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Green Development of Marine Fishery in Zhoushan City: Status Quo, Challenges and Countermeasures

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Abstract: ***As an important base for Chinas marine fisheries, Zhoushan City has achieved significant results in promoting the green development of marine fisheries in recent years. Leveraging its unique marine resources and policy support, Zhoushan City has formed a complete industrial chain that integrates fishing, aquaculture, processing, and sales, with a rich variety of seafood products and stable yields. However, with the over-exploitation of marine resources and increasing environmental pressures, Zhoushan Citys marine fisheries face numerous challenges, such as the decline in fishery resources, ecological pollution, and an unreasonable industrial structure. To address these issues, Zhoushan City has implemented a series of measures, including strengthening the protection of fishery resources, enhancing environmental supervision, and optimizing the industrial structure, aiming to achieve sustainable development in marine fisheries. This paper provides an in-depth analysis of the current status and challenges of green development in Zhoushan Citys marine fisheries, and proposes a series of targeted strategies and recommendations to provide valuable references for the green transformation and development of Zhoushan Citys marine fisheries.***

Keywords: Marine fishery, Green development, Sustainable development**.**

1. Introduction

The 21st century is hailed as the century of the ocean. In this era, fisheries, as an indispensable part of the marine economy and industrial system, are attracting increasing attention and demonstrating robust development vitality. However, in recent years, issues such as the intensifying depletion of fishery resources, unreasonable industrial structure, and lagging fisheries technology have gradually come to light, posing significant challenges to the further prosperity and deepening development of marine fisheries in Zhoushan City. The traditional model of fisheries development can no longer address these problems. On January 6, 2022, the "14th Five-Year Plan for National Fisheries Development" emphasized that during the "14th Five-Year Plan" period, fisheries development should adhere to the principle of green development, set green ecological goals, firmly establish the concept that "clear waters and green mountains are as valuable as gold and silver," leverage the unique functions of fisheries in ecosystem governance, conserve aquatic biological resources, and improve water environment conditions. Efforts should also be made to tap into the potential for reducing emissions and increasing carbon sequestration in fisheries, contributing to achieving peak carbon emissions and carbon neutrality.

In 2018, Zhoushan City issued the "Three-Year Action Plan for the Construction of National Green Fisheries Experimental Base (2018-2020)," which proposed that "by 2020, a new system of green fisheries development with Zhoushan characteristics will be basically established, exploring a modern path for fisheries development that integrates resources, environment, industry, and peoples livelihood, providing replicable, reference-worthy, and scalable Zhoushan solutions for the green development of Zhoushans fisheries."

The green development of fishery refers to the targeted transformation of production mode, optimization of industrial structure, implementation of integrated development and improvement of development quality, maintaining ecological stability and sustainable and efficient fishing, realizing the organic unity of fishery development and ecological resource protection, and making fishery greener, fishing villages more beautiful and fishermen richer.

The research on the green development of marine fisheries in Zhoushan City is of great significance for promoting the transformation and upgrading of local fishery economy, protecting marine ecological environment, and enhancing the sustainable development capacity of fisheries. Through in-depth studies, it can provide theoretical support and practical guidance for the green development of marine fisheries in Zhoushan City and even nationwide, promoting the rational use of fishery resources and environmental protection, achieving coordinated development of economic benefits, social benefits, and ecological benefits.

The research will focus on the current status, challenges, and strategies for the green development of marine fisheries in Zhoushan City. It will specifically cover an overview of marine fishery resources, green development measures and their effectiveness, the challenges faced, and strategies for optimizing industrial structure and enhancing fishery science and technology innovation capabilities. This will form a comprehensive understanding and in-depth analysis of the green development of marine fisheries in Zhoushan City, providing strong support for the formulation and implementation of relevant policies.

2. Current Situation of Green Development of Marine Fishery in Zhoushan City

2.1 General Situation of Marine Fishery Resources

Zhoushan city is located in the southeast coast of China, on the coast of the East China Sea. It is composed of many

islands and has unique Marine fishery resources. Its sea area is vast, the water quality is fertile and the natural environment is superior, which provides good conditions for the development of fishery.

