International Journal of Advanced Smart Convergence Vol.10 No.2 158-167 (2021)
http://dx.doi.org/10.7236/IJASC.2021.10.2.158

IJASC 21-2-21

A Comparative Study of Fishery Industry Competitiveness in China's Coastal Provinces

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Abstract

Fishery industry is an important part of agricultural industry in coastal countries. The purpose of this study is to use the theory of industrial competitiveness for reference, use Analytic Hierarchy Process (AHP) and Delphi method to establish the evaluation index system, and analyze the fishery industry competitiveness of 11 coastal provinces in China. This study data came from China Fishery Statistical Yearbook 2020. The results show that Shandong Province is the most competitive province in fishery industry among the coastal provinces. The inter-provincial differences are great. Not only the resource endowment is the factor that affects the fishery industry competitiveness, but also the long-term profitability is too. The proportion of recreational fishery in the fishery economic output value has become one of the main indicators to measure the competitiveness of the fishery industry. The findings of this study suggest that all regions should adopt measures in accordance with local conditions, promote the integrated development of the fishery industry, enhance the added value of fishery products and enhance the competitiveness of fishery industry. The disadvantage of this study is that the fishery industry competitiveness of China's coastal provinces is only compared and analyzed. The future direction is to carry out a comparative study on the international competitiveness of fishery with other east Asian countries.

Keywords: *Fishery, Industrial competitiveness, China's coastal provinces, AHP, Comparative analysis*

1. Introduction

Fishery industry is an important part of agricultural industry, and its development quality directly affects the development level of regional agricultural economy. During the 13th Five-Year Plan period, remarkable achievements have been made in the development of China's fishery industry. The supply of aquatic products is sufficient, the price is stable, the industrial structure is constantly optimized, and the income of fishermen has achieved rapid growth. At the end of 2019, China's total output of aquatic products was 64.8 million tons,

Manuscript Received: May. 16, 2021 / Revised: May. 20, 2021 / Accepted: May. 22, 2021
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an increase of 0.35% over 2018. The total output value of fishery economy was 2,640.65 billion Yuan, 2.1% higher than that of 2018 [1]. Fishery science and technology in genetic breeding, healthy breeding, disease prevention and control, processing and circulation, energy conservation, environmental protection equipment, facilities, resources conservation and ecological restoration, fisheries information, and other fields to provide support. Some frontier fields are beginning to enter the international stage and take the lead. A batch of ecology, green, high efficient fishery technology model is widely used. Fisheries Administration of Ministry of Agriculture and Rural Affairs(2021)shows the fishery science and technology progress contribution rate has increased from 58% in 2015 to 63% in 2020 [2]. At present, China's fishery is in the period of transformation from the traditional mode to the modern fishery, and the fishery is large but not strong. There are still some prominent problems. Such as the fishery legal and policy guarantee system is not perfect, the fishery infrastructure is weak, the equipment is backward, and the fishery industry benefits need to be improved urgently. The Chinese government has decided to vigorously implement the rural revitalization strategy in accordance with the requirements of high-quality development. Water area ecological environment management is used to force fishery transformation and upgrading, and fishery modernization is used to promote water area ecological environment restoration. We will pursue supply-side structural reform of the fishery industry, pursue green, safe, integrated, open and well-regulated development, improve the quality and efficiency of the fishery industry, reduce fishing and increase livelihood, pursue green development and enrich fishermen. We will promote the formation of a new pattern of fishery development featuring optimized industries, high-quality products, conservation of resources and environmental friendliness, and accelerate the building of a strong modern fishery country. Coastal provinces are the regions with the highest concentration of fishery resources in China. In 2018, the fishery output value of 11 coastal provinces was 911.668 billion Yuan, accounting for 71.14% of the national fishery output value [3].

The purpose of this study is to draw on the theory of industrial competitiveness, establish the evaluation index system by using *AHP* method, compare and analyze the fishery industry competitiveness of China's 11 coastal provinces, find out the main factors that affect the fishery industry competitiveness, and put forward countermeasures and suggestions to improve the fishery industry development. Under the background of the implementation of the rural revitalization strategy, the development of fishery is bound to form a strong economic belt, drive the large-scale development of fishery industrial clusters, and directly affect the effective supply of national agricultural products and the competitiveness of international agricultural products. It is of great significance to study the fishery industry competitiveness of China's coastal provinces to promote the fishery development and economic growth in China.

