Marine Economics and Resources

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Along with scientific and technological developments and the increasing scope of human activities, the importance of marine resources, the marine environment, marine space, and strategies regarding marine management have been gradually realized by countries worldwide. Due to their ecological and economic value, marine resources have always been, and remain, a dynamic force for human survival and development, and the value the ocean generates continues to increase. Marine research includes a combination of economic, social, and ecological elements. When exploiting and utilizing marine resources, people must not only consider economic objectives but also evaluate how that exploitation and utilization influences the local natural environment. Moreover, influences on society, the economy, and the environment after resource exploitation should also be preliminarily evaluated.

marine economy marine resources ocean marine innovation biodiversity

1. Marine Economy

Recently, China has paid increasing attention to green and sustainable development of the marine economy. As an important extension of land economy, the marine economy has become another growth point for China's new era of economic development.

Each sector of the marine industry can serve as an important impetus to drive the marine economy [1], including marine tourism [2]. The marine renewable energy industry [3] is conducive to optimizing the developmental structure and improving the developmental level of the marine economy. Efficiency in the marine industry is crucial for improving the marine economy. Many scholars have found that factors affecting efficiency in the marine industry include industrial agglomeration and environmental regulation, and they have advocated for strengthening interregional cooperation in coastal areas to promote marine industry agglomeration, alleviate environmental regulation constraints, promote environmental protection and marine industry efficiency, and develop the marine economy. However, Wang et al. [4] believe that productivity can be improved in the marine industry by strengthening financial support, which will enhance the efficiency of the marine industry, thereby also improving the marine economy.

Furthermore, a reasonable marine industrial infrastructure is also crucial to the development of the marine economy. Zhu et al. [5] proposed building a diversified industrial system to enhance economic risk resistance and promote marine economic development. Zhang et al. [6] also noted that optimization of the marine industrial infrastructure is a favorable foundation for the coordinated, stable, and rapid development of the marine economy. Wang and Wang [7] evaluated the contribution of China's marine industry through input–output analysis to

determine the inter-industry correlation, production induction, sector supply shortage, and employment induction effects, and explored the evolution of the marine industry infrastructure and improvement of the marine economy.

The development of the marine circular economy is very important for the marine economy overall, as this development is the only way to ensure the transformation of the marine economy development model. The development of the marine circular economy has multiple perspectives. From the development model perspective, Pardilhó et al. [8] used the extraction and utilization of marine macroalgae waste as an important model for the development of the marine circular economy. Zapelloni et al. [9] analyzed the marine equipment manufacturing sector by using fiber-reinforced polymers from a circular economy perspective to identify sustainable solutions at the manufacturing process stage. Lehmusto and Santasalo–Aarnio [10] have discussed energy utilization in the marine circular economy, analyzed the cost of lithium battery transformation through mathematical model development, and considered its feasibility as a key point of marine industry circular economy development. Fadeeva and Berkel [11] posit that a custom marine plastic-pollution policy that integrates the circular economy and life cycle perspectives is crucial for the recovery of fishery productivity and the development of the marine circular economy.

From the development measurement perspective, Ding et al. [12] have considered the two-way connection between economic production and environmental treatment subsystems in the marine circular economy system, which can be used to evaluate marine circular economic performance. Guo and Li [13] previously discussed marine circular economy theory, defects in China's current marine circular economic fiscal and tax policies, how to promote marine circular economic development, and the feasibility of fiscal policy construction. Zapelloni et al. [9] examined sustainable production solutions for marine equipment and stressed the importance of a circular economy.

2. Innovation in Marine Science and Technology and Marine Economy

Many scholars have studied marine scientific and technological innovation at the regional and industrial levels [14] [15]. For example, at the regional level, Zhong et al. [16] found significant differences in marine scientific and technological innovation in China's coastal areas from 2006 to 2016. Chavez Estrada et al. [17] and Alvarez et al. [18], respectively, studied the scientific and technological innovation of fishing boats in Chile and Spain, and further explored the rapid development of marine scientific and technological innovation caused by collective rights management and specialization. Xu et al. [19] examined the effect of science and technology finance on the scientific and technological innovation of the marine industry from the industry perspective, combining the development of and financing for scientific and technological development in the marine industry. Zhang and Wang [20] analyzed overall and partial marine scientific and technological innovation in China's coastal areas from 2006 to 2016 and found that marine industrial agglomeration and environmental regulation play a positive role in the development of marine scientific and technological innovation.