Zhoushan City boasts abundant fishery resources, diverse and magnificent. Among these, fish resources are particularly rich, mainly including large yellow croaker, small yellow croaker, ribbon fish, cuttlefish, mackerel, pomfret, mackerel, eel, and flounder. In addition, crab and shrimp resources are also considerable, totaling over 40 species, with the three-spined swimming crab, Horseshoe shrimp, and eagle-claw shrimp being the main representatives. These valuable fishery resources are primarily concentrated in the Zhoushan Fishing Ground, which covers multiple sea areas such as Zhongjieshan and Yangan, with a total area of about 34,000 square kilometers. Thanks to its superior natural conditions and rich biological resources, the Zhoushan Fishing Ground has nurtured more than 1,100 species of marine life.

In recent years, the fishery production in Zhoushan City has maintained steady growth. For example, in the first half of 2024, the total fishery output in Zhoushan City reached 662,200 tons, an increase of 4.42% compared to the same period last year. Among these, domestic fishing output was 294,800 tons, up 1.67% year-on-year; offshore fishing output was 311,700 tons, up 6.17% year-on-year; and aquaculture output was 55,800 tons, up 10.01% year-on-year. These fishery outputs not only meet local market demand but also sell far and wide, bringing significant economic benefits to Zhoushan City. At the same time, the development of the fishery industry has also boosted related industrial chains, such as fishery processing, cold chain logistics, and fishery equipment, further promoting the prosperity of the local economy.

2.2 Measures and Achievements of Green Development in Marine Fisheries

In recent years, Zhoushan City has achieved significant results in the green development of marine fisheries. By innovating and applying fishery technologies, Zhoushan City has continuously improved the efficiency and quality of its fisheries production. For example, promoting the use of modern fishing techniques and aquaculture models has reduced damage to marine ecosystems while increasing fishery yields and economic benefits.

In terms of fishery resource protection and restoration, Zhoushan City actively implements measures such as stock enhancement and artificial reef construction, effectively restoring nearshore fishery resources. Additionally, multiple marine special protection zones have been established, strictly limiting fishing activities to protect rare and endangered species and marine ecosystems. The implementation of these measures has ensured that the fishery resources in the Zhoushan waters are effectively protected and restored.

Marine ecological environment governance is also a crucial part of Zhoushan Citys green fishery development. By strengthening the management of pollutants from port and ship activities and carrying out coastal line restoration, Zhoushan City has effectively improved the quality of its marine ecological environment. At the same time, it has increased monitoring and law enforcement efforts on marine pollution to ensure continuous improvement of the marine ecological environment.

In terms of green fisheries policies and regulations, Zhoushan City has formulated a series of local laws and measures, providing strong support for the development of green fisheries. For example, it has issued regulations such as the “Zhoushan City National Marine Special Reserve Management Regulations,” which standardize fishing and aquaculture practices and protect marine ecosystems. Additionally, through policy guidance and financial support measures, it encourages fishermen and enterprises to actively participate in the development of green fisheries.

2.3 Construction of Green Fishery Industry Chain

In the construction of green fishery industry chain, the integrated development of fishing, processing and breeding is the core. By integrating fishing, processing and breeding links, the efficient utilization of resources and the coordinated development of industries can be realized.

The market for aquatic products and brand building are equally important. By establishing and improving the aquatic product market system, we can promote the circulation and sales of aquatic products. At the same time, strengthening brand building enhances the reputation and popularity of aquatic products, boosting market competitiveness. This helps drive the upgrading and transformation of the fishing industry, achieving sustainable development. In terms of brand building, Zhoushan City fully leverages its abundant fishery resources and unique geographical advantages to actively create the image of “Chinas Green Aquatic Products Capital.” Through enhanced brand promotion and publicity, it aims to increase the recognition and reputation of Zhoushans aquatic products. Additionally, it focuses on improving product quality and standardization, establishing a robust regulatory system for aquatic product safety to ensure their safety, quality, and traceability. In market expansion, Zhoushan City actively develops both domestic and international markets, enhancing cooperation and communication with dealers and consumers worldwide, driving dual growth in exports and domestic sales of aquatic products.

The resource utilization of fishery waste is also a critical component in building the green fishery industry chain. By employing advanced technological methods, fishery waste can be transformed into valuable resources such as fertilizers and feed. This not only reduces waste emissions but also provides raw materials for other industries, achieving the recycling of resources.

