



## OPEN ACCESS

## EDITED BY

Qi Xu,  
Jinan University, China

## REVIEWED BY

Yu Yan,  
Xiamen University, China  
Haoze Chen,  
Fuzhou University, China

## \*CORRESPONDENCE

Peirui Wang  
✉ p.r.wang@163.com

RECEIVED 10 August 2025

ACCEPTED 30 September 2025

PUBLISHED 15 October 2025

## CITATION

Wang P (2025) Reflections on the ocean economy development of Guangdong Province from the legal perspective: pathways, challenges and solutions. *Front. Mar. Sci.* 12:1683163. doi: 10.3389/fmars.2025.1683163

## COPYRIGHT

© 2025 Wang. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

# Reflections on the ocean economy development of Guangdong Province from the legal perspective: pathways, challenges and solutions

Peirui Wang<sup>1,2\*</sup>

<sup>1</sup>School of Law and Intellectual Property, Guangdong Polytechnic Normal University, Guangzhou, China, <sup>2</sup>Marine Strategy and Legal Team, Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), Zhuhai, China

China possesses the largest and fastest-growing ocean economy globally. However, as its development reaches an advanced stage, the Chinese government recognizes that further progress requires pursuing not only quantity but also quality, thus proposing the concept of high-quality development of the ocean economy. Generating the highest marine gross domestic product (GDP) in China, Guangdong Province has pioneered legislative measures to foster this high-quality development. The Regulation of Guangdong Province on Promoting High-quality Development of the Ocean Economy aim to address specific challenges in the development of ocean economy in Guangdong Province, including an irrational industrial structure, inadequate governance mechanisms, an imbalance between economic development and environmental protection, and insufficient supply of key resources for ocean economic development. Nevertheless, Guangdong's ocean economy development still confronts significant hurdles: deficient basic guiding concept for marine governance, an incomplete legal framework for marine governance, constrained comprehensive marine governance capabilities, insufficient support for key marine sectors, unbalanced regional progress, and a severe marine ecological situation. Consequently, Guangdong Province should clarify the basic guiding concept regarding marine governance, continue to improve the legal system of ocean economy, promote comprehensive marine governance, guide the development and upgrading of marine industries, strengthen regional legislative coordination, uphold the principle of green development, and proactively cope with climate change to promote high-quality ocean economic development.

## KEYWORDS

ocean economy, high-quality development, legal governance, law of the sea, Guangdong Province, China

# 1 Introduction

According to the report of The Ocean Economy to 2050 (OECD, 2025), China has become the world's largest single ocean economy, boasting the greatest total marine economic output and accounting for one-sixth of the global total. It also maintains the fastest growth rate, averaging 8% annually. As a major marine economic province in southern China, Guangdong achieved a marine GDP of 2,002.25 billion yuan in 2024. This figure represents 14.1% of its regional GDP and 19.0% of the national total, securing its top national ranking for the thirtieth consecutive years (Department of Natural Resources of Guangdong Province, 2025a).

Guangdong Province, recognized as China's most rapidly expanding and largest province concerning ocean economic development, has attained considerable success in recent years. However, as the scale of its ocean economy grows, official investigations reveal persistent challenges impeding high-quality development. These include uncoordinated industrial development, insufficient scientific and technological innovation capacity, inadequate resource security, and deficient efforts in marine environmental governance (Department of Natural Resources of Guangdong Province, 2025a). However, governance of the ocean economy is primarily based on fragmented policy documents, hindering the formation of synergistic governance efforts (Liu, 2025). To address these issues, the Standing Committee of Guangdong Provincial People's Congress passed the Regulation of Guangdong Province on Promoting High-quality Development of the Ocean Economy (hereinafter referred to as "the Regulation") on May 28, 2025. Officially effective since July 1, 2025, the Regulation represents China's first legislation specifically targeting the legal governance of ocean economy.

This article will focus on the development of Guangdong Province's ocean economy and conduct a multi-faceted analysis. It is structured as follows. Section 2, based on the current state of Guangdong Province's ocean economy, analyzes the necessity and feasibility of regulating its development from a legal perspective. Section 3, through examining the Regulation's core content, analyzes the specific pain points within Guangdong's ocean economic development that the Regulation seeks to address. Section 4, drawing on relevant legal governance practices in Guangdong and the current state of its ocean economy, analyzes the governance challenges in the ocean economic development process that the Regulation still fails to resolve, offering suggestions for improving the legalization of Guangdong Province's ocean economy.

## 2 The necessity of legal governance in the high-quality development of the ocean economy

### 2.1 The role of legal governance in the high-quality development of the ocean economy

As the ocean economy develops to a certain level, resource bottlenecks and environmental pressures intensify, necessitating the

pursuit of high-quality development (Sun et al., 2023). However, ocean economic development fundamentally requires legal safeguards. Chang (2010), through an examination of relevant policies, laws, cases, and theories on ocean governance, summarized the multiple factors<sup>1</sup> influencing "good ocean governance," identifying "the rule of law" as the paramount factor. Specifically, law fulfills the following roles in promoting high-quality ocean economic development.

#### 2.1.1 Promoting the sustainable development of the ocean economy

Law serves as a primary instrument for achieving established societal goals. In realizing sustainable ocean development, law, particularly national legislation, plays an indispensable role (Freestone, 2019). The ocean economy primarily encompasses production activities related to the development of marine resources and the utilization of marine space. Its defining characteristic is high dependence on marine resources, the marine environment, and marine space. While marine resources are abundant, the profit-driven nature of capital may lead participants in ocean economic activities to overexploit natural resources and damage the marine environment, thereby undermining the ocean economy's sustainable development. Addressing this dilemma, Pauli (2010) introduced the "Blue Economy" concept, arguing this model promotes ocean economic development while sustaining the marine environment and coastal areas, achieving equilibrium between economic growth and marine environmental protection. The "Blue Economy" concept was widely recognized by participants at the 2012 United Nations Conference on Sustainable Development.

Sustainable ocean economic development is inseparable from legal support. The legal governance of marine economies globally further substantiates that marine-related legislation exerts a significant positive effect on sustainability. Frohlich et al. (2023), examining over 2,000 international, federal, and state policies and regulations in Australia, identified factors affecting marine economic sustainability and proposed that systematic, locally adapted marine legislation fosters sustainable ocean economic development. Fasoulis (2022), analyzing Norway's ocean economic history, noted that influenced by the United Nations Convention on the Law of the Sea (UNCLOS), Norway has pursued legislation promoting the sustainable use of coastal and marine areas since the 1980s, achieving notable success.

#### 2.1.2 Guiding the optimization and upgrading of ocean economic industries

During ocean economic development, industrial optimization and upgrading facilitate the elimination of outdated production capacity, the cultivation of energy-saving, environmentally friendly, and high-value-added marine industries, and the transition of the ocean economy from "expansion" to "strengthening." In this process, law

<sup>1</sup> These factors are: the rule of law, participation, transparency, consensus-based decision making, accountability, equitability and inclusiveness, responsiveness, and coherency.

effectively guides industrial development, stimulates economic potential, and promotes the specialization, modernization, and diversification of related sectors (Becker-Weinberg, 2021).

On the one hand, laws effectively steer the upgrading and development of marine industries. Wang et al. (2025), analyzing marine economic data from 11 Chinese coastal provinces (2007–2021) combined with model analysis, found technological upgrading, industrial structure optimization, and capital investment significantly propel the green development of China's ocean economy and enhance economic development quality. Furthermore, based on data from China's Marine Eco-environmental Protection Enterprises from 2000 to 2022, scholars have analyzed the sectoral concentration and spatial distribution of these enterprises and concluded that the concentration of enterprises is significantly correlated with marine environmental legislation. Regulations on marine environmental protection issued by coastal provinces of China have heightened public awareness of environmental protection, thereby promoting the establishment of numerous Marine Eco-environmental Protection Enterprises (Li and Zhang, 2025).

On the other hand, the lack of legal guidance will limit the upgrading and development of industries. Chang and Wang (2017), researching China's renewable energy industry, found the lack of a clear legal basis for renewable energy development hindered the ocean renewable energy sector's progress compared to other marine enterprises.

### 2.1.3 Coordinating the relationship between economic development and environmental protection

China's ocean economic development trajectory indicates law demonstrably promotes environmental protection. Chen et al. (2024), using Chinese coastal provinces as samples, found environmental legal regulations significantly improved GTFP,<sup>2</sup> particularly in high-productivity regions. The study further demonstrated that key factors promoting GTFP include improvements in resource efficiency and the development of eco-friendly technologies (Chen et al., 2024). This suggests that legal governance promotes the efficiency of marine economic development and contributes to the harmonization of economic development and environmental protection (Nguyen, 2024). Furthermore, while marine resource exploitation is a crucial pillar of ocean economic development, it also generates significant carbon dioxide emissions, which is a major cause of ocean acidification. Liu et al. (2024b), analyzing carbon emission data from mining in China via quantitative analysis, concluded that legislation and transparency positively correlate with carbon emission reductions. This implies a more comprehensive legal framework and greater governance transparency can effectively lower carbon dioxide emissions, demonstrating that improved marine

environmental protection legislation effectively alleviates marine environmental pressures.

It should be acknowledged that there is a certain contradiction between legal governance and the development of the ocean economy. While legal governance may marginally sacrifice economic development efficiency, most research indicates its overall positive effect. As early as 1955, economist Simon Kuznets (1955) proposed the EKC (Environmental Kuznets Curve) to examine the relationship between environmental protection and economic development. The EKC curve demonstrates an initial correlation between economic growth and environmental degradation. However, governments can effectively mitigate this correlation by implementing environmental regulations at specific development stages, ultimately achieving a balance between economic growth and environmental improvement. This signifies sound legal governance positively influences economic development. Additionally, from a static perspective, regulatory oversight does increase enterprise operational costs, potentially affecting development. Dynamically, however, robust legal regulation stimulates enterprise innovation, thereby enhancing competitiveness in economic activities (Porter and Linde, 1995).

## 2.2 Problems in promoting the development of the marine economy in Guangdong Province

As one of the earliest provinces in China to embrace reform and opening up, Guangdong Province has taken a leading role in the development of ocean economy, consistently ranking first in the nation in terms of total marine GDP for over 30 years. However, the underdeveloped legal framework for marine economic legislation in Guangdong is inconsistent with the prosperity of its ocean economy. As a result, the province lacks the legislative safeguards essential for developing its marine economy. With the marine economy reaching a certain stage of development, the lack of legal support has exposed problems in Guangdong's marine economy, including industrial structure, management systems, environmental protection mechanisms, and support for development factors, which are hindering the further development of Guangdong's ocean economy.