As an important driving force of the sustainable development of the marine economy, research related to marine innovation has focused on the relationship between technological innovation and the marine economy. Lawrence

[21] noted that scientific and technological progress must be used to promote solutions to energy problems and explained the dialectical unity between the sustainable development of the marine economy and scientific and technological progress. Shao et al. [22] examined the short- and long-term relationship between marine economic growth technological innovation in China from 2006 to 2016 and found that they promote each other in the long term. Ren and Ji [23] studied the influence of scientific and technological innovation on the marine economy global trade finance program (GTFP) under environmental regulations in order to provide a theoretical basis for transforming and upgrading the marine economy under environmental regulations. Wang et al. [24] analyzed the interactive relationships between marine scientific and technological innovations, marine finance, and marine higher education. Wang and colleagues did this from a system-coupling perspective, and they constructed a composite system involving innovation, finance and higher education. Their system provides a decision-making reference for sustainable marine economic development. Liu et al. [25] measured scientific and technological innovation in China's coastal areas from 2006 to 2016 and found a non-linear relationship between scientific and technological innovation and high-quality marine economic development.

3. Marine Resources

3.1. Marine Resource Utilization

Marine resource development can effectively guarantee the survival and sustainable development of human society in the 21st century. The United States was among the first countries to realize the importance of marine resources and change its position regarding the ocean. The 21st Century Ocean Blueprint published in 2004 proposed, for the first time, the principle of the sustainable utilization of marine resources at the national strategic level, and established the policy goal of preserving the marine environment and protecting the integrity of the coastal environment. The National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes, issued in 2010, was the third national ocean policy in the United States and concerns ecosystem-based management as the basic principle of marine ecological environment conservation and the sustainable use of marine resources. In terms of marine ecological environment conservation, it puts forward requirements for protecting, maintaining, and restoring the ecological health and biodiversity of the ocean, coastal areas, and the Great Lakes region. Meanwhile, Australia also attaches great importance to the use and protection of marine resources. the Australian coast and its offshore waters can be roughly divided into four types of functional areas: ports, marine tourist areas, sea area wildlife refuges, and marine nature reserves. In these areas, artificial reclamation, reclamation, pollution, and abuse are forbidden in order to protect the marine-specific natural environment, biological resources, and biodiversity for the use of marine resources in marine fishery resource exploitation and the use of marine space resources, ocean energy resources, etc.

3.1.1. Marine Fishery Resource Utilization

Australia has established a full quota-management system for its fishing industry and legislated the electronic monitoring of fishing at sea. In examining the history of commercial fishing in southeast Australia, Santos et al. [26] noted that with technological progress and the emergence of new resources, fishing activities have moved offshore

and into deeper waters. That previous study found that in southeast Australia, the relatively short history of fishing and the small size of the fishing industry played important roles in limiting the extent to which fishing affected local populations and helped the local environment to recover when fishing restrictions were put in place. The authors presented the management history of complex multi-species trawling fisheries in southeast Australia over the past three decades. They illustrated the hazards of overfishing and noted that fisheries in southeast Australia have returned to positive profitability and made broad improvements in environmental performance, particularly in managing the effects of fishing on protected species and benthic habitats.

3.1.2. Marine Space Resource Utilization

Unlike in Australia, the efficient use of marine resources in other developed countries includes the use of not only marine species, fisheries, and seawater but also marine resources in architectural spaces. Some scholars used buildings in the shallow sea area of Kyushu prefecture, Japan as examples of buildings that should be investigated with regard to functionality, structure, setting, location conditions, offshore construction processes, and post-construction challenges. These scholars noted that, functionally, the structures of these buildings can make full use of regional marine resources and environments. Structurally, these buildings' architects consider the harsh environmental conditions of the coastal areas and provide architectural space at the beginning of construction. Therefore, marine architectural planning should combine use, function, and infrastructure with marine conditions. Ummerhofer et al. [27] analyzed marine resource characteristics in the Indian Ocean, which is conducive to the effective and rational exploitation and utilization of marine resources and the sustainable development of human society. As a result of social progress, the demand for the efficient use of marine space in the form of marine architecture is already high. Some scholars have noted that in Canada, due to the intensification of marine environmental activities and competition, access to marine resources and the utilization of marine space are important issues of concern in many coastal areas. From a policy perspective, such scholars have argued that the use of coastal areas should be a priority in all policy decision-making processes related to Canada's oceans and that the "access" system should be implemented to realize the effective use of marine space resources.

3.1.3. Marine Energy Resource Utilization

Marine energy generally refers to renewable natural energy contained in the ocean, mainly including tidal energy, wave energy, ocean current energy (tidal current energy), seawater temperature-difference energy, and seawater salt-difference energy. In a broader sense, marine energy also includes wind energy over the ocean, solar energy on the ocean surface, and marine biomass energy [28]. Extracting wave energy from the ocean is a promising solution for renewable energy production because of the high energy intensity of waves compared to other renewable energy sources [29]. China has rich ocean energy resources at an internationally advanced level for marine energy accumulation ability. However, the marine energy industry is still in its infancy, and China's proposed peak carbon and carbon-neutral strategy to achieve green energy and power transformation also provides a crucial opportunity for the development of marine energy resource use [30].

