Postprint: Linkage Strategies for Land-Sea Functional Zoning from a Land-Sea Coordination Perspective

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Abstract

The sea-land interface constitutes a critical spatial hub connecting land and marine functional zoning. Optimizing its natural ecological functions, economic and industrial functions, and national security functions is of great significance for promoting the coordination and integration of sea-land functional zoning and achieving positive interaction between the two domains. This simultaneously enhances economic, social, and environmental benefits, facilitates effective resource allocation, and advances sustainable social development. Based on clarifying the current development status and characteristics of China' s sea-land interface, this article systematically examines the key issues existing in the coordination and integration of sea-land functional zoning, and further proposes key construction tasks and development pathways to enhance the degree of coordination and integration.

Full Text

Preamble

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Research on Cohesion Strategy of Land-Sea Functional Oriented Zoning Based on Perspective of Land-Sea Coordination
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Abstract

The marine-terrestrial interlaced zone serves as a crucial spatial hub linking the functional zoning of both land and sea areas. Optimizing the natural ecological function, economic-industrial function, and national security function of this zone is of significant importance for promoting the coordination between land and sea functional oriented zoning and achieving their mutually beneficial interaction. It also contributes to enhancing economic, social, and environmental benefits, effectively allocating resources, and advancing sustainable social development. Building upon the clarification of the current development status and characteristics of China' s marine-terrestrial interlaced zone, this research systematically examines the key issues existing in the coordination between land and sea functional oriented zoning. Furthermore, it proposes key construction tasks and development pathways aimed at enhancing the coordination functions of the marine-terrestrial interlaced zone.

Keywords: major function oriented zoning, land-sea coordination, marine economy, policy suggestions

Vast land territories, extensive sea areas, and long coastlines constitute key components of China' s natural resources. The rational utilization and sustainable development of both ocean and land are of strategic significance for national socioeconomic development and ecosystem protection. Currently, the sustainable utilization of sea and land areas is primarily achieved through major function oriented zoning and marine functional zoning. Major function oriented zoning represents a critical institutional design for China' s territorial spatial development and protection, establishing the nation' s urbanization strategic pattern, agricultural strategic pattern, and ecological security strategic pattern, and forming a spatial organization scheme comprising optimized development zones, key development zones, restricted development zones, and prohibited development zones [1,2]. Simultaneously, to promote the rational and orderly development of the marine economy, China has introduced the *National Marine Functional Zoning*, forming ten major marine functional zones including port and shipping areas, fishery resource utilization and conservation areas, and mineral resource utilization areas, thereby providing sea-use guarantees for national economic and social development. However, natural attributes and utilization conditions between these two territorial spaces differ inherently [3], while they also share special connections through spatial interconnection, resource complementarity, and ecological intercommunication [4]. Consequently, phenomena of misalignment and incompatibility still exist in current planning management boundaries, territorial spatial classification, development and protection strategies, and spatial planning arrangements [5], leading to issues such as excessive marine environmental pressure and irrational marine resource utilization. Exploring optimization strategies for land-sea functional zones from a land-sea coordination perspective can facilitate better alignment and coordination between terrestrial major function oriented zones and marine functional zoning, thereby easing land-sea conflicts, promoting ecological environmental

protection and blue economic development, and enhancing the level of land-sea coordinated development.

Existing research primarily investigates the coordination and integrated development of land-sea functional zoning based on two orientations: economic-industrial functions and ecological environmental functions. Xu et al. [6] divided national functional zones from a land-sea integration perspective, establishing cross-coastal connectivity between land and sea by classifying development and conservation functional zones. Bao et al. [7] constructed four subsystems—marine-terrestrial ecological environment, marine-terrestrial economy, marine-terrestrial society, and marine-terrestrial socio-economic-ecological systems—from a geographical perspective to optimize functional zoning and promote marine-terrestrial spatial structure integration. Li et al. [5] proposed hierarchical and zoned management principles to coordinate land-sea territorial spatial development and protection activities based on actual conditions of various zones. Economically, Wang [8] argued that economic development issues in the marine-terrestrial interlaced zone should address the "dual economy integration" perspective, promoting mutual matching of elements, functions, and advantages to change the situation of "fighting separately" and eliminate the fragmentation and disconnection between traditional marine economic strategies and coastal terrestrial economic strategies. Zhang and Hu [9] emphasized the necessity of strengthening the correlation between marine and terrestrial economies based on input-output relationships. Luan and Wang [10] also argued that strengthening marine-terrestrial industrial connections and promoting common development, with a focus on coastal zones and based on the particularity of marine industrial structure evolution, is crucial. Ecologically, Yao et al. [11] proposed key tasks including marine ecological environment management zoning, land-sea collaborative emission control systems, and marine ecological supervision systems based on land-sea coordination principles. Li et al. [12] also suggested implementing regional land-sea coordinated ecological management strategies from three perspectives: from land to sea, land-sea interaction, and from sea to land.