### 2.2.1 Unbalanced marine industry structure

First, the disproportionately low share of the primary sector undermines Guangdong Province's advantages in marine biological resources. This study examined the ratios of the primary, secondary, and tertiary industries in the marine sector of Guangdong Province over the past decade (As shown in Figure 1). The basic data comes from the Guangdong Ocean Economic Development Report from 2016 to 2025, which is available on the website of the Department of Natural Resources of Guangdong Province.<sup>3</sup> Overall, the structure of Guangdong's marine industry has remained relatively stable during this period. While the proportion of the tertiary industry initially increased before declining, its share consistently exceeded 55%. The secondary industry consistently held the second-largest share, whereas the primary industry persistently maintained the smallest

<sup>2</sup> Green total factor productivity, which is a comprehensive indicator of the efficiency of all production factors, including labor, capital, and energy, within a relaxed economy under environmental constraints. It focuses not only on economic output but also on the environmental impact of the production process, pursuing the coordinated integration of economic development and environmental protection.

proportion. It is acknowledged that during early industrialization, a higher tertiary industry proportion often signifies greater technological advancement and value addition. However, Guangdong Province is already in the later stages of industrialization, a period of transformation and upgrading. Clearly, rather than simply pursuing a higher proportion of tertiary industry's output value, it should instead leverage its own comparative advantages and leverage its industrial strengths. Guangdong Province possesses a sea area of 419,300 square kilometers, 2.3 times its land area, abundant fishery resources, and a robust foundation in industry, research, and social development for constructing modern marine ranches. Yet, the primary industry's proportion has consistently remained below 4% for many years, indicating underutilization of these resource advantages.

Consequently, given Guangdong's actual conditions, the primary marine industry's share within the provincial marine industrial structure remains relatively small, presenting significant developmental potential. From the perspectives of optimizing the marine industrial structure, safeguarding national food security, and protecting the marine environment, it is imperative to promote the development of the primary marine industry, particularly deep-sea aquaculture and marine ranching, which have lower dependence on the marine environment and mineral resources.

Second, Guangdong Province's secondary and tertiary industries require further upgrading to reduce their reliance on marine resources and the environment. Empirical studies by scholars on the impact of Guangdong's industrial development on the marine environment reveal that the province's coastal economic belt achieved rapid growth driven predominantly by the secondary and tertiary industries. However, the amount of marine pollutant emissions have also increased annually (Zhang and Li, 2021). The increase in carbon dioxide emissions have exacerbated ocean acidification, adversely has adverse effects on marine ecosystems. Therefore, controlling carbon emissions to mitigate ocean acidification has become an international consensus (Harrould-Kolieb, 2016). While developing its ocean economy, Guangdong Province also prioritizes the control of carbon emissions. According to the 2024 Annual Carbon Emission Allocation Plan of Guangdong Province, six industries petrochemicals, papermaking, civil aviation, ceramics, transportation, and data centers, will be incorporated into Guangdong's carbon emission management and trading system (Department of Ecology and Environment of Guangdong Province, 2025). The vast majority of these industries are related to the secondary and tertiary industries. This shows that, in the context of energy conservation and emission reduction, the secondary and tertiary industries are also in urgent need of industrial upgrading to reduce carbon emissions.

Third, scientific research makes an insufficient contribution to industrial development. According to the composition of Guangdong Province's marine GDP in 2023, "Marine Research and Education" only accounted for 5.2%, indicating substantial room for improvement. (Department of Natural Resources of

Guangdong Province, 2024) Furthermore, according to the "Science and Technology Innovation Benefit Data of China's Coastal Provinces", although Guangdong Province ranks first in total ocean economic output, it ranks only fifth in science and technology innovation benefits, trailing Shanghai, Jiangsu, Tianjin, and Liaoning Province (Li et al., 2025).

Finally, the regional development of Guangdong's marine economy is also unbalanced. In 2024, the province's total marine economic output reached 2,002.25 billion yuan, with over three-quarters originating from seven cities of the Pearl River Delta: Guangzhou, Shenzhen, Zhuhai, Dongguan, Zhongshan, Jiangmen and Huizhou. Other coastal cities in eastern and western Guangdong accounted for less than a quarter (Department of Natural Resources of Guangdong Province, 2025a). This suggests that despite Guangdong's abundant marine resources and extensive 4,100-kilometer coastline, the majority of its ocean economic output concentrates in a few central cities, while marine industry development in other regions remains relatively underdeveloped.

### 2.2.2 Imperfect marine governance mechanism

Currently, marine governance in Guangdong Province operates at both national and provincial levels. At the national level, the primary departments involved in ocean economy governance are the Ministry of Natural Resources, the Ministry of Ecology and Environment, the Ministry of Agriculture and Rural Affairs, the Ministry of Transport, and the China Coast Guard. However, these departments primarily focus on oversight and guidance rather than specific management. The Ministry of Natural Resources oversees and implements marine strategies, marine resource development and protection, and marine spatial planning. The Ministry of Ecology and Environment is responsible for the prevention and control of marine pollution. The Ministry of Agriculture and Rural Affairs is responsible for the supervision of fisheries, fishery administration and fishing ports. The Ministry of Transport is responsible for ensuring maritime traffic safety, port and ship management. The China Coast Guard is mainly responsible for maritime rights protection and law enforcement and combating maritime crimes. As shown in Figure 2, ocean economy management responsibilities are dispersed across different departments, resulting in fragmented powers and responsibilities that fail to form a cohesive force.

The situation in Guangdong Province is more complex, primarily manifesting in the approval processes for maritime use at the micro-level and the handling of illegal marine activities. The Marine Comprehensive Law Enforcement Corps (a subordinate unit of the Guangdong Provincial Department of Agriculture) is primarily responsible for these marine governance tasks. However, this agency's mandate is limited to maritime administrative duties such as patrolling and surveillance, environmental protection, investigation and punishment of illegal maritime activities, and fishery management. It lacks authority over matters like industrial development, the business environment, and resource development. Governance of the ocean economic development field is fragmented across various functional departments, including Development and Reform Commission, Department of Natural Resources,

3 <https://nr.gd.gov.cn>.

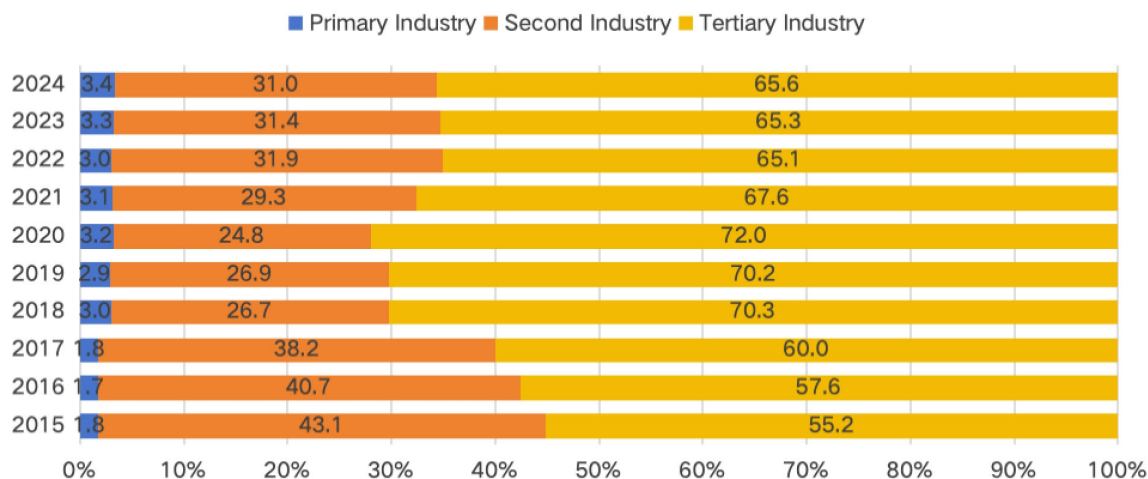


FIGURE 1  
Marine industrial structures in Guangdong (2015–2024).

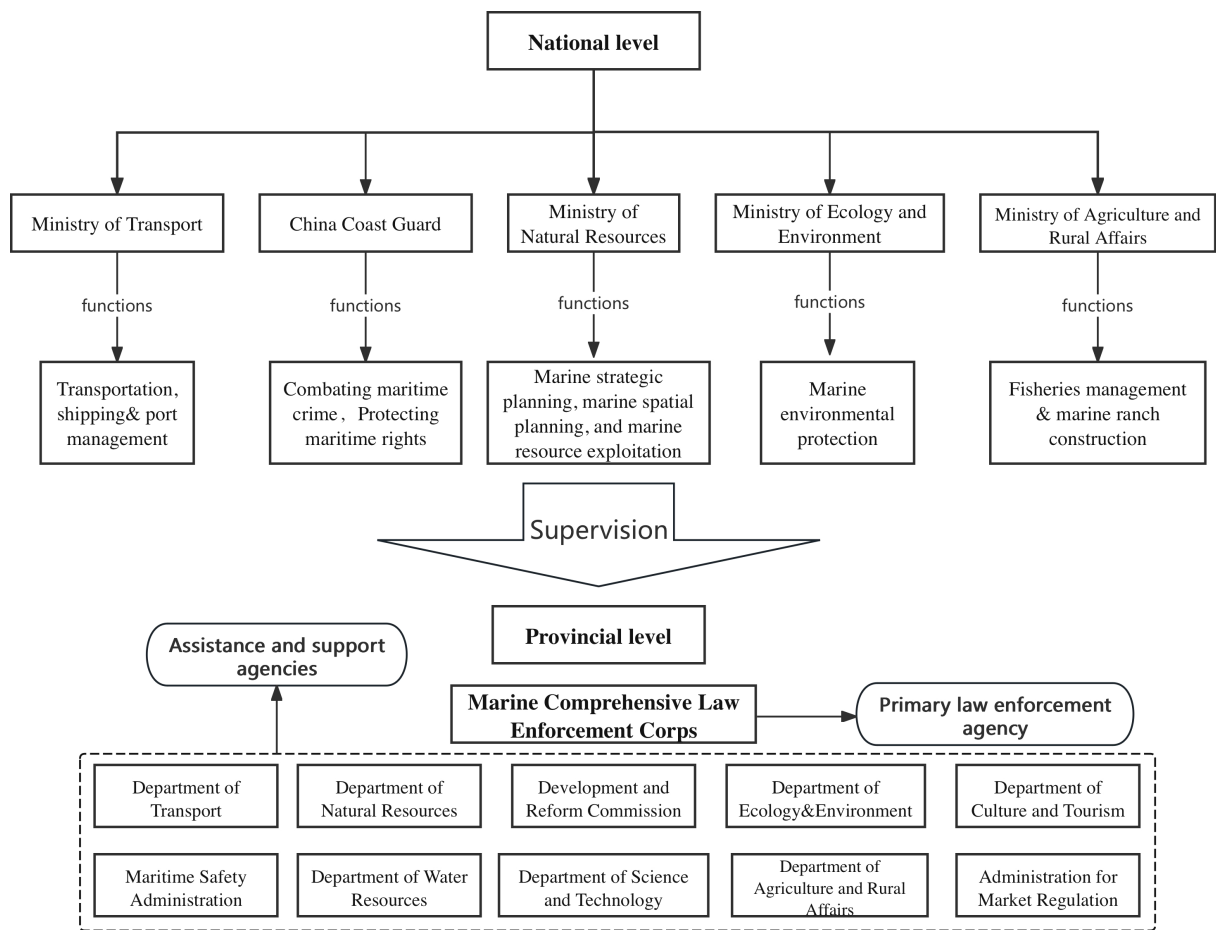


FIGURE 2  
Marine governance mechanism (national and provincial levels).