2. Literature Review

Competitiveness is the foundation and motive force of competition. As a complex and comprehensive theme, its connotation and form of expression often change with the different times background and research perspective. Xin Yi and others took the "olive" model as the theoretical framework, and believed that quality and safety, yield, product structure, circulation efficiency, marketing ability, exchange rate and trade policy were the main factors affecting the international competitiveness of agricultural industry [4]. According to the level of competitiveness mentioned by Michael Porter in "National Competitive Advantage", competitiveness can be divided into four levels according to the competitive subjects, national competitiveness, industrial competitiveness, enterprise competitiveness and product competitiveness. Wang Miao and other believe that the competitiveness of fishery industry is the comprehensive strength that the fishery industry in a certain region can compete for and control the market and maintain continuous growth and profit on the basis of more effective transformation and allocation of fishery resources than similar

industries in other regions in the process of development in the market economy environment [5]. Liu Chun-xiang divided the fishery competitiveness into aquatic product competitiveness and fishery industry competitiveness, and made a horizontal comparison of Zhejiang's aquatic product competitiveness by using explicit comparative advantage, intra-industry trade, explicit trade advantage, export competitiveness and other indexes. Based on the established evaluation index system, this paper conducted an empirical study on the fishery industry competitiveness of Zhejiang Province and compared it with other strong fishery provinces [6]. Some scholars use different research methods to discuss the competitiveness of fishery. Wang Miao et al. constructed the analysis framework of "SCP-S", defined the competitiveness and evaluation index system of fishery industry based on the theory of industrial organization, and used factor analysis method to comprehensively evaluate and rank the competitiveness of fishery industry in 9 coastal provinces and regions of China [5]. Based on the GEMS model, Qin Hong and others constructed an evaluation index system and conducted a quantitative evaluation on the competitiveness of Qingdao Marine fishery industry cluster based on a questionnaire survey of cluster enterprises [7]. Wang You-li and others evaluated the regional fishery competitiveness of Fujian Province from the perspective of production capacity by using the approach to ideal point method [8]. Wang Qian and others established a fishery inter-provincial competitiveness evaluation system, and used factor analysis to comprehensively evaluate and rank the fishery competition conditions of various provinces and cities in coastal areas. The results found that the international competitiveness of fisheries in coastal areas of the provinces and cities presents three obvious levels [9]. In addition, Wang Yi-yi (2012), Yang Yi-shui (2013), Zang Yan-yun (2017) and Zhang Li-ping (2019) also used grey system model, principal component analysis (*PCA*), analytic hierarchy process (*AHP*) and factor analysis method to study the fishery competitiveness of different provinces in China. Lee and Kim used *AHP* and Delphi Method to study the direction of South Korea's fishery policy and believed that the future fishery policy of South Korea should aim at supplying sustainable seafood for public consumption [10]. Therefore, the application of quantitative analysis method to analyze the competitiveness of regional fishery industry is conducive to clarify the advantages and disadvantages of regional fishery industry, the future development direction and the focus of industrial promotion. This study by reviewing the previous research of quantitative research methods, using the *AHP* method and Delphi method to establish evaluation index system, evaluate the competitiveness of 11 provinces in China's coastal fisheries industry. This paper compares and analyzes find the main influencing factors of regional fisheries industry competitiveness, and put forward countermeasures and Suggestions in the fishery industry competitiveness.

3. Analytical Methods

3.1 Analytic Hierarchy Process

American operations researcher T. L. Saaty proposed a decision-making method that combines orientation and quantification and is suitable for solving complex and multi-dimensional problems—Analytic Hierarchy Process (AHP).This method is a decision making method which decomposes the elements always related to the decision into the levels of goal, criterion and scheme, and on this basis carries on the qualitative and quantitative analysis. Specifically speaking, for a complex decision-making problem, the decision goal is decomposed into several levels of multiple indicators or constraints based on the comprehensive dimensions and perspectives of experts and decision-making subjects, and targeted comparisons are made between each level. Quantitative analysis obtains the single-level ranking value and total ranking value of each level, so that scientific and reasonable decisions can be made according to the ranking value of each index or constraint condition [11]. The specific steps are as follows:

3.1.1 Constructing structural model

(1) The highest level. There is only one element in this level, which is usually the predetermined goal or ideal result of analyzing the problem, so this level is also called the target level.