3. Challenges Facing the Green Development of Marine Fishery in Zhoushan City

3.1 Overfishing of Fishery Resources

In recent years, the number of motorized fishing boats in Zhoushan City has significantly increased, and the tonnage of these vessels is growing (see Figure 1). At the same time, fishermen are adopting more mechanized fishing methods.

These changes have undoubtedly intensified fishing activities, leading to a sharp decline in fishery resources. However, many fishermen have yet to recognize this serious issue and are unaware of the profound damage overfishing has inflicted on fishery resources. The exploitation of fishery resources is becoming increasingly excessive, with catch volumes far exceeding the regenerative capacity of the resources. This long-term uncontrolled fishing is the primary cause of the depletion of Zhoushans fishery resources. Zhoushan City, blessed with the natural treasure trove of the East China Sea fishing grounds, boasts unparalleled fishery resources that have historically attracted numerous fishermen for fishing operations. However, as fishing technology continues to advance and fishing intensity keeps rising, fishery resources are facing unprecedented pressure, gradually heading towards exhaustion. Under the shadow of overfishing, traditional fishery resources in the Zhoushan fishing grounds, such as large yellow croaker, small yellow croaker, and other four major economic fish species, have seen a significant reduction in their resource levels, with catch volumes plummeting. Moreover, marine environmental pollution has become increasingly severe, posing another major threat to fishery resources and further exacerbating the pressure on their protection [1].

Figure 1: Number of motorized fishing boats in Zhoushan City from 2014 to 2022

3.2 Marine Ecological Environment Pollution

The ecological pollution of Marine fishery in Zhoushan city is a complex and serious problem. The main pollution sources include ship discharge, offshore oil development, factory sewage discharge and the extensive use of agricultural chemical fertilizer.

Ship emissions are a significant source of marine pollution, including unprocessed fuel leaks, bilge water, and engine room wastewater being directly discharged into the ocean, causing damage to marine ecosystems. During offshore oil development, large amounts of waste and oily wastewater are also released into the sea, posing severe threats to marine life. Moreover, factories in coastal areas, especially those with high pollution such as dyeing, textile, and electroplating industries, discharge untreated wastewater directly into the ocean, further exacerbating marine pollution.

The deterioration of the ecological environment has had profound impacts on fisheries. First, pollution has led to a reduction in fishery resources; fishermen now have to travel farther across the seas to catch fish, resulting in a significant decline in catch yields. Second, pollution has disrupted marine ecosystems, causing a decrease in high-value fish populations and affecting fishermens economic income. Furthermore, marine aquaculture is also affected by environmental degradation; red tides and other marine disasters have dealt severe blows to the aquaculture industry.

3.3 Unreasonable Industrial Structure

The deepening development of green fisheries in Zhoushan City has been somewhat constrained by an unreasonable industrial structure. By conducting a thorough analysis of the income trends of major fishery industries shown in Figure 2, we can observe that from 2008 to 2018, despite the continuous growth in revenue from fishing, aquaculture, and related secondary and tertiary sectors, this growth pattern reveals an imbalance in the industrial structure. Specifically, the fishing industry accounts for a significant portion of income, with particularly notable annual growth rates. In contrast, while the secondary and tertiary sectors of the fishery industry have seen some growth, their contribution and growth rate appear relatively slow. Of particular concern is that the aquaculture sector has the lowest share of total revenue, further highlighting the current over-reliance on traditional fishing methods in Zhoushans fishery industrial structure.

This phenomenon indicates that the development of Zhoushan Citys fishing industry has yet to fully achieve diversification and modernization of its industrial structure, still primarily relying on traditional fishing methods. Therefore, to promote the sustainable development of green fisheries, Zhoushan City urgently needs to take effective measures to optimize the industrial structure of the fishing sector, increase support for emerging areas such as aquaculture, aquatic product processing, cold chain logistics, and recreational fishing, in order to achieve diversification, efficiency, and greening of the fisheries economy.