Department of Ecology and Environmental, Department of Transport, Department of Water Resources, Department of Culture and Tourism, Maritime Safety Administration, Department of Agriculture and Rural Affairs, Administration for Market Regulation and Department of Science and Technology. These departments handle the formulation of ocean economic development policies, management of marine resource development, marine environmental protection, maritime safety, vessel management, fisheries management, maritime tourism, protection of marine intellectual property, and marine scientific and technological innovation, respectively (as shown in Figure 2). In Guangdong Province, the governance mechanism for the ocean economy is handled by multiple departments, each operating independently without forming a true “comprehensive enforcement” system in the field of marine economic development, indicating a low level of systematization.

Furthermore, the approval process for marine production remains complex (as shown in Figure 3). For example, according to the Sea Areas Administration Law of China (Standing Committee of the National People's Congress, 2001), if a company's marine project involves the use of the sea areas that

may alter their natural attributes, such as enclosure or reclamation, it must undergo the following administrative approval process: First, Preliminary Review. During this stage, the company must submit a Feasibility Study Report on Sea Area Use to the local Department of Natural Resources. The report will be published on the government website and open to public comments. Next, experts in the marine industry and relevant departments will review the report. Only after passing the review can the company formally submit a preliminary review application. The preliminary review application is reviewed by the local Department of Natural Resources and must also be approved by the Development and Reform Commission, Department of Ecology & Environment, Department of Transport, Department of Water Resources, Department of Agriculture and Rural Affairs, Department of Forestry, Marine Comprehensive Law Enforcement Corps, and even the Chinese Navy. Second, Formal Review. After completing the preliminary review, the company must submit a formal application to the local Department of Natural Resources. Upon receipt of the application, the local Department of Natural Resources will conduct an on-site investigation and again seek the opinions of the Development and Reform Commission,

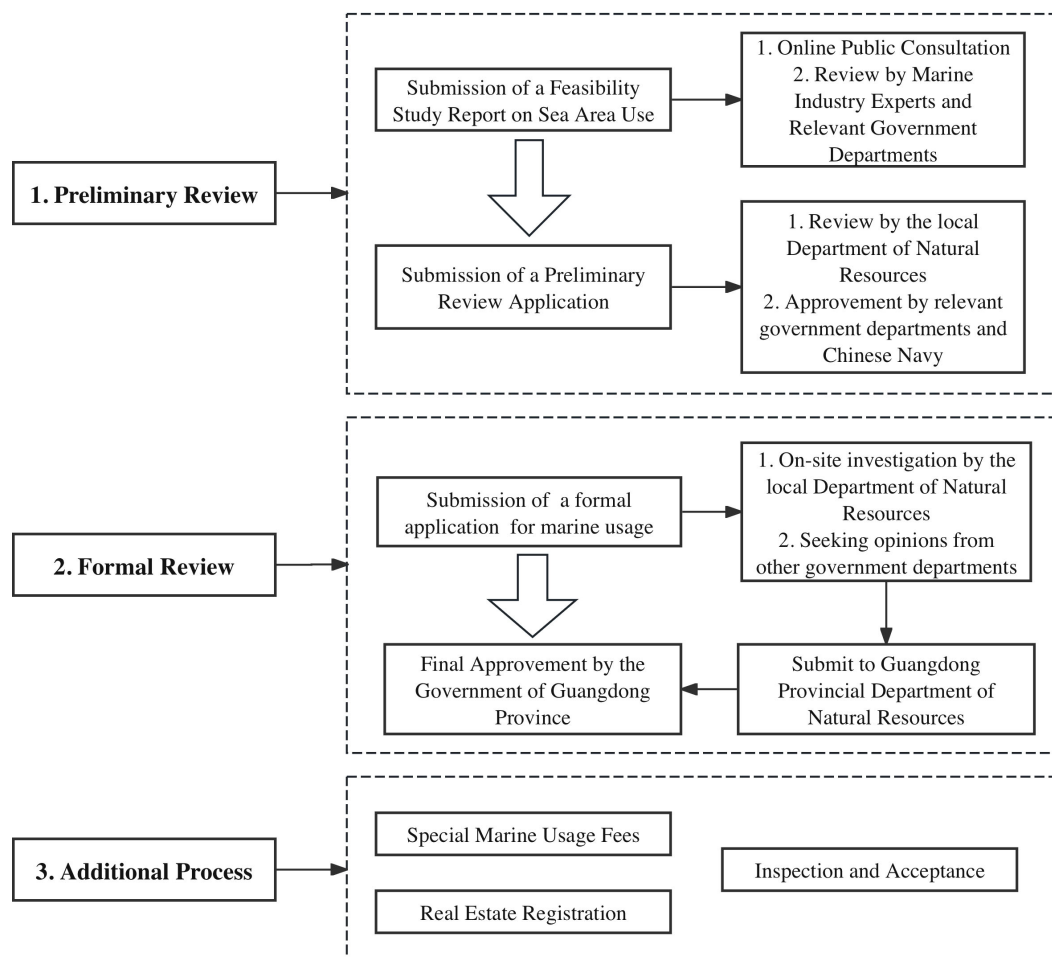


FIGURE 3  
Administrative approval process for marine usage.

Department of Ecology & Environment, Department of Transport, Marine Comprehensive Law Enforcement Corps, Maritime Safety Administration, and even the Chinese Navy. Once all these departments agree, the application must be submitted to the Guangdong Provincial Department of Natural Resources for review and final approval by the Guangdong Provincial Government. If the area of land reclamation exceeds 50 hectares or the area of sea enclosure exceeds 100 hectares, it must be approved by the State Council of China. Third, Additional Process. After obtaining approval, the company must pay a special marine usage fee and complete real estate registration. After the completion of offshore projects, the project can only officially commence if undergoes inspection and acceptance by the local Department of Natural Resources ([Department of Natural Resources of Guangdong Province, 2025b](#)).

It can be seen from this that the marine economic governance mechanism of Guangdong Province has problems such as dispersed powers, redundant institutions, insufficient coordination, complicated approval procedures and low degree of systematization, making it difficult to form comprehensive management of the development of the ocean economy. The efficiency of the ocean economic governance mechanism needs to be further improved.

### 2.2.3 Inharmonious relationship between economic development and environmental protection

Guangdong Province leads national development in both its ocean and terrestrial economies. However, behind this economic progress, environmental pollution issues remain prominent. Industrial upgrading drives the high-quality development of the ocean economy. Yet, analysis based on the distribution of industrial transfers within Guangdong Province and regional pollution data reveals that marine industrial upgrading in the Pearl River Delta has exacerbated pollution in other parts of the province. This stems from the tendency of some developed regions to achieve industrial upgrading by transferring outdated industries to less developed regions ([Wei et al., 2019](#)). Furthermore, an investigation into microplastic distribution in the Pearl River Delta's surface waters identified industrial distribution as the primary factor influencing microplastic abundance, indicating that pollution problems associated with Guangdong's marine industry development remain relatively severe ([Liu et al., 2024b](#)).

Guangdong Province has implemented measures to address marine pollution. However, applying the Environmental Kuznets Curve (EKC) method to data from 2006–2021 shows that environmental pollution indicators in Guangdong's nearshore waters followed an inverted-U-shaped pattern, improving initially but deteriorating as the marine economy expanded. This suggests that while Guangdong's marine pollution control achieved some success, pollution has rebounded in recent years alongside further marine economic expansion ([Guo et al., 2024](#)). An investigation into the ocean economy and ecological environment of the

Guangdong-Hong Kong-Macao Greater Bay Area concluded that marine ecological pressures have persisted unrelieved over the past two decades. Most cities are still experiencing a stage where socioeconomic development coexists with marine ecological damage. In cities such as Shenzhen, Guangzhou, Dongguan, and Zhongshan, damaged marine ecosystems are beginning to constrain further economic development. Strengthening marine ecological security is thus urgently needed through developing ecological industrial systems and clusters, implementing integrated land-sea ecological restoration, and promoting joint protection and coordinated governance across administrative boundaries ([Gao et al., 2022](#)).

In the process of ocean economic development in Guangdong Province, economic development still brings great pressure to the marine environment, the relationship between environment and economy is not coordinated, and the goal of achieving a win-win outcome between environmental protection and economic development remains unrealized.

### 2.2.4 Insufficient support for the development of ocean economy

The factors supporting the development of the ocean economy are The high-quality development of the ocean economy relies on the support of natural resources, infrastructure, capital, legal systems and other factors. However, an assessment of Guangdong's current ocean economic development reveals that these factors are inadequately provided and lack organic integration, resulting in insufficient momentum for marine economic growth. This insufficiency manifests primarily in the following aspects:

First, the utilization of natural resources, including sea, islands and land, is insufficient to meet the demands of marine development. According to regulations in China and Guangdong Province, individuals and organizations seeking marine use must undergo cumbersome approval procedures. Required documentation includes: a sea area use application form, a feasibility study report on sea area use, relevant credit proof materials, a map of the boundaries of the proposed sea area to be used, project approval materials, and a flood control plan approval from the water administrative department. A tiered approval system is set, with approval authority resting with provincial, municipal, or county-level marine administration departments based on the size of the area applied for ([The Standing Committee of the Guangdong Provincial People's Congress, 2021](#)). The "Feasibility Study Report on the Use of Marine Areas" must include: the necessity of the project's marine use, site selection and scale rationality, the project's impact and extent on marine resources and the ecological environment, compliance with planning, stakeholder coordination, countermeasures for ecological marine use, and the feasibility study conclusion ([The Ministry of Natural Resources of PRC, 2021](#)). Currently, there is no institutionalized mechanism in Guangdong Province for the fundamental investigation of marine resources, marine surveying,

marine data collection, and data sharing. This lack of a standardized mechanism hinders the preparation of approval materials for marine users, as they lack the necessary data support. Additionally, according to the Regulation on the Collection and Use of Charges for Sea Area Utilization in Guangdong Province (2024), marine users are required to pay special marine usage fees. Consequently, sea users in Guangdong face heavy financial burdens and cumbersome administrative procedures, hindering the efficiency of ocean economic development.