(2) The middle level. This level contains the intermediate links involved in the realization of the goal. It can be composed of several levels, including the criteria to be considered, sub-criteria, so this level is also called the criteria layer.

(3) The lowest level. This level includes all kinds of measures and decision-making schemes available for the realization of the goal, so it is also called the measure level or scheme level.

3.1.2 Construction of judgment matrix

Constructing judgment matrix is the key to use *AHP* method. The concrete method is to compare the importance of each evaluation index by several experts. And write the comparison result b_{jk} $(j,k=1,2,\ldots,n)$ as$B=(b_{jk})_{n\times n}$. In the formula, b_{jk} represents the importance degree of the j index compared with the k index, $b_{jk}=\frac{1}{b_{kj}}(j,k=1,2,\ldots,n)$.

3.1.3 Calculation of index weight

The weights of each index can be solved by the following methods:

(1) Normalize the columns of judgment matrix B.

$$\overline{b_{jk}}=\frac{b_{jk}}{\sum_{j=1}^{n}b_{jk}}(j,k=1,2,\ldots\ldots,n) \quad (1)$$

(2) Find the sum of each element of the judgment matrix.

$$\overline{\omega_j}=\sum_{k=1}^{n}\overline{b_{jk}}\,(j,k=1,2,\ldots\ldots,n) \quad (2)$$

(3) Normalize $\overline{\omega_i}$.

$$\omega_j=\frac{\overline{\omega_j}}{\sum_{j=1}^{n}\overline{\omega_j}}(j,k=1,2,\ldots\ldots,n) \quad (3)$$

Then $\omega=(\omega_1,\ \omega_2,\ \ldots,\ \omega_j,\ \omega_n)^T$ is the weight vector corresponding to the n indices in question, and there are$\omega_1+\omega_2+\cdots\cdots+\omega_n=1$.

3.1.4 Consistency test of judgment matrix

The consistency test of judgment matrix is carried out by the following methods:

(1) According to $B\omega=\lambda_{max}\omega$, the maximum eigenvalue of judgment matrix is obtained.

$$\lambda_{max}=\frac{1}{n}\sum_{j=1}^{n}\frac{B_j\omega}{\omega_j}(j=1,2,\ldots\ldots,n) \quad (4)$$

(2) Consistency index was calculated by$CI=\frac{\lambda_{max}-n}{n-1}$, where n is the number of evaluation indexes.

(3) Consistency index was calculated by$CR=\frac{CI}{RI}$. RI is the average random consistency index of the

corresponding order, and *RI* value [12] of matrix of each order is shown in Table 1.

Table 1. Average random consistency index table of order 1-9

Order	1	2	3	4	5	6	7	8	9
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46

When $CR \geq 0.1$, it is considered that the judgment matrix does not conform to the random consistency index and does not pass the consistency test. At this time, experts' opinions should be widely sought again, the judgment matrix should be adjusted, the judgment matrix should be re-determined, and the above calculation steps should be repeated until it meets the requirement of $CR<0.1$.

3.2 Index system construction and weight determination

Based on the research foundation of scholars such as Liu Chun-xiang et al. [6], an index system was constructed. In order to increase the objectivity and scientificity of weight determination, this study conducted a questionnaire survey among 7 researchers in aquaculture technology and fishery economy. By sorting out the questionnaire and constructing the judgment matrix, the evaluation indexes and weights constructed are shown in Table 2. After calculation, the results of consistency ratio *CR* are shown in Table 3, and their values are all lower than *0.1*, so the analysis is consistent.

Table 2. Evaluation index and weight of fishery industry competitiveness

Level（A）	Level（B）	Weight	Level（C）	Weight	Total weight of each index	Sequence
Fishery Industry Competitiveness A	Production capacity B1	0.151	Cultivation yieldC1	0.112	0.017	18
			Catch yieldC2	0.112	0.017	18
			Output of pelagic fisheryC3	0.112	0.017	18
			Fishery output value C4	0.399	0.060	6
			Fishery economy proportion C5	0.265	0.040	11
	Processing and trading capabilities B2	0.092	Total amount of processed aquatic products C6	0.750	0.069	4
			Import and export volume C7	0.250	0.023	17
	Ascending ability B3	0.192	Fishery production value increased C8	0.244	0.047	10
			Processing growth capacity C9	0.203	0.039	12
			Recreational fishery accounted of fishery economy C10	0.386	0.074	3
			Fishermen's income increased C11	0.167	0.032	14
	Long-term profitability B4	0.224	Production capacity per capita C12	0.750	0.168	1