Based on the above, this paper proposes that from a land-sea coordination perspective, the marine-terrestrial interlaced zone should serve as an important hub for land-sea functional interaction to explore the current status and existing problems of land-sea functional zoning coordination in terms of natural ecology, economic industry, and national security, and subsequently propose optimized development strategies for land-sea functional zone cohesion. This approach emphasizes scientific development principles based on land-sea correlation and interaction, forming strategic pathways for land-sea linkage and common development, thereby adapting to national security needs, fully leveraging the important roles of marine territory as economic space, strategic channel, resource base, and security barrier, while simultaneously promoting marine-terrestrial resource development, economic development, and environmental protection.

1 Theoretical Framework

Land and sea serve as spatial carriers for land-sea functional zoning [13], while processes such as resource flow, transportation connectivity, and industrial interaction occur most frequently in the marine-terrestrial interlaced zone. This paper constructs a theoretical framework for the coordinated development of land-sea functional oriented zoning (Figure 1 [Figure 1: see original paper]), using the marine-terrestrial interlaced zone as a spatial hub and the marine and terrestrial subsystems as spatial carriers.

1.1 Three Aspects of the Marine-Terrestrial Interlaced Zone

According to different dimensions of socioeconomic development, the organic connections between sea and land in the marine-terrestrial interlaced zone are primarily manifested in three aspects: natural ecosystem, economic industry, and national security.

(1) Natural Ecosystem. The natural ecosystem constitutes the natural geographical foundation of land-sea coordination, primarily considering the close ecological connections between sea and land, emphasizing the continuity and interdependence between marine and terrestrial systems and their interactions, while preventing excessive development pressure on either side from disrupting the ecological balance. In this system, material exchange between sea and land occurs through forms such as marine capture, hydrological cycles, sediment transport, and carbon cycling.

(2) Economic Industry. Economic industry represents an important component of both terrestrial and marine functional zones, emphasizing the close correlation between marine and terrestrial economies. Through optimized resource allocation and industrial chain optimization, it enhances the complementarity and coordination between marine and terrestrial industries, thereby promoting the coordinated and sustainable development of terrestrial and marine functional zones. In this process, the marine-terrestrial interlaced zone primarily experiences energy flow, raw material supply, pollution discharge, and personnel movement.

(3) National Security. National security primarily focuses on the comprehensive management of maritime-terrestrial borders, strategic channels, marine resources, territorial seas, ports, and border areas to ensure their security and controllability, representing the strategic prerequisite for the normal operation of various functions in land-sea functional zones. In this process, marine-terrestrial interaction in the interlaced zone involves port security, route safety, channel security, territorial sea rights, and exclusive economic zone rights.

1.2 Relationships Among the Three Aspects of the Marine-Terrestrial Interlaced Zone

The relationships among the natural ecosystem, economic industry, and national security in the marine-terrestrial interlaced zone, along with key elements involved in each aspect, are illustrated in Figure 2 [Figure 2: see original paper].

(1) Natural Ecosystem. The natural ecosystem provides essential material foundations such as raw materials and energy for economic industry development, serving as the material basis for economic industries. It also constitutes an important component of national territory, including water sources, soil, forests, and minerals, which are crucial for national infrastructure construction and production activities. The natural ecosystem comprises two main elements: resources and environment. Regarding resources, it is necessary to focus on promoting the development and improvement of the resource management system in the marine-terrestrial interlaced zone, controlling the intensity of local urban development, coastal industries, and other economic activities, and promoting the sustainable utilization of marine resources. Environmentally, it is essential to continue strengthening the land-sea linkage mechanism for environmental protection, conduct strict monitoring and governance of major pollutants, and continuously promote the improvement of the ecological environment in the marine-terrestrial interlaced zone.