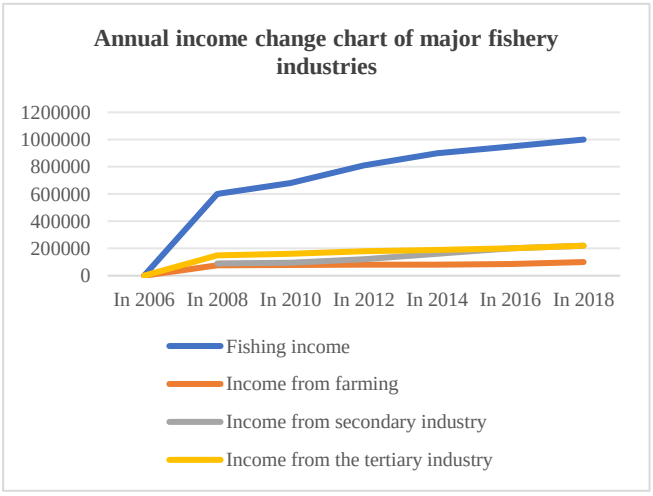

Figure 2: Annual income change of major fishery industries in Zhoushan City

4. Countermeasures for Green Development of Marine Fishery in Zhoushan City

4.1 Strengthening the Management of Fishery Resources

In terms of the total management system for fishery resources, Zhoushan City strictly enforces the national "dual control" policy for fishing vessels, implementing a management system of "total control, tiered determination, graded responsibility, and orderly adjustment" for all domestic fishing boats in the city. This system aims to control the number and power of fishing vessels, prevent overfishing, and protect the sustainable use of fishery resources. Based on the current status of fisheries development, the Zhoushan municipal government has set control indicators for the total number and power of domestic fishing vessels in each county (district), which are then broken down and implemented at all levels of government and relevant departments to ensure the effective enforcement of the system.

In addition, Zhoushan City actively promotes the release and enhancement of fishery resources. By releasing various aquatic organisms such as large yellow croakers, Mans needleless cuttlefish, and jellyfish, it has effectively restored the fishery resources in the Zhoushan fishing grounds, generating significant ecological, economic, and social benefits. In recent years, Zhoushan City has invested substantial funds into stock enhancement and release programs, bringing back traditional economic fish species that were once on the brink of extinction, thus injecting new vitality into the sustainable development of the Zhoushan fishing grounds. Efforts have also been made to strengthen the construction of monitoring and evaluation systems for fishery resources, improving data accuracy and timeliness, providing reliable support for scientific decision-making [5].

4.2 Promoting Marine Ecological and Environmental Protection

Adopt proactive ecological restoration and protection measures, including wetland recovery, coral reef restoration, and afforestation. By restoring and protecting ecosystems, we can promote biodiversity and ecological balance, improve the quality of the environment, and protect aquatic ecosystems, which is crucial for maintaining the green development of aquatic product production. First, strengthening marine environmental monitoring and early warning is the foundation of green fisheries development. Zhoushan City should establish a comprehensive marine environmental monitoring network to obtain real-time information on water quality, marine biological resources, and marine disasters. Through advanced monitoring technologies and early warning systems, timely detection and handling of marine pollution and depletion of biological resources can be achieved, providing scientific evidence for the sustainable use of fishery resources [6].

Secondly, implementing marine ecological restoration projects is a crucial guarantee for the green development of fisheries. Zhoushan City should increase investment in marine ecological restoration projects by constructing artificial reefs, repairing damaged coastlines, and restoring marine ecosystems to enhance biodiversity and productivity. At the same time, it should strengthen supervision and evaluation of these projects to ensure their quality and effectiveness, providing a favorable ecological environment for the recovery and enhancement of fishery resources.

4.3 Optimizing the Structure of the Fishery Industry

As an important base for the countrys distant-water fishing industry, Zhoushan City should actively explore and utilize its unique policy and geographical advantages. The governments primary responsibility is to increase support for distant-water fishing. Specific measures include establishing a special fund for distant-water fishing, providing financial subsidies and other economic support to practitioners, and strengthening their technical training and guidance. At the same time, efforts should be made to modernize and upgrade core equipment such as distant-water fishing vessels and gear, aiming to improve the efficiency and safety of fishing operations. Furthermore, given that distant-water fishing vessels and personnel often operate far from home in the depths of the ocean or even in exclusive economic zones of neighboring countries, they face numerous risks. Therefore, the government must further strengthen the protection of distant-water fishing vessels and personnel, ensuring their safety and legal rights are effectively safeguarded.