			Fishermen income C13	0.250	0.056	7
	Science and Technology Promotion Capability B5	0.121	Number of promotion agencies C14	0.209	0.025	16
			Expenditure of extension agencies C15	0.240	0.029	15
			Promote performance C16	0.551	0.067	5
	Resource endowment B6	0.220	Aquaculture area C17	0.375	0.083	2
			The number of aquatic seedlings C18	0.233	0.051	9
			The number of fishing boats C19	0.150	0.033	13
			The number of fishery employees C20	0.241	0.053	8

Table 3.Consistency test results

B1-CR	B2-CR	B3-CR	B4-CR	B5-CR	B6-CR	A-CR	Total order sorting-CR
0.013	0	0.019	0	0.018	0.054	0.091	0.033

3.3 Data sources and Research Objects

The 20 evaluation indicators in the 6 factors designed in this study are mainly collected and sorted through statistical data from China Fisheries Statistical Yearbook 2020, China Statistical Yearbook 2020 and the official website of the Ministry of Agriculture and Rural Affairs, PRC (the fishery statistical data in Taiwan has not been included yet). The indicators in this study are the fishery statistical data of 11 coastal provinces of China in 2019. Since the indicators data of fishery competitiveness are different in dimension, the original indicators data should be standardized and the 20 indicators data should be processed without dimension according to Equation (5). Coastal provinces in China are Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi Zhuang autonomous region and Hainan. The standardized indicators data are shown in Table 4.

$$Y_j(t) = \frac{X_i(t) - minX_i(t)}{maxX_i(t) - minX_i(t)} \quad (5)$$

Where $i= 1,2,\ldots\ldots,20;\ t = 1,2,\ldots\ldots,11$， $X_i(t)$ is the indicators value of the ith in t province, and $Y_i(t)$ is the dimensionless value.

Table 4.Thestandardizeddataofindicatorsin 11 coastal provinces of China

Province / Indicators	TJ	HB	LN	SH	JS	ZJ	FJ	SD	GD	GX	HN
C1	0.019	0.087	0.510	0.000	0.556	0.327	0.813	0.828	1.000	0.372	0.075
C2	0.000	0.074	0.229	0.048	0.215	1.000	0.657	0.651	0.406	0.189	0.321
C3	0.015	0.108	0.513	0.355	0.018	0.856	1.000	0.801	0.131	0.035	0.000
C4	0.014	0.110	0.374	0.000	1.000	0.654	0.847	0.886	0.876	0.320	0.228
C5	0.497	0.000	0.404	0.538	0.675	1.000	0.887	0.373	0.599	0.212	0.668

C6	0.000	0.012	0.358	0.002	0.192	0.297	0.643	1.000	0.202	0.111	0.059
C7	0.195	0.007	0.630	0.323	0.035	0.270	0.867	1.000	0.766	0.000	0.025
C8	0.506	0.721	0.707	0.383	0.000	0.798	0.796	0.133	0.761	1.000	0.676
C9	1.000	0.847	0.337	0.512	0.453	0.573	0.553	0.407	0.263	0.457	0.000
C10	0.392	0.408	0.438	0.104	0.304	0.155	0.000	0.999	0.437	0.032	0.483
C11	0.906	1.000	0.569	0.372	0.789	0.880	0.839	0.673	0.907	0.540	0.000
C12	0.249	0.050	0.168	1.000	0.018	0.169	0.181	0.080	0.096	0.000	0.096
C13	0.874	0.227	0.304	0.920	0.925	1.000	0.536	0.571	0.468	0.508	0.000
C14	0.000	0.172	0.112	0.076	0.867	0.373	0.702	0.929	0.638	1.000	0.005
C15	0.087	0.165	0.141	0.442	0.934	0.572	0.313	0.653	1.000	0.641	0.000
C16	0.136	0.008	0.171	0.001	0.080	0.018	0.002	1.000	0.090	0.043	0.000
C17	0.015	0.158	1.000	0.000	0.714	0.294	0.288	0.902	0.563	0.207	0.048
C18	0.005	0.003	0.008	0.000	0.059	0.023	0.009	0.007	1.000	0.068	0.008
C19	0.000	0.082	0.220	0.025	0.251	1.000	0.463	0.394	0.342	0.170	0.178
C20	0.007	0.130	0.394	0.000	0.772	0.510	0.689	1.000	0.942	0.612	0.177

