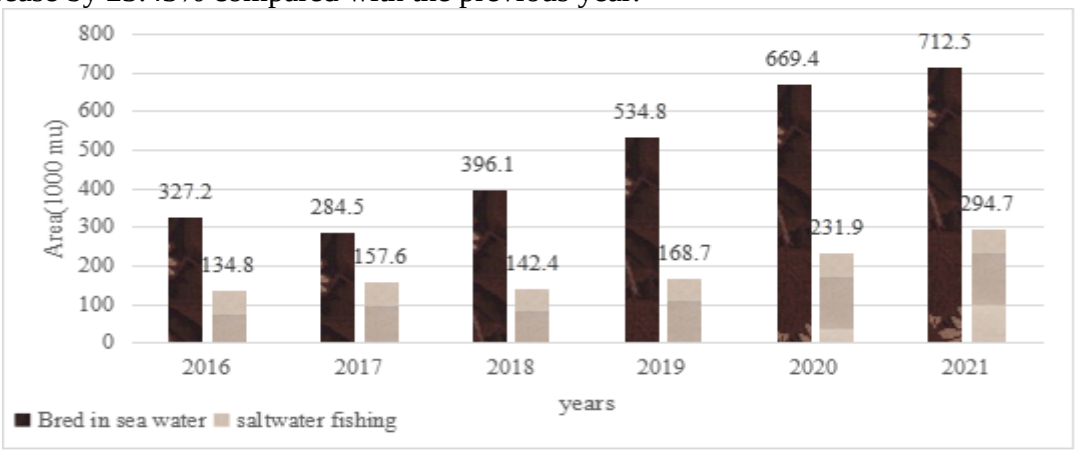

Figure 2. Marine aquaculture and marine fishing area in K province

Figure 2 shows the marine aquaculture area and marine fishing area in K province. The area of mariculture is basically on the rise, and only in 2017 the aquaculture area decreased, from 3.272 million mu in 2016 to 2.845 million mu in 2017. In 2018, the marine aquaculture area in K province was 3.961 million mu, and in 2019 it was 5.348 million mu. By 2020, the marine aquaculture area in K province has more than halved to 6.694 million mu. In 2021, the marine aquaculture area in K province will reach 7.125 million mu. However, the change in marine fishing area did not increase significantly, and with the increase of years, the gap between marine fishing area and mariculture area became larger and larger, which indirectly indicated that the output of marine aquaculture would increase and the amount of marine fishing would decrease.

3.3. Intensive Utilization of Marine Salt Resources

The distribution of sea salt in my country is divided into the southern salt area and the northern salt area. Among them, the northern salt area is the main salt-producing distribution area. Although the salt production in K province is not in the forefront, it also occupies a certain position. As shown in Table 2, in 2021, the output of sea salt will reach 3.182 million tons, the total industrial output value will reach 337.42 million yuan, and the total area of salt fields will reach 64,854

hectares. In addition, in 2021, potassium chloride will reach 5,041 tons, and industrial bromine will reach 567 tons. The years with the highest production of sea salt and the largest industrial output value are all in 2019; in 2021, the total area of salt fields is the largest, and the output value of potassium chloride is the largest; in 2020, the output value of industrial bromine is the largest.

Table 2. Utilization status of marine salt industry in K province

	2016	2017	2018	2019	2020	2021
Sea salt production (10,000 tons)	256.8	231.4	287.6	325.3	279.5	318.2
Total industrial output (ten thousand yuan)	27543	22768	30538	34967	31250	33742
Total area of salt pans (ha)	54281	53975	58573	62134	59263	64854
Potassium chloride (tons)	3638	4215	4279	4835	4356	5041
Industrial bromine (tons)	672	543	645	498	731	567

4. Results Analysis and Recommendations

4.1. Analysis of Quantitative Evaluation Results of Intensive Utilization of MR Based on Information Entropy

Table 3. Degree of intensive utilization of MR

	2016	2017	2018	2019	2020	2021
Marine mineral resources	2	1	3	2	3	2
Marine fishery resources	1	2	3	2	2	1
Marine salt resources	1	1	2	3	2	2

Combined with the status quo of intensive utilization of MR in K province analyzed above, this paper uses information entropy to evaluate the degree of intensive utilization of marine mineral resources, marine fishery resources, and marine salt resources in K province from 2016 to 2021, with grades 1-3. Represents the level of intensive utilization of MR. Among them, 1 represents a low degree of intensive utilization of MR, 2 represents a moderate degree of intensive utilization, and 3 represents a high degree of intensive utilization. The results are shown in Table 3. The marine mineral resources of K province have the highest degree of intensive utilization in 2018 and 2020, the marine salt industry resources have the highest degree of intensive utilization in 2018, and the marine salt industry resources have the highest degree of intensive utilization in 2019.

4.2. Countermeasures for Intensive Utilization of MR

(1) Increase publicity and raise awareness of the ocean

The government should focus on raising the national ocean awareness, increase efforts to publicize the principles, policies, laws and regulations of ocean management, use video, audio and other media to publicize the forms and trends of ocean development at home and abroad, and clarify the sense of urgency we face . Popularize people's marine scientific knowledge and enhance marine environmental protection and economic awareness [18].

(2) Adhere to both development and protection

While developing and utilizing MR, we should pay attention to the development scale and speed that should be compatible with the environmental resources and the carrying capacity of the environment, take a modern and new marine industry path, accelerate the transformation of economic growth patterns, and make MR rational, cyclical and orderly. use, and gradually realize the sustainable development of resources and economy. The focus of protecting the marine environment is to control land-based pollution. First, in terms of the harmless treatment of domestic

waste and urban sewage discharge, it is necessary to gradually realize the rationalization, harmless and valuable treatment of garbage, and discharge of domestic sewage that meets the standards [19].

(3) Give full play to the leading role of science and technology

Adhering to the scientific concept of development and the idea of increasing the contribution rate to marine science and technology, it strives to cultivate the abilities of various talents in marine scientific research, development and management. We need to maintain the stability of MR through scientific management; upgrade the backward marine industry through the application of modern science and technology. The intensive utilization of oceans should overcome the shortage of land and energy supply, and change to an extensive, scattered and low-level way that mainly relies on the consumption of material resources. It is necessary to focus on marine scientific and technological innovation, and gradually build a strong marine economy.

5. Conclusion

Since the reform and opening up, the development of MR, which has gradually entered the stage of rapid development, has become an important economic pillar, especially in the economic development of my country's coastal areas, which has gradually occupied an irreplaceable position. Outstanding achievements and great progress have been made in the development of MR in all aspects. This paper understands the degree of intensive utilization of MR in K province by analyzing the status quo of the utilization of three MR in K province, and puts forward suggestions for improving the intensive utilization of MR, hoping to promote the sustainable development of MR in this province.

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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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