(2) Economic Industry. Economic industry represents the primary direction for natural resource development and utilization, involving energy, minerals, water resources, and serving as the cornerstone for developing environmentally friendly industries such as clean energy. Economic industry is also related to national development and prosperity, as well as national security and stability. Infrastructure construction and technological innovation driven by economic industries are important pillars of national security. Economic industry is fundamentally composed of primary, secondary, and tertiary industries. Currently, China' s marine industry presents a structure dominated by marine tertiary industry, supplemented by marine secondary industry, and with marine primary industry as an important component. The next step should focus on China' s three major marine economic circles to enhance the stability of primary industry, the structural resilience of secondary industry, and the driving capacity of tertiary industry.

(3) National Security. National security serves as the safeguard for resource and environmental security in border areas and is an important prerequisite for the stable operation of industrial chains, while territory itself involves both land and sea spaces. Terrestrial security primarily refers to territorial integrity and the inviolability of territorial land and airspace. Maritime security is more complex, involving different maritime rights and interests including internal waters, territorial seas, contiguous zones, and exclusive economic zones, as well as special areas such as disputed waters and contested islands. Additionally, due to the critical internal and external connectivity attributes of sea areas, their

characteristics regarding resource development, demarcation, and geostrategic attributes are vital for national sovereignty integrity, transportation and trade security, and strategic material supply. At present, China' s "residual rights" in maritime rights and interests need further clarification and improvement, and security of key maritime transport channels and route safety also require further attention.

2 Current Situation and Problems in China' s Marine-Terrestrial Interlaced Zone

2.1 Natural Ecosystem

2.1.1 Relatively Complete Resource Management System, Yet Underutilized Resource Potential China possesses a long coastline and vast sea areas, providing abundant opportunities and development potential for economic activities in coastal and offshore zones. The marine-terrestrial interlaced zone, as the most significant area for marine-terrestrial interaction [14], is also an important component of the "social-ecological system" [15]. Land resource allocation in this zone has become key to China' s strategic economic push from land to sea [16]. Currently, based on laws and regulations such as the *Marine Environmental Protection Law of the People' s Republic of China*, the *Sea Area Use Management Law of the People' s Republic of China*, and the *Island Protection Law of the People' s Republic of China*, China has established a relatively complete system for coastal zone management and monitoring, sea area resource utilization, and island resource utilization, thereby synergistically promoting ecological environmental protection, rational resource utilization, and sustainable development of coastal zones. Additionally, many localities have combined their actual conditions to form diversified management frameworks and innovative explorations tailored to local circumstances. For example, Guangdong Province issued the *Implementation Measures for Coastline Occupation and Compensation (Trial)* in July 2021, which clarified and strengthened the establishment, implementation, and supervision processes of the coastline occupation and compensation system. Through monetization of coastline occupation behaviors, an ecological product value realization mechanism has been formed, promoting capital flows between different regions within the province and enhancing the feasibility of coastline restoration activities. The successful transfer of coastline occupation and compensation indicators in the sea areas around Kanyuan Village and Bochang Village, Tiaofeng Town, Leizhou City, Zhanjiang, also became China' s first coastline occupation and compensation indicator transaction, representing a successful exploration of the ecological and resource value of coastlines.

However, due to the construction of urban development land, ports, terminals, and coastal industries, the original coastline has contracted, and land resources and fishery resources in the marine-terrestrial interlaced zone face severe pressure. Development activities are concentrated in nearshore areas, with promi-

nent issues of overdevelopment in coastal waters and insufficient deep-sea development that require attention. Coastal cities inside the coastline and nearshore waters outside the coastline are the most direct marine-terrestrial relationship in land-sea coordination [17], and major human development activities are also highly concentrated in this region, creating an unbalanced situation in deep-sea versus nearshore development, utilization, and growth. Against this backdrop, large-scale port construction, booming coastal tourism, and concentrated fishery resource development have created enormous environmental pressure. Simultaneously, due to the great depth of deep-sea areas, variable meteorological conditions, and high technical difficulty, the development and utilization of deep-sea resources face challenges, and the resource potential of deep-sea areas has therefore not been fully realized, with limited sustainable and diversified development in deep-sea areas.