※FJ-Fujian; GD-Guangdong; GX-Guangxi; HN-Hainan; HB-Hebei; JS-Jiangsu; LN-Liaoning; SD-Shandong; TJ-Tianjin; SH-Shanghai; ZJ-Zhejiang (The following is the same)

4. Analysis Results

This study calculated the original data of constructed indicators after standardized processing and their corresponding weights, and obtained the evaluation results and ranking of the fishery industry competitiveness of China's coastal provinces, as shown in Table 5 and Figure 1.

Table 5. Evaluation results of fishery industry competitiveness in 11 coastal provinces of China

Province / Indicators	TJ	HB	LN	SH	JS	ZJ	FJ	SD	GD	GX	HN
B1	0.021	0.011	0.060	0.028	0.101	0.116	0.128	0.107	0.103	0.038	0.047
B2	0.004	0.001	0.039	0.008	0.014	0.027	0.064	0.092	0.032	0.008	0.005
B3	0.121	0.129	0.097	0.057	0.065	0.099	0.086	0.118	0.107	0.084	0.067
B4	0.091	0.021	0.045	0.220	0.055	0.084	0.060	0.045	0.042	0.028	0.016
B5	0.012	0.010	0.018	0.015	0.054	0.027	0.027	0.109	0.051	0.047	0.000
B6	0.002	0.023	0.111	0.001	0.111	0.086	0.076	0.141	0.159	0.059	0.020
A	0.251	0.195	0.371	0.328	0.401	0.440	0.442	0.612	0.494	0.264	0.155

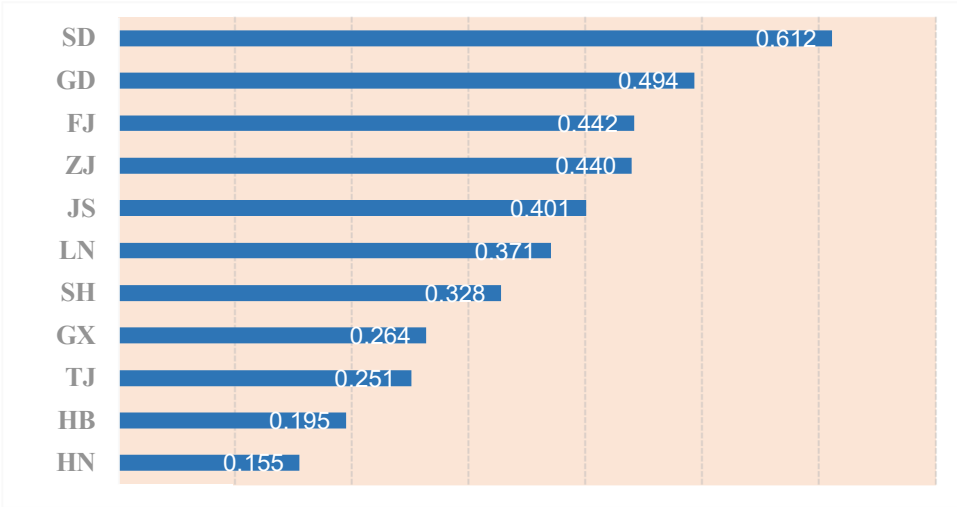

Figure 1. Distribution of fishery industry competitiveness of China's coastal provinces

It can be seen from Table 5 that among the 11 coastal provinces in China, Shandong Province has the strongest competitiveness in fishery industry, with an evaluation score of 0.612, which is consistent with the research results of Liu Chun xiang et al. [6]. Guangdong ranked second, with a score of 0.494; Fujian ranked third, with a score of 0.442; Zhejiang ranked fourth with a score of 0.440, while Jiangsu ranked fifth with a score of 0.401. The evaluation scores of fishery industry competitiveness of these four provinces have little difference, and these provinces are all distributed in the southern coastal areas of China. The other provinces were Liaoning, Shanghai, Guangxi, Tianjin, Hebei and Hainan, with scores of 0.371, 0.328, 0.264, 0.251, 0.195 and 0.155respectively. See Figure 1 for ranking distribution of fishery industry competitiveness of 11 coastal provinces of China.