3.2. Natural Resource Property Rights System

As a type of natural resource, the management of marine resources is based on and referenced by the system of natural resource property rights. Natural resource property rights determine the allocation efficiency of economic resources and provide an important basic system for strengthening ecological protection and promoting the construction of ecological civilization. Consummate with the system of natural resources in the rights system is the premise of natural resources property rights system reform. Therefore, the study of specific rights within the natural property rights system results in many different viewpoints. The right to resources can be defined as a person's legal right to the rational utilization of natural resources, including natural resource rights and artificial resource rights. Reform of the paid use system of natural resources owned by society as a whole is a key part of the reform of the property rights system for natural resources. Some scholars have proposed that natural resource rents, renewable energy, and urbanization reduce ecological footprints, indicating that they have a positive contribution to environmental quality. Institutional reform will guarantee the transformation of the natural resource property rights system and will accelerate the implementation of the system accordingly.

Some studies have posited that the implementation and transformation of the natural resource property rights system needs to break through conventional administrative means, actively innovate the administrative supervision system, and overcome the "last kilometer" of transformation from institutional system construction to governance efficiency. This is particularly important. Pamela Jagger et al. [31] proposed that the reform of the natural resource property rights system must adhere to the principle that nothing prohibited by law can be done. All manner of civil subjects can equally enjoy all types of civil rights related to natural resources according to law, and these rights should be strictly protected to ensure that any infringement is remedied. Only in this way can the civil rights of natural resources, including marine resources, be added to the "protection lock" and "safety gate" of the rule of law. Studies have also emphasized that legal systems should be used to facilitate the implementation of the system of natural resource property rights; however, China has mainly adopted conventional administrative means, such as supervision, inspection, notification, and accountability. The use of environmental taxes is also an effective implementation method, and one that is likely to be applied to matters related to the marine environment, as well as to those of other areas and countries [32]. Thomas Sikor et al. [33] also proposed that the policy system of natural resource property rights must transform its objectives and legislatively confirm abstract environmental policies by virtue of the standardization and stability of laws to ensure the effective implementation of the system.

3.3. Marine Resources Management System

Regarding marine resource management systems, the United States has taken the global lead. Singleton [34] conducted research on fishery resource management in the Pacific Northwest and posited that when establishing a community-based or jointly-managed natural resource management system, the participation of national government departments could effectively improve the probability that the system will be successfully established. Although the current relationship between the state and the community is relatively tense, the natural resource management model is extensive. However, the establishment of a common natural resource management system should not completely overturn the existing management model and then re-establish a new model, but should gradually improve the existing model, a process in which social trust plays an important role. Borja et al. [35] and Fulton et al. [36] have posited that the United States is a country that typically combines centralized and

decentralized management systems. The administration of maritime affairs in the United States is distributed among federal agencies, whereas maritime law enforcement is centralized by one agency. In the United States, state governments are responsible for marine resources within a three-mile territorial sea offshore area, whereas the federal government is responsible for marine resources from 3–200 nautical miles offshore. Laws and programs enacted by the federal government are functionally carried out by federal executive agencies. Sutton–Grier et al. [37] studied three acts protecting coastal zones and marine habitats—the Clean Water Act, the Coastal Zone Management Act, and the Oil Pollution Act—from the perspective of coastal blue carbon resources. They found that the federal government has already integrated some ecosystem functions and services into existing resource regulation and pollution reduction practices. If carbon resource regulation is integrated into the existing regulatory system as an additional ecosystem service, no legislative obstacles exist from a legal perspective. This only depends on advanced science that can more accurately measure the movement and emission rates of blue carbon between different environments and marine habitats.

In France, the Marine Fishery and Aquaculture Management Bureau, the Marine Oil, Gas and Other Mineral Resources Management Bureau, and the Marine Renewable Energy Management Bureau are under the French Ministry of Oceans. The coastal regions, provinces, and cities have also established corresponding marine resource management agencies, thereby forming a typical centralized management system of marine resources. The United Kingdom is a country that typically implements a decentralized marine management system. The Ministry of Maritime, Air and Environmental Group is responsible for the coordination of government ministries of foreign-related maritime policy and law. The Ministry of Communications is responsible for maritime traffic safety management and marine environmental protection and survival. The Department for Environment, Food and Rural Affairs is responsible for 200 nm fishing area management and fishery resource protection. The Department of Energy is responsible for managing oil and gas resource development. The Land Commission regulates seabed and beach placer mining, and the Coal Board regulates seabed coal development, among other things.

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