2.1.2 Overall Environmental Improvement in Marine-Terrestrial Interlaced Zone, Yet Coastal Ecological Pressure Remains Significant
Strengthening the land-sea linkage mechanism is a key prerequisite for coastal zone management and marine ecological environmental protection. The *Outline of the 14th Five-Year Plan for National Economic and Social Development of the People' s Republic of China and the Long-Range Objectives Through 2035* proposes "exploring the establishment of an integrated management system that coordinates coastal areas, river basins, and sea areas" and "creating a sustainable marine ecological environment," providing key principles for marine environmental protection. Benefiting from China' s active initiatives in marine environmental protection and water pollution control, the marine environment in China' s marine-terrestrial interlaced zone has continuously improved. According to data from the *China Marine Ecological Environment Status Bulletin*, from 2016 to 2022, the proportion of excellent-quality water area in China' s coastal waters showed an overall upward trend, while the proportion of worst-quality water area (Category IV or below) decreased overall (Figure 3 [Figure 3: see original paper]). On October 24, 2023, the Sixth Session of the Standing Committee of the Fourteenth National People' s Congress voted to adopt the newly revised *Marine Environmental Protection Law of the People' s Republic of China*, which officially took effect on January 1, 2024. This law further strengthens prevention and control measures for four major pollution types: land-based source pollution, construction project pollution, waste dumping pollution, and pollution from ships and related operations. It proposes clear norms and management measures for river basin pollution prevention, wastewater discharge control, and solid waste management to safeguard the marine environment and promote sustainable development. The revision of the *Marine Environmental Protection Law* emphasizes synchronized control and governance of river basin and sea area ecosystems, strengthening holistic management of marine pollution control and forming a land-sea coordinated management system with further institutional coordination.

However, at present, China' s coastal development still exerts relatively severe

pollution discharge and ecological disturbance on the ocean. The trend of water quality deterioration in nearshore waters has not been curbed, ecosystems are frequently affected, and marine ecological disasters such as red tides and green tides occur frequently. Approximately 80% of sea area pollution originates from land, involving water pollution and waste pollution [18]. Urban agglomeration expansion, industrial growth, and population increase have brought numerous pressures on water resources and the ecological environment [19], a phenomenon that is more typical and prominent in sea-related regions. China currently has three major marine economic circles: northern, central, and southern, which geographically overlap with the three national-level urban agglomerations of Beijing-Tianjin-Hebei, Yangtze River Delta, and Guangdong-Hong Kong-Macao Greater Bay Area [17]. These three urban agglomerations have the highest population density, largest migrant population, and most frequent personnel exchanges in China, with strong population agglomeration momentum [20]. The high concentration of economy, industry, and population has brought enormous pressure on the regional ecological environment, with the marine-terrestrial interlaced zone being a key area where ecological environmental pressure is concentrated. Taking the Yangtze River Economic Belt as an example, it discharges more than half of the nation' s wastewater and one-third of its waste gas [21]. Wastewater contains industrial, agricultural, and urban domestic sewage, involving pollutants such as organic matter, heavy metals, nitrogen, and phosphorus. The discharge of these pollutants into the ocean often leads to water eutrophication, excessive algal reproduction, and marine ecological disasters such as red tides and green tides. According to the *2022 China Marine Ecological Environment Status Bulletin*, in 2022, there were 67 red tide incidents in China' s sea areas, covering a cumulative area of 3,328 square kilometers across 12 provinces with affected areas exceeding 100 square kilometers each. Atmospheric pollutants such as sulfur dioxide and nitrogen oxides in waste gas are deposited into the ocean through atmospheric precipitation, causing seawater acidification and marine ecosystem damage that harms coral reefs and shellfish. Toxic and harmful substances contained in industrial waste entering the sea through rivers also pollute seabed sediments and marine organisms.

2.2 Economic Industry

According to relevant data from the *China Marine Economic Statistics Bulletin*, China' s marine-related industries achieved substantial development from 2013 to 2022 (Figure 4 [Figure 4: see original paper]). Particularly from 2013 to 2019, the gross production value of marine-related industries increased continuously. In terms of total volume, in 2022, China' s marine economy grew steadily, with a national marine production value of 3,854.2 billion yuan, representing a year-on-year increase of 13.19%. Among the three industries, the primary industry contributed 434.5 billion yuan, the secondary industry 1,356.0 billion yuan, and the tertiary industry 2,063.7 billion yuan (Figure 5 [Figure 5: see original paper]). In recent years, the growth rate of marine-related industries has slowed, urgently

requiring the development of new business forms, exploration of new production capacities, and promotion of the marine economy to a new level.