From the perspective of the six factors that constitute the competitive power of fishery industry, the most influential factors are long-term profitability and resource endowment. Shandong Province ranks the first in competitiveness. The most prominent competitiveness of fishery industry is resource endowment and scientific and technological promotion ability, while other factors are relatively high. Compared with Zhejiang Province and Shanghai, Jiangsu Province still lacks the ability of science and technology popularization and long-term profitability. As an international metropolis, Shanghai is not strong in fishery processing and trade ability and sustainable development ability, but it has strong long-term profitability, which may be due to the influence of urban high-end consumer market. As a big agricultural province, all the elements of fishery industry competition are not prominent in Hebei province. Therefore, Hebei province should make good use of the advantages of abundant fishery resources, speed up scientific and technological innovation and achievement transformation, strengthen the integrated development of fishery first, second and third industries, improve the sustainable development ability and long-term profitability of fishery, and enhance the overall competitiveness. Hainan Province is located in an important strategic position in the South China Sea. Although Hainan Province has rich fishery resources, it should strengthen fishery processing and trade as well as the development of recreational fishery and improve the added value of fishery products based on the influence of national security strategy and other factors. The situation of fishery industry competition factors in China's coastal provinces is shown in Figure 2. From 20 concrete evaluation index, index of the top five is production capacity per capita, aquaculture area, recreational fishery economy proportion, aquatic products processing capacity and science and technology to promote the performance. This is the main factors influencing the competitiveness of regional fishery industry, fisheries

development policy in various areas and regional economic development planning should consider these factors.

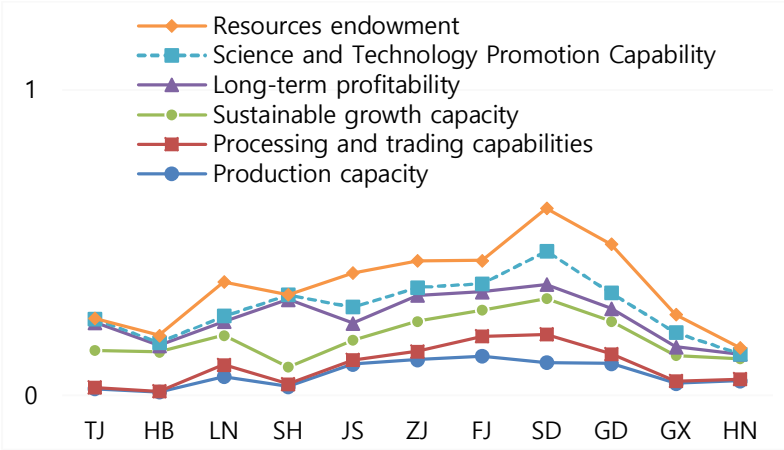

Figure 2. Situation of fishery industry competition factors in China's coastal provinces

5. Conclusions

Under the background of China's implementation of the rural revitalization strategy, the evaluation of regional fishery industry competitiveness is conducive to promoting the adjustment and optimization of fishery industry structure. By establishing the evaluation index system of fishery industry competitiveness, this paper evaluates the fishery industry competitiveness of China's coastal provinces with the methods of *AHP* and Delphi method. The results show that Shandong Province has the strongest competitiveness in fishery industry among the 11 coastal provinces, and the differences among provinces are great. Long-term profitability and resource endowment are the two main factors affecting the competitiveness of fishery industry. The per capita production capacity, aquaculture area, the proportion of recreational fishery in the fishery economy, the amount of aquatic products processed and the performance of scientific and technological promotion are the five main indicators that affect the competitiveness of the fishery industry. It is suggested that all regions should take measures according to local conditions, develop leisure fishery at the right time, pay attention to improving labor productivity, expand fishery to the secondary and tertiary industries, and improve fishery products' added value and industrial competitiveness.

This study is insufficient because it only conducts comparative analysis on the fishery industry competitiveness of China's coastal provinces. The future research direction is to compare the international competitiveness of fishery with other east Asian countries.

Acknowledgement

This work was supported by Sehan University Research Fund in 2021.

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