Zhoushan City has been developing aquaculture for a long time and holds an unshakable position in the fishery economy. In particular, over the past few decades, the growth of the aquaculture industry has led to many new forms of farming methods, with continuous optimization of products and structures. Currently, it has developed into an industry that significantly impacts the fishing sector [7].

The aquatic product processing industry is one of the most important sectors in Zhoushans fishery economy. Its rapid development over the past few decades has played a significant role in promoting economic growth and increasing disposable income for fishermen. However, Zhoushan still faces challenges such as low economic output and lagging processing technology in the field of aquatic product processing. In light of this, it is imperative to introduce advanced core equipment for deep processing of aquatic products to enhance processing techniques and mechanized production processes. At the same time, key technologies, equipment, and systems suitable for on-board processing must also be introduced to comprehensively improve the depth and quality of aquatic product processing [8].

4.4 Enhancing the Innovation Capacity of Fishery Science and Technology

For the green development of Zhoushan Citys fisheries, enhancing the innovation capability of fisheries science and technology is a crucial step. First, increasing investment in fisheries science and technology research and development is the foundation for improving this capability. Zhoushan City should increase its investment in fisheries scientific innovation, supporting research institutions and enterprises to develop key technologies, promoting innovation and progress in fisheries science and technology. At the same time, it should strengthen exchanges and cooperation with domestic and international fisheries science and technology, introducing advanced technologies and concepts to enhance the overall level of fisheries science and technology.

Secondly, promoting the transformation and application of fishery science and technology is key to enhancing the

innovation capabilities in this field. Zhoushan City should establish a mechanism for the transformation and application of fishery science and technology, encouraging and supporting the industrial application of research outcomes in fisheries, and promoting the deep integration of fishery science and technology with fishery production. By disseminating advanced fishery technologies and management practices, the efficiency and effectiveness of fishery production can be improved, fostering the green development of fisheries.

Encourage fishery enterprises to adjust themselves and transform and upgrade, introduce advanced production technology and equipment, improve product quality and market competitiveness, through technological innovation and equipment upgrading, achieve the modernization and green development of aquatic products processing industry [9].

5. Conclusions and Recommendations

Zhoushan City has made significant progress in the green development of marine fisheries in recent years. Through a series of conservation and restoration measures, fishery resources have been effectively improved, and the marine ecological environment is gradually improving. In particular, by strengthening marine environmental monitoring and early warning, implementing marine ecological restoration projects, and enhancing fishery science and technology innovation capabilities, Zhoushan City has taken solid steps toward the green development of fisheries.

However, facing the challenges of global climate change, aggravating Marine pollution and declining fishery resources, the green development of Marine fishery in Zhoushan city still faces many difficulties. How to achieve sustainable development of fishery economy while protecting Marine ecological environment is an urgent problem to be solved at present.

In the future, Zhoushan City should continue to increase efforts in promoting green development of marine fisheries. Specifically, first, it needs to further improve the marine environmental monitoring network, enhance early warning capabilities, and ensure the safety of the marine ecosystem; second, it should vigorously implement marine ecological restoration projects, restore damaged marine ecosystems, and increase biodiversity; third, it should strengthen fishery science and technology innovation, promote the transformation and application of fishery scientific and technological achievements, and improve fishery production efficiency.

On this basis, Zhoushan City should also actively explore new models and paths for green fisheries development. For example, it can develop distant-water fishing to expand the utilization of fishery resources; promote the integration of fisheries with tourism, culture, and other industries to create a brand for fishery tourism; strengthen cooperation and exchanges with international fishing organizations to introduce advanced fishery management practices and technologies.

In summary, the green development of marine fisheries in Zhoushan City is a long-term and arduous task that requires joint efforts from the government, enterprises, and all sectors of society. Only by adhering to the concept of green development, enhancing technological innovation and ecological protection, can we achieve sustainable development of the fishery economy and leave future generations a clear blue sea and sky. It is recommended that Zhoushan City continue to increase investment, improve policies, and promote the continuous success of green development in marine fisheries.

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