Second, infrastructure support for the marine economy is inadequate. From a hardware perspective, key elements like ports and shipping suffer from insufficient supply. According to statistics from the Ministry of Transport, the total port throughput of Guangdong Province in 2024 was 194,399 million tons, ranking third nationwide, behind Jiangsu (304,673 million tons) and Shandong (207,387 million tons). This throughput constituted only 11.05% of the national total, a figure disproportionate to the scale of Guangdong's ocean economy. Furthermore, port throughput within the province is heavily concentrated in the Pearl River Delta cities of Guangzhou, Shenzhen, and Zhuhai, with Shantou Port in eastern Guangdong and Zhanjiang Port in western Guangdong contributing relatively small proportions (The Ministry of Transport of PRC, 2025). From a software perspective, Guangdong Province does not have a normalized mechanism for basic surveys of marine resources, marine mapping, and marine data collection, insufficient financial support.

Third, financial support is insufficient. This is reflected in the irrational allocation of government funds for marine economic governance. According to the Regulation on the Collection and Use of Charges for Sea Area Utilization in Guangdong Province (2024), the provincial government collects Charges for Sea Area Utilization (CSAU), allocating 30% to the central government and retaining 70%. These charges are primarily used for marine infrastructure construction and offshore island reconstruction projects. However, there is an insufficient allocation of funds for marine pollution control, the promotion of marine-related industries, and marine scientific and technological innovation (Yang et al., 2016). Furthermore, financing channels for the ocean economy are insufficient. Guangdong Province has not established dedicated financing channels and financial products to support the development of the ocean economy, which hinders the necessary financial support for ocean economic development.

Finally, legal safeguards are insufficient. Economic development relies on legal safeguards, and maritime laws can promote the optimization of the marine business environment, the development of industries, and the enhancement of risk resistance. However, Guangdong Province currently lacks laws and regulations on industrial promotion, industry management and dispute resolution within the ocean economic development field, leaving the sector without robust institutional safeguards. While the enactment of the Regulation of Guangdong Province on Promoting High-Quality Development of the Ocean Economy has partially addressed this gap, strengthening legal safeguards for the marine economy remains a long-term endeavor, and a significant deficit persists in the legal supply required for its development.

### 3 Overview of the regulation of Guangdong Province on promoting high-quality development of the ocean economy

#### 3.1 The legislative background and main contents of the regulation

The Regulation is a legal measure taken by Guangdong Province to safeguard the development of its ocean economy. In 2021, the Government of Guangdong Province released the “14th Five-Year Plan of Guangdong Province for Ocean Economic Development”, outlining the development plan for Guangdong's ocean economy over the next five years. In addition to proposing measures to promote ocean economic development through industrial upgrading, technological innovation, and sustainable development, the plan also prioritizes the improvement of the marine governance system and related laws and regulations (People's Government of Guangdong Province, 2021). The legislature recognizes the necessity for the summary and refinement of the experience accumulated over the years in promoting the development of the ocean economy into legal content, so as to better promote the development of Guangdong's marine strategy. Consequently, the formulation of the Regulation was included in the Legislative Plan of Guangdong Province in 2024 (The Standing Committee of the Guangdong Provincial People's Congress, 2024). Finally, the Regulation was adopted by the Standing Committee of the Guangdong Provincial People's Congress on May 28, 2025 and officially entered into force on July 1, 2025.

Serving as China's first local regulation specifically targeting the development of the ocean economy, the Regulation primarily focus on the various elements involved in the process of ocean economic development. The Regulation consist of 53 articles and are divided into seven chapters: General Provisions, Industrial Development, Scientific and Technological Innovation, Green Development, Open Cooperation, Service and Support, and Appendices.

Chapter 1, “General Provisions,” primarily clarifies the legislative purpose, scope of application, fundamental principles, competent authorities, supporting departments, their respective powers, coordination mechanisms between departments, and the planning of coastal and marine spatial areas. Chapter 2, “Industrial Development,” emphasizes optimizing the layout of marine space, fostering coordinated industrial development, cultivating emerging marine industries, driving the upgrading and transformation of traditional industries, enhancing marine service levels, and boosting the government's capacity to support industrial development. Chapter 3, “Scientific and Technological Innovation,” emphasizes the construction of innovation systems and platforms, the aggregation of innovation factors such as technology, talent, and capital in marine enterprises, strengthening marine technology research and development, improving the mechanism for the transformation of marine scientific and technological achievements, and promoting the creation and application of intellectual property in



the marine field. Chapter 4, “Green Development,” primarily stipulates the establishment of a marine resource development and protection system, the promotion of intensive and efficient utilization of marine spatial resources, the strengthening of marine ecological protection and restoration, the development of blue carbon sinks, and the promotion of the conversion of marine ecological value. Chapter 5, “Open Cooperation,” focuses on integrating into global ocean cooperation and governance, strengthening international cooperation in deep-sea areas, promoting coordinated development of marine industries, enhancing cooperation between Guangdong, Hong Kong, Macao, and inter-provincial and inter-city cooperation, and promoting the cross-regional flow of production factors. Chapter 6, “Service and Support,” prioritizes improving departmental coordination mechanisms, strengthening the support of resources, funds, and institutional factors for marine economic development, and enhancing the hardware and software facilities required for marine economic development. Chapter 7, “Supplementary Provisions,” mainly concerns the effective date of the Regulation.

## 3.2 Challenges the regulation aim to address

The regulation addresses potential challenges encountered during the development of Guangdong Province’s marine economy to promote its high-quality development. Its substantive focus encompasses the following aspects:

### 3.2.1 Promote the development of marine economic industries

In response to the irrational structure of Guangdong’s marine industry, the Regulations attempt to play the guiding role of the law in industrial development, and make provisions from the aspects of promoting the upgrading of traditional industries, the development of emerging industries, enhancing scientific and technological innovation’s contribution to industrial development, and optimizing marine spatial layouts, thereby aiming to foster high-quality ocean economic growth.

First, the Regulation promotes leveraging Guangdong Province’s marine resource advantages to upgrade traditional marine industries. Notably, an AIS technology-based study surveying fishing intensity in Guangdong revealed unexpectedly low levels in coastal areas. Fishing activity was higher in eastern and western Guangdong compared to significantly lower levels in central Guangdong waters (surrounding Hong Kong and Shenzhen), potentially indicating severe degradation of coastal fishery resources (Chen et al., 2023). This serves as a warning to the sustainable development of Guangdong Province’s traditional marine fishing industry. Accordingly, Article 19(1) of the Regulation clarifies the authority of county-level governments to cultivate and develop modern fisheries.<sup>4</sup> The subsequent provisions also stipulate measures to support the development of fisheries, such as establishing distant-water fishing bases, implementing resettlement and exit mechanisms for offshore aquaculture, streamlining approval procedures for deep-sea aquaculture,

reducing or exempting sea area use charges, promoting recreational fishing, and refining the summer fishing moratorium alongside closed fishing periods and zones. Article 20(1) explicitly mandates support for modern marine ranching development, encompassing land and sea use for aquaculture land and sea use, aquaculture approvals, credit, and insurance. It further stipulates establishing supervision systems for aquaculture vessels and registration systems for aquaculture equipment.<sup>5</sup> Additionally, Articles 21 to 24 of the Regulation also make targeted provisions for the modernization of traditional industries such as marine oil and gas exploration and development, marine chemical industry, marine shipbuilding, and maritime transportation. On the one hand, the above provisions simplify the procedures for marine administrative approval and improve the development efficiency of the marine industry. On the other hand, they clearly stipulate the government’s responsibility to support and cultivate the marine industry, which can provide guarantees for the further development of Guangdong Province’s marine industry.

Second, encourage the application of new technologies and promote the development of emerging marine industries. In recent years, advances in emerging technologies such as Artificial Intelligence, Big Data, Blockchain have been profoundly driving industrial development. These technologies not only improve production efficiency and management levels but also give rise to new business models and growth points. Integrating industry and technology within the ocean economy boosts competitiveness and enables sustainable development. Article 12 stipulates that the government shall foster emerging marine industries, promote digital and intelligent transformation of the ocean, and build a modern marine industrial system.<sup>6</sup> Article 13 mandates measures such as supporting and guiding electronic information companies to expand into the marine field and accelerating the integration and application of Internet of Things, Big Data, and Artificial Intelligence technologies within the marine sector.<sup>7</sup> Furthermore, Articles 14 to 16 respectively address the development and application of new marine equipment, the construction of marine biotechnology platforms, and the development of the offshore wind power industry chain. Based on the opportunities and challenges that emerging technologies present to the marine industry, these provisions clearly define the government’s responsibility to encourage the application of emerging technologies in the marine sector and promote the development of emerging marine industries. Previously, these government responsibilities were only mentioned

4 Article 19 (1): The government at or above the county level in coastal areas shall cultivate and develop the modern fishery industry and support the construction of key cold chain logistics bases and distant-water fishery bases.

5 Article 20 (1): The government at or above the county level in coastal areas shall support the construction of modern marine ranches, strengthen the provision of supporting infrastructure and the guarantee of land and sea use for industrial purposes, establish a linked approval mechanism for aquaculture sea use, and promote the simultaneous issuance of real property rights certificates for sea area use and aquaculture licenses for waters and tidal flats in accordance with regulations, and provide policy support in areas such as credit and insurance in accordance with regulations.

in internal documents, but now they are formally established through the Regulation.

Third, strengthening the transformation of technological achievements to enhance the contribution of scientific and technological innovation to industrial development. Scientific and technological innovation can improve production efficiency and is a key driver of marine industrial development. Article 31(1) explicitly provides guidance and support for developing marine science and technology innovation platforms, including marine enterprises, universities, research institutions, and laboratories, to enhance innovation capabilities.<sup>8</sup> Article 32(1) clarifies that the government shall establish a mechanism for transforming marine scientific and technological achievements, improve application services for industrializing these achievements.<sup>9</sup> Article 32(2) states that the government should promote the creation and application of marine intellectual property, and enhance intellectual property protection mechanisms.<sup>10</sup> Previously, the transfer of scientific and technological achievements was primarily undertaken by research institutes, universities, or enterprises. Intellectual property infringements frequently occurred, limiting their motivation for innovation. The above mentioned provisions clarify the government's responsibility in the transformation of scientific and technological achievements, technological innovation, and intellectual property protection, increasing the government's involvement in promoting innovation in the marine sector.

6 Article 12: The governments of the province and of cities at or above the prefecture level and relevant departments shall cultivate and develop emerging marine industries, promote quality improvement and efficiency enhancement in traditional marine industries, expand and upgrade marine service industries, advance the digital and intelligent transformation of marine industries, cultivate and strengthen marine industrial chains led by leading enterprises, create distinctive marine brands, and establish a modern marine industrial system with international competitiveness.

7 Article 13: The relevant competent departments of industry and information technology, development and reform, science and technology of the government of the province and of cities at or above the prefecture level shall guide and support electronic information enterprises to expand into the marine field, improve the research and development capabilities of high-end marine electronic equipment, and accelerate the integration and application of technologies such as the Internet of Things, big data, and artificial intelligence in the marine field.