2.2.1 Primary Industry Plays a Fundamental Role in Marine Industry, Yet Production Methods Require Upgrading In 2022, China' s marine industry involved a primary industry production value of 434.5 billion yuan, accounting for 21.05% of the nation' s marine industry gross production value, demonstrating the fundamental role of agricultural industry in marine economic development. Sub-sectors mainly involve marine fisheries and coastal beach planting. Among them, marine fisheries hold an important position in the marine industry, with a production value reaching 434.3 billion yuan, accounting for 99.95% of the primary industry production value and growing at 4.4%, indicating relatively stable development. However, problems such as traditional farming methods, backward fishing technology and facilities, weak processing foundations, single cooperation forms, and weak safety production and management awareness [22,23] still exist, resulting in insufficient stability of the fishery industry and characteristics of sporadic and frequent safety accidents. Additionally, the production value of coastal beach planting was 200 million yuan, with a growth rate of -1.8%.

2.2.2 Clean Energy Sector Shows Prominent Progress in Secondary Industry, Yet Industrial Structure Resilience is Insufficient In 2022, the secondary industry production value in China' s marine industry was 1,356.0 billion yuan, indicating the significant position of industry in marine economic development. Sub-sectors mainly involve marine engineering construction, marine aquatic product processing, and marine engineering equipment manufacturing. Currently, China' s marine economy secondary industry exhibits a "2-1-1" industrial structure characteristic, where oil and mineral product development accounts for half of the secondary industry output value, marine engineering construction, marine shipbuilding industry, and marine aquatic product processing account for one-quarter, and the remaining one-quarter is composed of six other smaller-scale industries. Specifically, marine chemical industry and marine oil and gas industry production values account for 52.54% of the marine economy secondary industry production value, dominating the marine economy secondary industry. Marine engineering construction, marine shipbuilding industry, and marine aquatic product processing account for 29.03% of the marine economy secondary industry production value, representing important components. The remaining six industries including marine engineering equipment manufacturing, marine pharmaceuticals and biological products, and marine power industry collectively account for 18.43% of the output value.

In terms of growth rate, industries with higher growth rates include marine power industry, marine mining, marine shipbuilding industry, and marine oil and gas industry (Figure 6 [Figure 6: see original paper]), with the marine power industry being the most prominent. In 2022, China' s marine power industry production value was 39.5 billion yuan, with a year-on-year growth of 20.9%,

achieving remarkable development in a short period. The *Action Plan for Carbon Peak Before 2030* proposes adhering to equal emphasis on land and sea, promoting coordinated and rapid wind power development, improving the offshore wind power industry chain, and encouraging the construction of offshore wind power bases. Driven by related carbon peak policies, China's "offshore wind power+" industry has achieved rapid development. "Offshore wind power+" represents innovative thinking in the clean energy sector. Through comprehensive and innovative integration of multiple industries and technologies, it promotes the sustainable development of offshore wind power and further advances green energy development and environmental protection to build a more sustainable industrial system. Under this development concept, new business forms of energy systems such as "offshore wind power + marine ranch" and "offshore wind power + energy storage technology" have emerged in China. Currently, China has successively completed and commissioned "offshore wind power+" projects such as the Shandong Changyi Marine Ranch and Sanxia 300 MW offshore wind power integration demonstration project, the Laizhou offshore wind power and marine ranch integration research and test project, the Huadian New Energy Guangdong Yangjiang Qingzhou III 500 MW offshore wind power project, and the Guangdong Yangjiang offshore wind power energy storage technology demonstration project, thereby achieving diversified utilization of marine resources and improving the economic benefits of marine activities. The marine shipbuilding industry has also developed rapidly, with a production value of 96.9 billion yuan in 2022, representing a 9.6% increase from the previous year. According to International Shipping Forum data, in 2023, China' s shipowner fleet scale reached 249.2 million gross tons, making China the world' s largest shipowning nation by gross tonnage, marking further improvement in China' s maritime transport capacity and supply chain stability.