8 Article 31 (1): The government of the province and of cities at or above the prefecture level and their relevant competent departments for science and technology, education, the marine economy, natural resources, fisheries, etc., shall strengthen the construction of marine sci-tech innovation platforms and infrastructure, enhance the construction of large-scale marine scientific installations, promote the construction of national-level innovation platforms, and guide and support marine-related enterprises, institutions of higher education, and scientific research institutions in strengthening the construction of marine sci-tech innovation vehicles such as engineering technology research centers and laboratories, so as to improve marine sci-tech innovation capabilities.

Fourth, the Regulation aims to optimize marine spatial layouts and achieve land-sea coordinated development. Coordinating land and sea spatial layouts enhances marine resource utilization efficiency and fosters deep integration and coordinated development between land and sea economies. Article 6 of the Regulations clearly stipulates that a “Guangdong Coastal Zone and Marine Spatial Plan” should be formulated to coordinate the development of coastlines, offshore waters, and deep-sea areas, promoting the integrated protection and coordinated development of land and sea. Simultaneously, a “Guangdong Provincial Marine Economic Development Special Plan” should be formulated to promote the development of the marine economy.<sup>11,12</sup> This provision clarifies the main body that leads marine spatial planning and provides necessary guidance for the scientific and rational use of the ocean.

### 3.2.2 Optimize the management system of ocean economy

The ocean economy encompasses diverse facets, rendering its development a systematic project. Therefore, marine regulations cannot be viewed in isolation; different marine laws must establish effective interactions to maximize their governance role (Trevisanut et al., 2020). Unified legislation and systematic law enforcement are also necessary in marine governance (Tyagi and Pandya, 2024). Guangdong Province's current marine economic management system exhibits dispersed departmental powers, unclear division of labor, and low systematization, reducing marine law enforcement effectiveness. Coordinating diverse powers to jointly advance marine economic development and establish systematic marine governance constitutes a key challenge the Regulation addresses.

First, the Regulation clarifies departmental responsibilities to enhance marine management capabilities. Article 5(1) and Article 5

9 Article 32 (1): The government at or above the county level and their relevant competent departments for science and technology, etc., shall be responsible for guiding and coordinating the promotion of the transformation of marine sci-tech achievements within their administrative regions, improve the mechanism for such transformation, and enhance services for the industrial application of marine sci-tech achievements.

10 Article 32 (2): The government at or above the county level and their relevant competent departments for market regulation, etc., shall promote the creation and utilization of intellectual property in the marine sector, strengthen the protection, management, and service of intellectual property, and improve the mechanism for intellectual property rights protection.

11 Article 6: The competent department for natural resources of the provincial government shall organize the formulation of the provincial coastal zone and marine spatial plan and submit it to the provincial government for approval, so as to coordinate the development of the coastal zone, nearshore sea areas, and deep and distant sea areas, and to advance integrated land-sea protection and coordinated development.

12 The government of the province and of coastal cities at or above the prefecture level shall, in light of their local resource endowments, environmental carrying capacities, and the foundational status of their marine economies, organize the formulation of special plans for marine economic development.

(3) define the marine economic management system, designating the “Guangdong Provincial Development and Reform Commission” as the leading entity. Supporting functional departments, including education, science and technology, industry and information technology, finance, human resources and social security, natural resources, ecological environment, transportation, water conservancy, fisheries, culture and tourism, market supervision, government affairs and data, sports, energy, marine comprehensive law enforcement, local financial management, are responsible for promoting the high-quality development of the marine economy within their respective responsibilities.<sup>13</sup> This delineates the primary administrative and supporting functional departments for marine economic administration, which to a certain extent improves the dilemma of unclear responsibilities of various departments in Guangdong Province in marine governance.

Second, the Regulation establishes a marine economic management coordination mechanism to enhance efficiency. Article 4(2) stipulates that governments shall establish a coordination mechanism for marine economic work, designed to resolve cross-regional and cross-departmental issues impeding marine economic development.<sup>14</sup> This effectively improves management efficiency under a multi-departmental management model, as marine governance involves multiple fields and therefore requires coordination and cooperation among multiple departments.

Third, the Regulation emphasizes the “service” function of administrative agencies to provide support for the development of the ocean economy. A defining characteristic is its de-emphasis of administrative functions in favor of highlighting responsibilities to provide data support, risk assessment, public services, policy support, skills training, and infrastructure development for marine economic activities. This means that the government no longer just plays the role of regulator in the process of economic development, but also acts as a service provider, working together with market players to promote high-quality development of the ocean economy.

13 Article 5 (1): The development and reform departments or other departments designated by the government at or above the county level (hereinafter referred to as the competent marine economic departments) shall be responsible for promoting high-quality development of the marine economy within their respective administrative regions. The competent marine economic departments of the government of the province and of coastal cities at or above the prefecture level shall handle the routine work of the marine economic coordination mechanism. Article 5 (3): Departments in charge of education, science and technology, industry and information technology, finance, human resources and social security, natural resources, ecological environment, transportation, water resources, fisheries, culture and tourism, market regulation, government affairs and data, sports, energy, comprehensive marine law enforcement, local financial management, maritime administration and other relevant agencies shall, according to their respective responsibilities, carry out relevant work to promote high-quality development of the marine economy.

### 3.2.3 Promoting the sustainable development of ocean economy

Sustainable development holds significant importance in the field of ocean economic development. The growth of the ocean economy depends on whether this economic development is both sustainable and comprehensive (Koehring et al., 2021). Ocean economic expansion often increases resource consumption, leading to overexploitation, resource depletion, and environmental pollution. Therefore, sustainable ocean economic development requires reconciling economic growth with environmental protection, improving resource utilization efficiency, developing a circular economy, and promoting economic advancement without environmental sacrifice. Coordinating this relationship remains an unresolved research challenge (Agarwal, 2022). From the perspective of carbon emissions, in 2019, the total carbon emissions of Guangdong Province exceeded those of Canada, ranking 11th globally, with a total of approximately 569.1 million tons of carbon dioxide. Although Guangdong has implemented a cap-and-trade system for related industries in recent years, the total carbon emissions remain relatively high. Monte Carlo Simulation results project Guangdong's 2030 carbon emissions between 50.29 million and 64.36 million tons of carbon dioxide (Luo et al., 2025). Rising emissions exacerbate ocean acidification, adversely impacting marine ecosystems. Consequently, energy conservation and emission reduction pressures persist significantly in Guangdong. Based on this, the Regulation adheres to a green development concept, guiding sustainable ocean economic development through the following provisions:

First, the Regulation clarifies that the concept of green development should be upheld during the development of the ocean economy. Article 33 of the Regulation states that during the development of the ocean economy, a sound system for the development and protection of marine resources should be established, strict standards should be adhered to in ecological protection, resource utilization and coastline retention management. It further emphasizes that all marine development and construction activities shall proceed scientifically and sustainably.<sup>15</sup> This provision makes it clear that the development of the marine economy must not come at the cost of environmental damage and resource abuse.

Second, a management and control mechanism for marine resources and space has been established to improve the utilization rate of marine resources. Article 34 clarifies that competent authorities shall enhance coastline protection and utilization, guide efficient and green nearshore water use, expand development space in deep and distant waters, and regulate island protection, development, and utilization. Simultaneously, a tiered sea area use rights system will be implemented, such as the layered use for “offshore wind power -

14 Article 4 (2): The government of the province and of coastal cities at or above the prefecture level shall establish and improve a coordination mechanism for the marine economy to coordinate and resolve major cross-regional and inter-departmental issues in promoting the development of the marine economy.

marine aquaculture - submarine pipelines,” to promote the intensive and efficient use of marine space resources.<sup>1617</sup>

Third, a routine marine ecological environment monitoring and protection mechanism is established. Article 38 of the Regulation stipulates the establishment of a marine debris cleanup system, while strengthening land-based pollution control and marine debris monitoring.<sup>18</sup> Furthermore, Article 48(1) explicitly mandates the government to enhance its marine pollution emergency response capacity. From routine monitoring and protection to emergency response, a comprehensive approach to marine environmental protection will be established, moving away from a “pollution first, then treatment” model.<sup>19</sup> The above provisions transform Guangdong Province’s existing environmental protection model from pollution control to pollution prevention, achieving a shift from passive to active.

Fourth, new models for environmental protection and revitalization are explored. Article 36(1) stipulates the government may support social capital participation in marine ecological restoration by granting time-limited natural resource use rights.<sup>20</sup> Article 37 clarifies exploring marine ecosystem carbon sequestration value transformation through the implementation of carbon sink investigation, monitoring, and accounting, aiming to stimulate public interest in ecological conservation.<sup>21</sup> The above provisions stimulate the motivation of private forces to participate in marine environmental protection

and effectively improve the efficiency of marine environmental governance.

### 3.2.4 Strengthening factors support for the development of ocean economy

Supportive factors are crucial for the high-quality development of the ocean economy. As a key economic engine, marine economic growth necessitates robust support from key elements like land, capital, talent, energy, and water resources. To strengthen this factor support, the Regulation establishes the following provisions:

First, marine resource supply is strengthened. As fundamental inputs, the protection level of marine resources directly impacts the implementation and progress of marine industry projects. Article 42 clarifies that authorities shall conduct basic marine resource surveys, marine mapping, marine data collection, and monitor the protection and utilization of sea areas, islands, and coastlines. It further mandates sharing, managing, and applying the aforementioned data to promote efficient data element flow.<sup>2223</sup> Article 43(1) of the Regulation clearly states that the land, sea, island, and forest use needs of marine projects must be protected in accordance with the law. The Regulation also streamlines marine use approval processes to improve efficiency.<sup>24</sup> The above provisions can ensure that participants in marine activities have sufficient access to sea, land, islands and marine data to safeguard the development of the marine economy.

Second, financial support for marine economic industries is strengthened. Fiscal policy support effectively enhances competitiveness, risk resilience, and development levels within marine industries. Article 29(1) of the Regulation clearly states that the government may adopt inclusive fiscal subsidies, such as financial grants, loan interest subsidies, and incentives, to support and guide marine-related enterprises to increase their investment in scientific research.<sup>25</sup> Article 44(1) emphasizes strengthening the coordination of financial resources and budgets for marine industry

15 Article 33: The government at or above the county level in coastal areas shall adhere to the green development of the marine economy, improve the system for the development and protection of marine resources, strictly adhere to the ecological protection red lines, environmental quality bottom lines, and resource utilization upper limits, strictly implement the control targets for the natural shoreline retention rate, and scientifically advance all types of marine-related development, protection, and construction activities.

16 Article 34: The relevant competent departments for natural resources of the government at or above the county level in coastal areas shall strengthen the control over marine ecological space and marine development and utilization space, improve the level of coastline protection and utilization efficiency, guide the efficient and green utilization of nearshore areas, expand the development space in deep and distant seas, and regulate the protection, development, and utilization of uninhabited islands.