However, it should be noted that China' s marine economy secondary industry currently exhibits high dependence on oil and mineral resource extraction, with insufficient sustainability and resilience. The lack of a diversified secondary industrial structure means that once impacted by international market fluctuations, technological changes, or policy adjustments, the total economic volume could collapse in a short time. Additionally, the petroleum, natural gas, and specific chemical marine resources that these industries primarily rely on are limited, and excessive development may lead to resource depletion and create ecological environmental pressure. Moreover, the development of marine chemical and marine oil and gas industries is typically accompanied by environmental pollution and ecosystem destruction risks. Oil and gas exploration and chemical product preparation involve risks of toxic and harmful substance leakage and wastewater discharge, which may cause irreversible negative impacts on marine ecology and simultaneously harm the development of primary industries such as fisheries and beach planting.

2.2.3 Transportation Industry Grows Steadily in Tertiary Industry, Yet Marine Tourism Shows Insufficient Driving Capacity In 2022, the

tertiary industry production value in China's marine industry was 2,063.7 billion yuan, accounting for 53.54% of the 2022 marine industry gross production value, demonstrating the leading role of the service industry in marine economic development and reflecting the comprehensive and diversified development direction of China' s marine economy. In specific marine industries, sub-sectors mainly involve marine tourism and marine transportation. The marine transportation industry achieved a growth rate of 6%, realizing relatively stable growth. Transportation infrastructure construction has significant impacts on regional economic growth [24,25]. In land-sea coordination, transportation infrastructure construction also plays an important role. For cross-sea bridges and undersea tunnels, their construction effectively connects originally water-separated land areas, enhancing transportation convenience between different locations and further promoting the flow of people, logistics, and capital. Consequently, land areas connected by cross-sea bridges see significantly enhanced location advantages. Taking the Zhoushan Cross-Sea Bridge connecting Ningbo and Zhoushan as an example, the 48.16-kilometer bridge changed Zhoushan's original geographically isolated position separated by water and further strengthened the location advantages of Zhoushan' s surrounding islands and seaports.

However, marine tourism has shown poor development momentum in recent years. From 2013 to 2019, China' s marine tourism industry production value grew steadily for seven consecutive years, but has declined significantly since 2020 (Figure 7 [Figure 7: see original paper]). Affected by the pandemic, the marine tourism growth rate in 2022 was -10.3%. Meanwhile, China' s cruise marine tourism also faces problems such as incomplete industrial chains, limited promotional efforts, inadequate infrastructure and supporting facilities, imperfect ecological protection mechanisms, single product offerings, and talent shortages [26,27], resulting in insufficient capacity to drive regional economic development.

2.3 National Security

2.3.1 Non-Traditional Security Factors in Maritime Safety Pose Serious Threats to China' s Cargo Ship Ocean Shipping Over 60% of China' s trade volume comes from marine transportation, which serves as a link connecting China with other countries. Since 2015, China' s shipping industry has developed rapidly, particularly in the dry bulk and container ship sectors. As of August 12, 2023, China has become the world' s largest shipowning nation, with a fleet scale of 249.2 million tons, accounting for 15.9% of the market share. It can be said that maritime safety occupies an important position in China' s international trade and maritime transport. However, factors such as piracy, weather and meteorological conditions, navigation obstacles, ship technical failures, ship collisions, and fires pose significant threats to maritime transport safety. Among these, traditional safety factors such as weather and meteorological conditions, navigation obstacles, and ship technical failures are relatively easy to analyze, judge, predict, and handle, and accident probability

can be reduced and ship safety ensured through improved technical levels and professional crew training. However, piracy—the key non-traditional security factor in maritime safety—has a more dynamic and complex occurrence and evolution process. As piracy is essentially profit-driven criminal behavior, it will not disappear with technological progress, social development, or civilizational advancement. As Swope stated, the ocean is a refuge for criminal behavior in human society [28], or rather, piracy is an extension of kidnapping and violence on land [29].

Currently, the security situation for Chinese cargo ships in ocean transport is not optimistic. From 2014 to 2021, the number of Chinese cargo ships attacked overseas increased for eight consecutive years, involving complex and varied ship types. Taking the Gulf of Guinea as an example, due to its key geostrategic position and important energy supply role, coastal countries in the Gulf rely on maritime transport for economic and trade exchanges with the outside world. However, piracy within the Gulf has risen rapidly over the past 25 years and has evolved from opportunistic maritime robbery into highly violent and organized complex criminal behavior. Active piracy has made the Gulf of Guinea a "new danger zone" as described by the International Crisis Group (ICG). In the new era, piracy has become an important regional security issue threatening regional development and national stability [30]. In recent years, during the ocean shipping of Chinese cargo ships, the Gulf of Guinea has become the region with the most frequent attacks, strongest violence, most extensive attack locations, and highest attack success rates. From 2019 to 2021, Chinese cargo ships experienced eight pirate attacks in the Gulf of Guinea, with five resulting in pirates boarding the vessels. In more than half of these boarding incidents, vicious events such as kidnapping and hijacking occurred, leading to loss of control over vessels and cargo and threats to crew safety.

2.3.2 Sea Expansion is Key to China' s Development, and Safeguarding Maritime Rights is Crucial for Foreign Trade, Energy Security, and Soft Power Enhancement Moving from inland to the ocean and from the ocean to the world is an important pathway for national development [31]. The integrity of territorial seas, or the pursuit of maritime rights and interests, is crucial for national foreign trade, energy security, soft power, and international influence. The pursuit of maritime rights and interests primarily focuses on "residual rights" not explicitly stipulated or prohibited in the *United Nations Convention on the Law of the Sea* [32]. Currently, China' s pursuit of "residual rights" mainly focuses on maritime delimitation issues and derived island sovereignty disputes.

The South China Sea issue is a key problem in maritime delimitation, primarily involving sovereignty disputes over South China Sea islands and demarcation of the Beibu Gulf boundary. Among these, the Sino-Vietnamese maritime boundary dispute in the Beibu Gulf waters is the most complex [33]. The Beibu Gulf is an overlapping area of Chinese and Vietnamese rights claims, with certain

disputes existing regarding the division of territorial seas, exclusive economic zones, and continental shelves. On June 30, 2004, China and Vietnam reached the *Agreement Between the People' s Republic of China and the Socialist Republic of Viet Nam on the Delimitation of the Territorial Seas, Exclusive Economic Zones and Continental Shelves in the Beibu Gulf*, and the *Agreement on Fishery Cooperation in the Beibu Gulf* also took effect. The two countries resolved territorial boundary disputes through peaceful means, which has positive significance for Asia-Pacific peace and stability and friendly Sino-Vietnamese development. On March 4, 2024, China scientifically delineated the northern territorial sea baseline of the Beibu Gulf according to the *Law of the People's Republic of China on the Territorial Sea and the Contiguous Zone* of February 25, 1992, further clarifying China' s 12-nautical-mile territorial sea boundary, which is crucial for safeguarding China' s maritime rights and interests and promoting international cooperation. However, in the South China Sea issue, Vietnam, the Philippines, Malaysia, and Brunei still have numerous illegal sovereignty claims over South China Sea islands and have illegally conducted land reclamation and oil and gas resource exploitation activities, affecting China' s resource development and other economic activities in the South China Sea. It is urgent for China to engage in regular bilateral or multilateral negotiations with other Southeast Asian countries based on a firm sovereignty stance to achieve a win-win situation for South China Sea development.

2.3.3 The "Malacca Dilemma" Remains an Important Risk Factor in China' s Geopolitical and Economic Security China has a high dependence on energy resources such as petroleum and natural gas and important raw materials such as iron ore. Most of these resource demands need to be imported from around the world through maritime transport. More than 60,000 vessels of 300 gross tons pass through the Strait of Malacca annually, including a large number of oil tankers transporting oil from the Middle East to China, Japan, and other destinations [34]. In 2017, China surpassed the United States to become the world' s largest oil importer. In 2018, approximately 70% of China' s oil needs were met through imports. Currently, 84% of China' s oil must be transported through the Strait of Malacca. From a geopolitical security perspective, this maritime channel is critical for China' s geopolitical security situation.

Although China is actively seeking diversification of energy import channels including the China-Myanmar oil and gas pipeline and the Central Asia oil and gas pipeline, the important position of the Strait of Malacca for China' s energy supply remains unneglectable. Currently, oil transported to China through the Central Asia oil and gas pipeline and the China-Myanmar oil and gas pipeline reaches 400,000 barrels per day and 420,000 barrels per day respectively, while oil transported through maritime channels reaches 6.5 million barrels per day. It can be said that the "Malacca Dilemma" will continue to exist for a considerable period of time, and its resulting geopolitical and economic risks cannot be ignored. Once the strait is affected by tensions leading to shipping obstacles,

China' s maritime rights and strategic security will be directly threatened.