17 The competent department for natural resources of the government of the province shall regulate and orderly advance the work of establishing three-dimensional and layered rights for sea areas, explore layered sea use for activities such as offshore wind power, marine aquaculture, and submarine pipelines, and promote the intensive, economical, and efficient utilization of marine spatial resources.

18 Article 38: The government at or above the county level in coastal areas shall, in light of local conditions, scientifically and rationally delineate coastal building setback lines, construct public facilities for sports and leisure, establish a marine debris cleanup system, strengthen the control and monitoring of land-based pollution entering the sea, interception, collection, salvage, transport, and treatment of marine debris, carry out pollution control for ships, ports, and mariculture, and ensure public access to the sea.

19 Article 48 (1): The government at or above the county level in coastal areas and their relevant departments shall strengthen the construction of the marine early warning and monitoring system, conduct marine disaster risk assessments, establish and improve the emergency response system for maritime accidents, and enhance the level of support for navigation and maritime operations, emergency response to marine pollution, and maritime rescue and salvage services.

20 Article 36 (1): The governments at or above the county level in coastal areas and their relevant competent departments for natural resources, forestry, etc., shall strengthen the systematic protection and restoration of marine ecological barriers such as mangrove forests, coastal wetlands, islands, bays, and estuaries; and shall, through incentive policies such as granting the right to use natural resources for a certain period in accordance with the law, encourage and support the participation of private capital in marine ecological protection and restoration.

21 Article 37: The government at or above the county level in coastal areas shall organize surveys, monitoring, and accounting of marine carbon sinks, enhance the carbon sink capacity of marine ecosystems, and explore ways to promote the realization of the carbon sink value of marine ecosystems.



development and marine science and technology innovation, alongside optimizing financing channels.<sup>26</sup> The above provisions establish the government's responsibility to financially support the development of the ocean economy, which effectively improves the risk resistance of participants in maritime activities.

Third, essential hardware and software infrastructure for ocean economic development is improved. Marine infrastructure serves as the supporting platform; its development level directly relates to the marine industry's agglomeration effect and sustainable development capacity. Article 24(1) of the Regulation of the Regulation stipulates that the government should support the development of smart ports and enhance marine transportation capacity.<sup>27</sup> Article 25 of the Regulation stipulates that relevant competent authorities should enhance shipping transactions, shipping finance, shipping insurance, maritime legal services, and shipping technical services to provide support for the development of the shipping industry.<sup>28</sup> Article 26(1) of the Regulation also clearly stipulates the protection for marine tourism development infrastructure.<sup>29</sup> The above provisions attempt to build a government-led marine infrastructure system by clarifying the government's responsibilities in marine infrastructure construction.

## 4 Improving legal governance of ocean economy in Guangdong

The Regulation addresses some pain points and difficulties in Guangdong's ocean economic development, charts a course for its legal governance, and initiates legal governance for high-quality

ocean economic development. However, subsequent legal governance must still address several issues.

### 4.1 Problems in Guangdong's ocean economic legal governance

First, the legal governance of Guangdong's ocean economy lacks a fundamental guiding concept. The government of Guangdong Province has not clearly defined the guiding concept that should be followed in marine governance activities at the current stage, resulting in fragmented legislative, judicial, and law enforcement procedures, and highly dependence of the governance process on administrative orders and regulations. Such fragmented governance model obviously fails to cope with the ever-changing ocean economic landscape and mobilize the enthusiasm of all parties involved in marine governance. Consequently, two problems have emerged. On the one hand, lacking a fundamental guiding concept diminishes unified and clear governance objectives across administrative departments in marine governance, resulting in fragmented governance measures and deficient synergy. On the other hand, lacking a fundamental guiding concept hinders the consensus establishment among participants in marine activities and the coordination of interest conflict among ocean economic stakeholders.

Second, the marine regulatory system is incomplete. The ocean is an organic whole, and human-induced changes such as increased sea temperature, salinity variations, ocean acidification, dissolved oxygen depletion and sea-level rise are interconnected phenomena, not

22 Article 42: The competent department for natural resources of the government of the province shall, in accordance with its duties, carry out basic surveys of marine resources and marine surveying and mapping, collect marine data in accordance with the law, and strengthen the surveillance and monitoring of the status of the protection and utilization of sea areas, islands, and coastlines.

23 The competent department for government affairs and data of the government of the province shall support the construction of a marine data space and, in conjunction with relevant departments, strengthen the aggregation, sharing, management, and application of various types of marine data to promote the efficient flow of marine data elements.

24 Article 43 (1): The government at or above the county level shall, in accordance with territorial space plans, guarantee the land, sea, island, and forest use needs of marine-related projects in accordance with the law.

25 Article 29 (1): The government at or above the county level shall promote the concentration of innovation factors such as technology, talent, and capital in marine-related enterprises, and support enterprises in undertaking national, provincial and municipal key marine sci-tech projects.

26 Article 44 (1) The government at or above the county level shall strengthen the coordination of fiscal resources and budgets for the development of marine industries and for sci-tech innovation, optimize investment and financing mechanisms, and implement policies for fee reduction rewards and subsidies for government-backed financing guarantees and policies for re-guarantee subrogation compensation.

27 Article 24 (1): The relevant competent departments for development and reform, and transport of the government of the province and of cities at or above the prefecture level shall improve the marine transport network and multimodal transport corridors, strengthen the construction of port and shipping infrastructure, advance the upgrading and renovation of old ports, support the construction of smart ports, and enhance marine transport capacity.

28 Article 25: The government of the province and of cities at or above the prefecture level and their relevant competent departments for transport, local financial regulation, judicial administration, commerce, maritime administration and other relevant departments, shall improve the capacity of shipping services including shipping transactions, shipping finance, shipping insurance, maritime legal services and shipping technical services. Qualified regions shall be supported in cultivating modern shipping service institutions, building modern shipping service clusters, developing a shipping headquarters economy, promoting the construction of an international ship registration center and an international anchorage service base, and strengthening the construction of international transit ports.

29 Article 26 (1): The government at or above the county level in coastal areas shall improve policies and measures to promote the development of the marine tourism industry, strengthen the survey, development, and utilization of marine tourism resources, support the construction of high-level coastal tourist resorts and scenic areas, strengthen the construction of infrastructure such as coastal tourist highways, seaside promenades, and land-to-island transport terminals, and create a distinctive coastal tourism belt.



isolated events. Yet, fragmented management regulations struggle to address the increasingly severe chain reactions resulting from these issues. Consequently, adopting a systemic approach to comprehensive marine governance is necessary (Craig, 2022). However, in Guangdong Province, current ocean economy legislation is confined to single-sector regulations such as the Regulation of Guangdong Province on Promoting High-quality Development of the Ocean Economy, the Guangdong Provincial Regulation on the Use of Marine Areas and the Guangdong Provincial Regulation on Fisheries Management. A systemic foundational marine law guiding marine legal system development is absent. Additionally, enforcement powers dispersed among multiple agencies constrain comprehensive governance capacity, leaving marine governance effectiveness suboptimal.

Third, key ocean economy industries lack necessary legal support. According to the survey conducted by the OECD (2025), the global ocean economy is currently dominated by two major ocean economic activities: “Offshore oil and gas extraction and nearshore industry” and “Marine and coastal tourism,” serving as primary drivers of national ocean economic development. From both Guangdong and national perspectives, these industries also rank highly. Furthermore, marine new energy industries, significantly promoting high-quality marine economic development, have received insufficient governmental attention. The Regulation provides only sporadic clauses concerning the upgrading and development of these industries, proving inadequate for effective industry support.

Fourth, the issue of regional development imbalance has not been resolved. Such imbalance compromises marine economic resilience (Wei et al., 2025). According to the data from the Report on the Development of Guangdong’s Marine Economy (2025), more than three-quarters of the marine economic output in Guangdong Province is concentrated in the Pearl River Delta. This indicates substantial untapped potential in other regions, and efforts should be made to further activate the vitality of ocean economic development in these regions to promote coordinated regional development of the ocean economy in Guangdong (Department of Natural Resources of Guangdong Province, 2025a). Regrettably, relevant legislation lacks specific provisions addressing this issue, leaving regional coordination legislation for Guangdong’s ocean economy an unresolved gap.

Finally, marine ecological pressures remain severe, particularly as climate change and emerging pollutants adversely impact high-quality ocean economic development. Analyzing China’s fishery development over two decades, scholars note that balancing emission reduction requirements, fishery production maintenance, and sustainable management enhancement constitutes a major national challenge (Zhang et al., 2025). With the tightening of carbon emission caps in Guangdong Province, marine-related enterprises will face significant pressure to reduce energy consumption and emissions. Guiding the upgrading of these enterprises is an urgent legislative need in Guangdong. Furthermore, plastics have become among the most extensively used materials in industrial development. Empirical research on marine pollutants in Guangdong reveals plastics as the primary marine debris source (47%–99% of total debris), with 82%–86%

originating from coastal human activities and shipping/fishing operations (Deng et al., 2024). Thus, improving the management of plastic waste is also a challenge in marine economic governance. In addition, climate change, including warming seawater, acidification, and rising sea levels, will also have an adverse impact on the development of some marine industries, which urgently need to be addressed.

## 4.2 Suggestions on improving the legal governance of ocean economy in Guangdong Province

First, marine governance in Guangdong Province should be guided by the concept of Maritime Community with a Shared Future (MCSF) proposed by Chinese President Xi Jinping, stating that humanity is a community with a shared future connected by the ocean, and all stakeholders in marine activities should jointly cope with marine risks and challenges, and maintain peace, stability, and prosperity of the ocean. From a necessity perspective, MCSF advocates for safeguarding the common interests of all mankind and functions in building consensus targeting marine governance, demonstrating its profound impact on global marine governance (Wang, 2023). The application and legalization of the concept of MCSF can better unite all parties involved to jointly face the challenges brought by marine environmental pollution, depletion of biological resources, loss of biodiversity and global climate change (Jin, 2025). From a feasibility perspective, the Chinese academic community has carried out numerous beneficial explorations upon the proposal of the concept of MCSF in 2019. Scholars have found that these studies cover the concept, connotation, theoretical basis, contribution to international marine governance theory, and specific paths to building a community with a shared future for the ocean (Xu and Tan, 2023), thereby laying the foundation for Guangdong Province to guide marine governance based on the MCSF concept.