3 Key Construction Tasks and Development Paths for Enhancing Coordination Functions in China' s Marine-Terrestrial Interlaced Zone

3.1 Forming an Overall Layout for Marine Economic Development

Based on the existing northern, eastern, and southern marine economic circles, and combining regional resource endowments and economic levels, regional marine economic development priorities should be formed. Corresponding subsidies and support policies should be introduced for high market demand and environmentally friendly high value-added industries such as marine energy industry, marine biomedicine, and marine equipment manufacturing to promote the development and growth of regional characteristic marine industry clusters, and on this basis, form a batch of blue economy leading demonstration zones. Simultaneously, the key position of deep-sea areas in marine major function oriented zoning in the new era should be highlighted, clarifying the resource endowments and development potential of deep-sea areas to fully release sea-oriented new quality productive forces and drive the development of whole industrial chain elements. The important role of marine power industry in providing environmentally friendly and diversified energy supply should be fully leveraged to promote the development of new business forms such as "offshore wind power + marine ranch," "offshore wind power + energy storage technology," "offshore wind power + deep-sea mineral development," and "offshore wind power + Power-to-X technology," thereby driving the development of whole industrial chain elements from sea to land, including wind power equipment manufacturing, wind power equipment parts supply, offshore wind power platform construction, wind power project operation and development, and wind power equipment technical services.

3.2 Promoting Marine Resource Utilization and Ecological Environmental Protection

Promoting the important role of marine resources in southeastern coastal areas in achieving carbon peak and carbon neutrality can bridge the geographical mismatch between carbon emissions and carbon sequestration. The Beijing-Tianjin-Hebei, Yangtze River Delta, and Pearl River Delta marine economic circles are important sources of carbon emissions and also important agglomeration areas for marine economy and related high-tech industries. Leveraging their economic and technological advantages can promote the rapid development of carbon capture, utilization, and storage technologies and enterprises in important coastal urban agglomerations, thereby using marine resources to drive terrestrial ecological environmental protection and easing the pressure on the natural environment caused by economic and population agglomeration. The important role of the marine-terrestrial interlaced zone in easing the environ-

mental pressure from land to sea should be further clarified, especially in the three major economic regions of Beijing-Tianjin-Hebei, Pearl River Delta, and Yangtze River Delta. It is necessary to handle the relationship between their highly concentrated economic industries and prominent pollution discharge in nearshore waters based on the marine-terrestrial interlaced zone. Under the overall framework of the newly revised *Marine Environmental Protection Law of the People's Republic of China*, a cross-regional cooperation mechanism should be established to share information and resources for ecological environmental protection in the marine-terrestrial interlaced zone. A cross-regional and cross-departmental dynamic monitoring network for pollution sources and pollutants should be established to ensure the timeliness and effectiveness of governance measures. Simultaneously, the transformation, relocation, and upgrading of high-pollution and high-energy-consuming enterprises in the marine-terrestrial interlaced zone should be further promoted to minimize marine ecological environmental pressure from land-based sources.

3.3 Emphasizing Maritime Rights Pursuit and Marine Security Safeguarding

The enhancement of strategic material transport capacity and territorial rights protection capacity in the new era should be strengthened through marine major function oriented zoning. Under the existing balanced marine-wide functional zoning framework for natural environment and economic development, China should actively pursue the "residual rights" of key islands and sea areas based on geographical environmental characteristics, ownership relations, resource endowments, environmental carrying capacity, climate conditions, and strategic importance. Security and stability monitoring of key transport channels such as South China Sea routes should be strengthened to further handle the close connections among marine and natural environment, economic industry, and national security. Specifically, it is necessary to emphasize the prevention and governance of non-traditional security factors in ocean transport, strengthen monitoring of high-risk areas for shipping activities, provide real-time data support and early warnings for cargo ships going to sea, and prevent and reduce the occurrence of maritime insecurity incidents. Secondly, based on the existing international maritime rights framework, peaceful negotiations should be conducted on key maritime delimitation issues and illegal sovereignty claims by other countries to promote regional dialogue and cooperation and strive for national maritime "residual rights." Additionally, regional maritime cooperation should be strengthened, and China should actively participate in regional maritime patrols, monitoring and early warning, and cooperation framework formulation to safeguard national initiative in regional maritime affairs.

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Note: Figure translations are in progress. See original paper for figures.