Second, a ocean-related legal system aiming to promote comprehensive marine governance should be established under the guidance of the Basic Ocean Law. Modern marine governance requires robust cross-departmental cooperation and information sharing. However, fragmented departmental legislation impedes coordinated law enforcement and comprehensive governance (Kelly et al., 2018). Despite the established preliminary marine economic governance pattern led by the Development and Reform Commission with multi-department coordination, Guangdong Province lacks foundational rules, basic principles and coordination mechanisms targeting marine governance. In addition, the pursuit of relatively narrow governance goals by departments hinders synergistic efforts. Therefore, Guangdong Province should also improve its comprehensive marine legislation and enhance the effectiveness and coherence of the marine legal system. The formulation of the Basic Ocean Law will establish a cross-departmental and cross-jurisdictional integrated management mechanism to guide subsequent marine legislation. Globally, there are several common models of the basic ocean law. The Marine and

Coastal Access Act of the United Kingdom<sup>30</sup> adopts a comprehensive and detailed model, including the Marine Management Organisation, Exclusive Economic Zone, UK Marine Area and Welsh Zone, Marine Planning, Marine Licensing, Nature Conservation, Management of Inshore Fisheries, Fisheries, Enforcement, Coastal access, etc., totaling 325 articles with almost every aspect of ocean economy. The Basic Act on Ocean Policy of Japan<sup>31</sup> adopts a programmatic model, consisting of only four sections: General Provisions, Basic Plan on Ocean Policy, Basic Measures, and Headquarters for Ocean Policy, totaling 38 articles. The Japanese model is principled and serves only as a guideline, overseeing other maritime laws and regulations. The United States adopts a simpler model. The Oceans Act of the United States<sup>32</sup> has only 7 articles, with the aim to establish the United States Commission on Ocean Policy. The commission studies issues in the field of ocean development and submits a report of its findings and recommendations regarding United States ocean policy to Congress and the President. Guangdong is a province of China, its legislative authority and capacity are relatively limited compared with the central government. Consequently, adopting the Japanese model or the American model seems like a better choice.

Third, promoting and guiding the development and upgrading of the marine industry through legislation should be realized. Legislation plays a crucial role in guiding the upgrading of industries. Based on data from 2022, scholars have evaluated the emission reduction effects of wind power and solar power generation in Guangdong Province. The application of these new energy sources has led to a gradual reduction in atmospheric pollutants and carbon dioxide emissions in Guangdong Province, resulting in significant economic and social benefits (Zhu et al., 2025). Consequently, law's guiding role should promote marine new energy industries. Simultaneously, guiding internal industry upgrades remains essential for achieving high-quality marine industrial development. Specifically, the Regulation of Guangdong Province on Promoting the Development of Marine New Energy Industries could be enacted to promote the development of industries such as offshore wind power, solar energy, and tidal energy that help reduce pressure on the marine environment. Furthermore, stricter Carbon Emission Limits could be established to guide marine-related enterprises in eliminating outdated production capacity and proactively promote industrial upgrading. Crucially, law's role in industrial development is primarily guiding rather than restrictive. Studies of China's new energy sector indicate overly complex regulations can obstruct new energy application, technological innovation, and novel marine

applications. This calls for innovative regulatory approaches that guide healthy industry development without environmental compromise (Recio-Blanco, 2015).

Fourth, Regional coordinated legislation should be strengthened to foster balanced marine economic development. Coordinated development constitutes a key feature of high-quality development, and the rule of law provides an effective mechanism to advance it (Wang, 2024). The 2022 revised Organic Law of Local People's Congresses and Local People's Governments stipulates that provincial, municipal, and prefecture-level people's congresses and their standing committees may conduct coordinated legislation based on regional development needs. The 2023 revision of the "Legislation Law" also explicitly granted "regional coordinated legislation" legal status and validity, stipulating that provinces, autonomous regions, municipalities, prefectural, and autonomous prefectural levels could establish regional coordinated legislation mechanisms. Guangdong Province was the first province in China to promote rural revitalization and achieve coordinated urban-rural development through legislation. The promulgation of the "Guangdong Province Regulations on Promoting Rural Revitalization" has effectively promoted rural development and narrowed the development gap between regions in Guangdong Province, offering valuable experience for ocean economy regional coordination legislation. Therefore, implementing regional coordinated legislation for the ocean economy is essential to promote balanced regional development and enhance marine economic quality.

Finally, legally safeguarding green development baselines and proactively addressing climate change impacts should be considered. Governance of the ocean environment will not only benefit the restoration of the marine ecological environment but also bring greater economic benefits to the development of the ocean economy (Pierce, 2023). Scholars have explored the critical interaction between high-quality development of China's ocean economy and low-carbon development, noting that the ocean economy's contribution to global GDP is increasingly significant, yet its expansion accompanies serious environmental issues like greenhouse gas emissions and marine pollution. Thus, pursuing high-quality ocean economic development is imperative (Pan et al., 2024). Furthermore, under climate change and technological innovation pressures, existing marine rules no longer provide optimal order. The marine legal system requires reform to balance stakeholder rights and obligations (Hasin, 2023). Guangdong should persistently uphold green development in marine governance, improving marine environmental protection mechanisms and optimizing marine spatial planning to actively counter climate change's adverse effects on ocean economic development.

## 5 Conclusion

Pursuing high-quality development of the ocean economy is an inevitable choice when the ocean economy reaches a certain scale. Striving for breakthroughs in industrial upgrading, scientific and technological innovation, and sustainable development is an inevitable choice for China's ocean economic development at this

30 United Kingdom (2009). Marine and Coastal Access Act 2009 (c. 23). London: United Kingdom. Available at: <https://www.legislation.gov.uk/ukpga/2009/23/contents> (Accessed Aug. 25, 2025).

31 Japan (2007). Basic Act on Ocean Policy (Act No. 33 of 2007). Tokyo: Japan. Available at: <https://www.japaneselawtranslation.go.jp/en/laws/view/4770> (Accessed Aug. 25, 2025).

32 United States (2000). Oceans Act of 2000, Public Law No. 106-256 (08/07/2000). Washington D.C.: United States. Available at: <https://www.congress.gov/bills/106th/congress/senate-bill/2327/text> (Accessed Aug. 25, 2025).

stage. This article explores the coupling relationship between legal regulation and marine economic development, clarifying law's positive role in promoting sustainable marine economic growth, guiding marine industrial optimization and upgrading, and coordinating economy-environment relations. In the pursuit of high-quality development of the marine economy, law can provide essential safeguards for economic development. In response to current challenges in Guangdong Province's marine economic development, Guangdong Province has enacted the Regulation of Guangdong Province on Promoting High-Quality Development of the Ocean Economy. These regulations address issues related to industrial development, scientific and technological innovation, green development, resource security and international cooperation, aiming to elevate Guangdong Province's ocean economic development to new heights. The Regulation's promulgation initiates Guangdong's path toward legalized ocean economic development, exploring high-quality advancement through a robust legal framework. These regulations demonstrate the necessity and feasibility of legal governance in ocean economic development.

As China's inaugural legislation in ocean economic development, the Regulation pioneers a novel legal governance model for promoting marine economic growth. Nevertheless, challenges persist in advancing comprehensive marine governance, fostering industrial upgrading, coordinating regional development, and strengthening environmental governance. Continuous refinement during implementation is essential to develop a Guangdong-specific ocean economic legal governance path, explore new governance models, and incorporate mature practical experience into legislative improvements, thereby progressively enhancing Guangdong Province's ocean economic legal system.

Future ocean economic development will inevitably progress toward sustainability and high quality. Throughout this process, the law will continue to safeguard and promote ocean economic development, address the dual governance conflicts between land and sea, coordinate regional marine economic development, cope with climate change and marine plastic waste pollution, thereby ensuring high-quality development of the ocean economy. Admittedly, the development of the ocean economy depends not only on legal protection, but also on factors such as improving market economy mechanism, developing science and technology, and strengthening international cooperation. Due to space limitations, this article mainly discusses legal factors. Other factors require further investigation.

## References

- Agarwal, A. (2022). Sustainable development of the blue economy through public private partnerships. *Indian J. Integrated Rsch. L.* 2, 1.
- Becker-Weinberg, V. (2021). Two key ocean governance challenges for Sao Tome and Principe. *Afr. J. Int'l Comp. L.* 29, 400–417. doi: 10.3366/ajicl.2021.0373
- Chang, Y. C. (2010). International legal obligations in relation to good ocean governance. *Chin. J. Int. Law.* 3, 589–605. doi: 10.1093/chinesejil/jmq024

## Author contributions

PW: Resources, Conceptualization, Writing – original draft, Data curation, Writing – review & editing, Investigation, Visualization.

## Funding

The author(s) declare financial support was received for the research and/or publication of this article. This research was funded by the following project: Guangdong Provincial Philosophy and Social Science Fundamental Project, China (Grant No. GD24XFX10) and Guangzhou Municipal Philosophy and Social Sciences Planning 2023 Annual Topics, China (Grant No.2023GZGJ216).

## Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Chen, Y. S., Sun, Z., Zhou, Y., Yang, W., and Ma, Y. (2024). Can the regulation of the coastal environment facilitate the green and sustainable development of the marine economy? *Ocean Coast. Manage.* 254, 107203. doi: 10.1016/j.ocecoaman.2024.107203
- Craig, R. K. (2022). Re-valuing the ocean in law: exploiting the panarchy paradox of a complex system approach. *Stan. Env't LJ.* 41, 3. doi: 10.2139/ssrn.3902667
- Deng, W. H., Tang, J. Y., Luo, Y. C., Chen, H., Zeng, D. N., and Ye, K. M. (2024). Pollution characteristics, sources and risk assessment of marine litter in Guangdong province. *Mar. Environ. Science.* 43, 696–706. doi: 10.13634/j.cnki.mes.2024.05.014
- Department of Ecology and Environment of Guangdong Province (2025). Annual carbon emission allocation plan of Guangdong Province in 2024. Available online at: [https://gdee.gd.gov.cn/shbtwj/content/post\\_4679397.html](https://gdee.gd.gov.cn/shbtwj/content/post_4679397.html) (Accessed June 20, 2025).
- Department of Natural Resources of Guangdong Province (2024). Guangdong ocean economic development Report. Available online at: [https://nr.gd.gov.cn/zwgknew/tzgg/tz/content/post\\_4479269.html](https://nr.gd.gov.cn/zwgknew/tzgg/tz/content/post_4479269.html) (Accessed June 20, 2025).
- Department of Natural Resources of Guangdong Province (2025a). Understanding the Guangdong ocean economic development Report. Available online at: [https://nr.gd.gov.cn/zwgknew/sjfb/sjs/content/post\\_4737959.html](https://nr.gd.gov.cn/zwgknew/sjfb/sjs/content/post_4737959.html) (Accessed June 15, 2025).
- Department of Natural Resources of Guangdong Province (2025b). Regulations on the review and approval of provincial-administered sea use projects. Available online at: [https://nr.gd.gov.cn/zwgknew/tzgg/tz/content/post\\_4673645.html](https://nr.gd.gov.cn/zwgknew/tzgg/tz/content/post_4673645.html) (Accessed August 25, 2025).
- Fasoulis, I. (2022). Navigating the nexus between UNCLOS and the sustainable development goals: perspectives from transitions in Norway's ocean governance regime. *Hung. J. Leg. Stud.* 63, 258–278. doi: 10.1556/2052.2022.00358
- Freestone, D. (2019). Sustainable development, ocean governance and marine protected areas. *Asia-Pac. J. Ocean Law Policy.* 4, 127–141. doi: 10.1163/24519391-00402002
- Frohlich, M., Fidelman, P., Dutton, I., Haward, M., Head, B. W., Maynard, D., et al. (2023). A network approach to analyse Australia's blue economy policy and legislative arrangements. *Mar. Policy.* 151, 105588. doi: 10.1016/j.marpol.2023.105588
- Gao, L. H., Ning, J., Yan, A., and Yin, Q. R. (2022). A study on the marine ecological security assessment of Guangdong-Hong Kong-Macao great bay area. *Mar. pollut. Bull.* 176, 113416. doi: 10.1016/j.marpolbul.2022.113416
- Guo, Q., Yang, C., Wang, X., Wan, Z., Zhang, G., Cui, J., et al. (2024). New Insights on the Spatial and Temporal Distribution Characteristics of Chinese Marine Environmental Quality and its Driving Factors from 2003 to 2021. *Ecol. Indic.* 161, 111903. doi: 10.1016/j.ecolind.2024.111903
- Harrould-Kolieb, E. R. (2016). Ocean acidification and the UNFCCC: finding legal clarity in the twilight zone. *Wash. J. Envtl. L. Pol'y.* 6, 613.
- Hasin, G. (2023). Ocean governance in the 21st century: a 'New package-deal'. *Yale J. Int'l L.* 48, 223. doi: 10.2139/ssrn.4052022
- Jin, Y. M. (2025). The "Rule-of-law" Implication of a maritime community with a shared future. *Asia-Pacific Secur. Maritime Affairs.* 4, 1. doi: 10.19780/j.cnki.ytaq.2025.4.1
- Kelly, C., Ellis, G., and Flannery, W. (2018). Conceptualising change in marine governance: learning from transition management. *Mar. Policy.* 95, 24–35. doi: 10.1016/j.marpol.2018.06.023
- Koehring, M., Kemper, K., and Thomson, A. P. (2021). The post-COVID-19 ocean economy: building back bluer. *Ocean Yearb.* 35, 1–17. doi: 10.1163/22116001\_03501002
- Kuznets, S. (1955). "International differences in capital formation and financing," in *Capital Formation and Economic Growth* (Princeton University Press, Princeton), 19–111. Universities-National Bureau Committee for Economic Research.
- Li, B., Jiang, X., Xiang, K., and Hu, Y. (2025). Regional disparities and dynamic evolution of marine science and technology innovation in China. *Reg. Stud. Mar. Sci.* 87, 104213. doi: 10.1016/j.rsma.2025.104213
- Li, Z., and Zhang, C. (2025). Spatial evolution and resilience analysis of marine eco-environmental protection enterprises. *Mar. pollut. Bull.* 216, 117953. doi: 10.1016/j.marpolbul.2025.117953
- Liu, X. Z. (2025). Legislation empowers the blue economy: before and after the promulgation of the regulation of Guangdong province on promoting high-quality development of the ocean economy. *Voice People.* 6, 27–28.
- Liu, W., Li, S., Zhou, Y., Cai, Y., Liu, C., and Yang, Z. (2024a). Characteristics, drivers and ecological risk assessment of microplastics in the surface water of urban rivers in Guangdong-Hong Kong-Macao greater bay area cities-A case study of Dongguan city. *Environ. pollut.* 362, 125024. doi: 10.1016/j.envpol.2024.125024
- Liu, D., Shang, Z., Lin, T., and Yue, S. (2024b). Balancing law, sustainability, and the economy in China's responsible mineral resource extraction path. *Resour. Policy.* 90, 104783. doi: 10.1016/j.resourpol.2024.104783
- Luo, G., Wu, D., Liu, L., Yang, P., and Lv, H. (2025). Carbon emission reduction strategies in Guangdong province of China: A cost-effectiveness perspective. *J. Environ. Sci.* 155, 910–923. doi: 10.1016/j.jes.2024.05.054
- Nguyen, N. B. (2024). How does a sustainable ocean economy affect national GDP? *Cogent Eco. Financ.* 12, 2435926. doi: 10.1080/23322039.2024.2435926
- OECD (2025). The ocean economy to 2050. Available online at: [https://www.oecd.org/en/publications/2025/03/the-ocean-economy-to-2050\\_e3f6a132.html](https://www.oecd.org/en/publications/2025/03/the-ocean-economy-to-2050_e3f6a132.html) (Accessed June 15, 2025).
- Pan, L., Meng, Q., Wang, Z., Wu, J., and Yu, J. (2024). Coordinated measurement of marine economy: high-quality and low-carbon development in China. *Ocean Coast. Manage.* 257, 107342. doi: 10.1016/j.ocecoaman.2024.107342
- Pauli, G. A. (2010). *The Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs* (New York: Paradigm publications).
- People's Government of Guangdong Province (2021). The 14th five-year plan of Guangdong Province for ocean economic development. Available online at: [http://www.gd.gov.cn/zwgk/wjk/qbwj/yfb/content/post\\_3718595.html](http://www.gd.gov.cn/zwgk/wjk/qbwj/yfb/content/post_3718595.html) (Accessed August 25, 2025).
- Pierce, T. A. (2023). Partnering law and biodiversity for healthy coastal communities: restorative ocean farming. *Hastings Env't LJ.* 29, 111. Available online at: [https://repository.uclawsf.edu/hastings\\_environmental\\_law\\_journal/vol29/iss2/2](https://repository.uclawsf.edu/hastings_environmental_law_journal/vol29/iss2/2) (Accessed June 15, 2025).
- Porter, M. E., and Linde, C. V. D. (1995). Toward a new conception of the environment-competitiveness relationship. *J. Econ. Perspect.* 9, 97–118. doi: 10.1257/jep.9.4.97
- Recio-Blanco, X. (2015). Deployment of ocean renewable energy through area-based management: finding an adequate legal framework. *Envtl. L. Rep. News Analysis.* 45, 11051.
- Standing Committee of the National People's Congress (2001). *The Sea Areas Administration Law of China (in Chinese)*. Available online at: [https://www.gov.cn/gongbao/content/2001/content\\_61173.htm](https://www.gov.cn/gongbao/content/2001/content_61173.htm) (Accessed June 15, 2025).
- Sun, C. Z., Wang, L. J., Zou, W., and Zhai, X. Q. (2023). The high-quality development level assessment of marine economy in China based on a "2+ 6 + 4" Framework. *Ocean Coast. Manage.* 244, 106822. doi: 10.1016/j.ocecoaman.2023.106822
- The Ministry of Natural Resources of PRC (2021). Notice on standardizing the preparation of materials for sea area use argumentation. Available online at: [https://www.gov.cn/zhengce/zhengceku/2021-01/14/content\\_5579825.htm](https://www.gov.cn/zhengce/zhengceku/2021-01/14/content_5579825.htm) (Accessed June 18, 2025).
- The Ministry of Transport of PRC (2025). Port Cargo & container throughput in 2024. Available online at: [https://xxgk.mot.gov.cn/2020/jigou/zhghs/202503/t20250326\\_4165984.html](https://xxgk.mot.gov.cn/2020/jigou/zhghs/202503/t20250326_4165984.html) (Accessed June 18, 2025).
- The Standing Committee of the Guangdong Provincial People's Congress (2021). Guangdong provincial regulations on the administration of sea area use. Available online at: [https://nr.gd.gov.cn/zwgknew/sjfb/sjs/content/post\\_4737959.html](https://nr.gd.gov.cn/zwgknew/sjfb/sjs/content/post_4737959.html) (Accessed June 18, 2025).
- The Standing Committee of the Guangdong Provincial People's Congress (2024). The legislative plan of Guangdong Province in 2024. Available online at: [https://www.gdpc.gov.cn/gdrdw/zixun/dongtai/content/post\\_197496.html](https://www.gdpc.gov.cn/gdrdw/zixun/dongtai/content/post_197496.html).
- Trevisanut, S., Giannopoulos, N., and Holst, R. (2020). *Regime Interaction in Ocean Governance* (Leiden: Brill Nijhoff).
- Tyagi, S., and Pandya, M. H. (2024). From source to sea: legal perspectives on harmonizing water management and ocean protection. *Nirma ULJ.* 14, 21.
- Wang, C. L. (2023). The significance of the concept of a maritime community with a shared future in the international law-making process: taking the BBNJ agreement as an example. *Mar. Policy.* 149, 105509. doi: 10.1016/j.marpol.2023.105509
- Wang, P. (2024). Providing solid legal guarantees for regional coordinated development. *J. People's Congress China.* 8, 30–31.
- Wang, W., Wu, Y., He, X., and Wu, R. (2025). New marine productivity empowers green development of the marine economy: theoretical mechanism and empirical evidence. *Reg. Stud. Mar. Sci.* 82, 104042. doi: 10.1016/j.rsma.2025.104042
- Wei, Y., Cui, Q., and Liu, Y. (2025). An assessment for marine economic resilience and exploration of enhancement strategies: A case study of China. *Mar. Policy.* 174, 106597. doi: 10.1016/j.marpol.2025.106597
- Wei, D., Liu, Y., and Zhang, N. (2019). Does industry upgrade transfer pollution: evidence from a natural experiment of Guangdong province in China. *J. Clean. Prod.* 229, 902–910. doi: 10.1016/j.jclepro.2019.04.294
- Xu, Q., and Tan, Z. (2023). Building a maritime community with a shared future: scholarly reflections on China's new ocean vision. *Mar. Policy.* 149, 105508. doi: 10.1016/j.marpol.2023.105508
- Yang, L., Wang, P., Cao, L., Liu, Y., and Chen, L. (2016). Studies on charges for sea area utilization management and its effect on the sustainable development of marine economy in Guangdong province, China. *Sustainability* 8, 116. doi: 10.3390/su8020116
- Zhang, J., Chen, J., Gao, G., and Lv, M. (2025). Decoding carbon emissions in China's marine fisheries: trends, drivers, and pathways to sustainability. *J. Clean. Prod.* 520, 146101. doi: 10.1016/j.jclepro.2025.146101
- Zhang, Y. Q., and Li, M. L. (2021). An empirical study on coordinative relation between marine environment and economic growth in Guangdong coastal economic zone. *Ocean Dev. Manage.* 38, 16–26. doi: 10.20016/j.cnki.hykyfjgl.2021.04.003
- Zhu, J., Jang, J. C., Zhu, Y., Dong, X., Wang, S., Xing, J., et al. (2025). Co-benefits of wind and solar power deployments for air pollutants and carbon emissions reduction in Guangdong province of China. *Environ. pollut.* 378, 126485. doi: 10.1016/j.envpol.2025.126485