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Development and reform of marine spatial planning in China under the new territorial spatial planning system

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Abstract

Over the last two decades, countries worldwide have become increasingly aware of the potential of marine space, which has led to a significant development in marine spatial planning (MSP) and the proliferation of studies and practical exploration of MSP issues. In China, MSP is undergoing a new series of reforms. Despite discussions in the academic community on the methods and mechanisms of MSP, issues related to planning, system designs, and implementation priorities for the next stage of MSP in China remain unresolved. This study describes the multiplan integration characterization of MSP in China. It intends to address these issues by presenting a potential MSP system and defining the specific contents and tools that need to be applied to coastal spatial planning (CSP). CSP will be at the core of MSP in China in the future.

Keywords Marine spatial planning, Territorial spatial planning, China, Multiplan integration, Coastal spatial planning

1 Introduction

China's open economy is heavily reliant on the ocean and coast. With the increase in the intensity of using coastal resources in China and the accompanying increase in marine pollution and ecosystem degradation, scholars have recognized the need for the improved management of marine space. As such, marine spatial planning (MSP) in China has become a blueprint and guide for the comprehensive protection and sustainable development of the coastal resources of the country. However, China's commitment to the pursuit of sustainable economic development has resulted in additional higher requirements for the use of coastal resources and for the

protection of coastal ecology. These measures have far-reaching implications for China's MSP system.

Planning marine space across industries is an important consideration for China's authorities in their effort to comprehensively reform and establish a system for territorial spatial planning (TSP). In May 2019, a document entitled 'Several Opinions of the Central Committee of the Chinese Communist Party and the State Council on Establishing the System of TSP and Supervising its Implementation' clearly proposed the establishment of a system for a multiplan integration including the ocean and prepared a coastal spatial specific planning to create special TSP in coastal areas. This initiative represents a new era of disruptive historical reform for the spatial planning system of China. It includes the breakup of the existing forms of MSP and the reconstruction of a new MSP system that places TSP and coastal spatial planning (CSP) at the core of the system.

MSP has been developing and evolving for more than 50 years worldwide and has been commonly practiced by coastal states. In the 1970s, the Great Barrier Reef Marine Park Act promulgated in Australia included provisions

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of a framework for the planning and management of the Marine Park. Moreover, it established an authority responsible for the development of the planning program of the Great Barrier Reef Marine Park (Chris et al., 2015; Gerry, 2002). Several proposals put forward at the World Summit on Sustainable Development in 2002 have also greatly promoted the development of the concept of MSP. Since then, Europe and the United States have conducted studies on integrated MSP and proposed many recommendations and measures for reinforcing the work (Wang et al., 2008; Zhang et al., 2011).

MSP policies in Australia, Europe, and the United States initially defined a supportive framework for MSP. In 2014, Directive 2014/89/EU of the European Parliament (Depellegrin et al., 2021) introduced an obligation of member states to establish coastal spatial plans by 2021. The core issues mainly involve three aspects (Wang & Ma, 2022), namely integrating land–sea interactions, coordinating the coastal or marine areas of two or more administrative regions, and developing compatible marine spatial functions. The Marine Planning Handbook, which was released by the United States in 2013, points out that scientific and rational marine or coastal planning reduces conflicts in sea-area use, maximizes regional economic interests, facilitates the sustainable development of the ecological environment, and realizes the value of economic, social, and ecological objectives (Li, 2011; Liu, 2015). As one of the first countries to conduct MSP, China has experienced a general development process from exploration to maturity and from the mode of development first and protection later to, recently, seeking development while protecting the environment (Liu & Li, 2011). A new round of the institutional reform plan of 2018 by the State Council of the People's Republic of China (Zhou & Zhao, 2017) proposes the establishment of a TSP system, which integrates spatial planning, such as major function, land use, and urban and rural planning and marine functional zoning, into a unified TSP. Through this system, MSP is reshaped, and the CSP under preparation is the major special planning that involves marine spatial management.

Experts and scholars have also examined the theoretical methods and procedures of MSP. It is believed that ecosystem-based management is inseparable from MSP (Paul, 2008; Melissa et al., 2010; Harris, 2022). MSP can utilize ecosystem-based management approaches (Fanny et al., 2008), and marine spatial planners need to understand the heterogeneity of ecosystems and the impact of human activities on ecosystem functionality and the delivery of ecosystem services (Larry & Elliott, 2008; Choi et al., 2021; Ramadhan et al., 2022). Meanwhile, MSP provides a catalytic support in the field of ecosystem-based coastal spatial management (Elianny et al.,

2016). A few studies, such as Gonçalo (2013) and Fang (2019), concluded that MSP assessment and stakeholders' participation in the whole process of MSP (Wesley et al., 2018; Zaucha & Kreiner, 2018; Yet et al., 2022) are essential procedures that can increase the scientificity of MSP. In addition, experts and scholars have summarized the practice of MSP and found that MSP has achieved certain degrees of success in various countries (Wu et al., 2018; Ehler, 2020), especially in China, where the MSP system with marine functional zoning as the core has been relatively mature (Teng et al., 2019). However, further attention to key ecological zones may be necessary. Although scholars have witnessed the fruitful results of MSP, the reform trend and development direction of MSP in China warrant further studies given the continuous development of the practice of the MSP system. Based on the analysis of the present situation and characteristics of MSP in China, this study puts forward the development direction of MSP in China to draw implications for the exploration and practice of the reform of MSP.

2 Development history of marine spatial planning (MSP) in China

China's MSP development process can be broadly divided into three stages (Fig. 1) in terms of system formation and orientation shift (Yu & Li, 2020).

2.1 Initial exploration

In 1989 and 1998, the State Oceanic Administration conducted small- and large-scale marine functional zoning, which laid the work and technical foundation for the formal construction of marine functional zoning in China. The National Ocean Development Plan, which was launched in 1994, proposed the zoning concept of developing five key coastal areas and three special development zones. The United Nations Convention on the Law of the Sea came into force in the same year, which has significantly expanded the jurisdictional scope and rights of coastal states to sea areas. Similarly, MSP gradually extended from a single sea-area administration to the construction of coastal planning systems and mechanisms, marine economic development, marine ecological protection, maintenance of marine rights and interests, and other fields.

2.2 System formation

The Law of the People's Republic of China on the Administration of Sea Areas, which was promulgated in 2002, establishes an integrated administration system of sea areas based on marine functional zoning, the right to use sea areas, and the paid use of sea areas. This remains that marine functional zoning has been the core of MSP in China to the present day (Lu et al., 2015) and forms

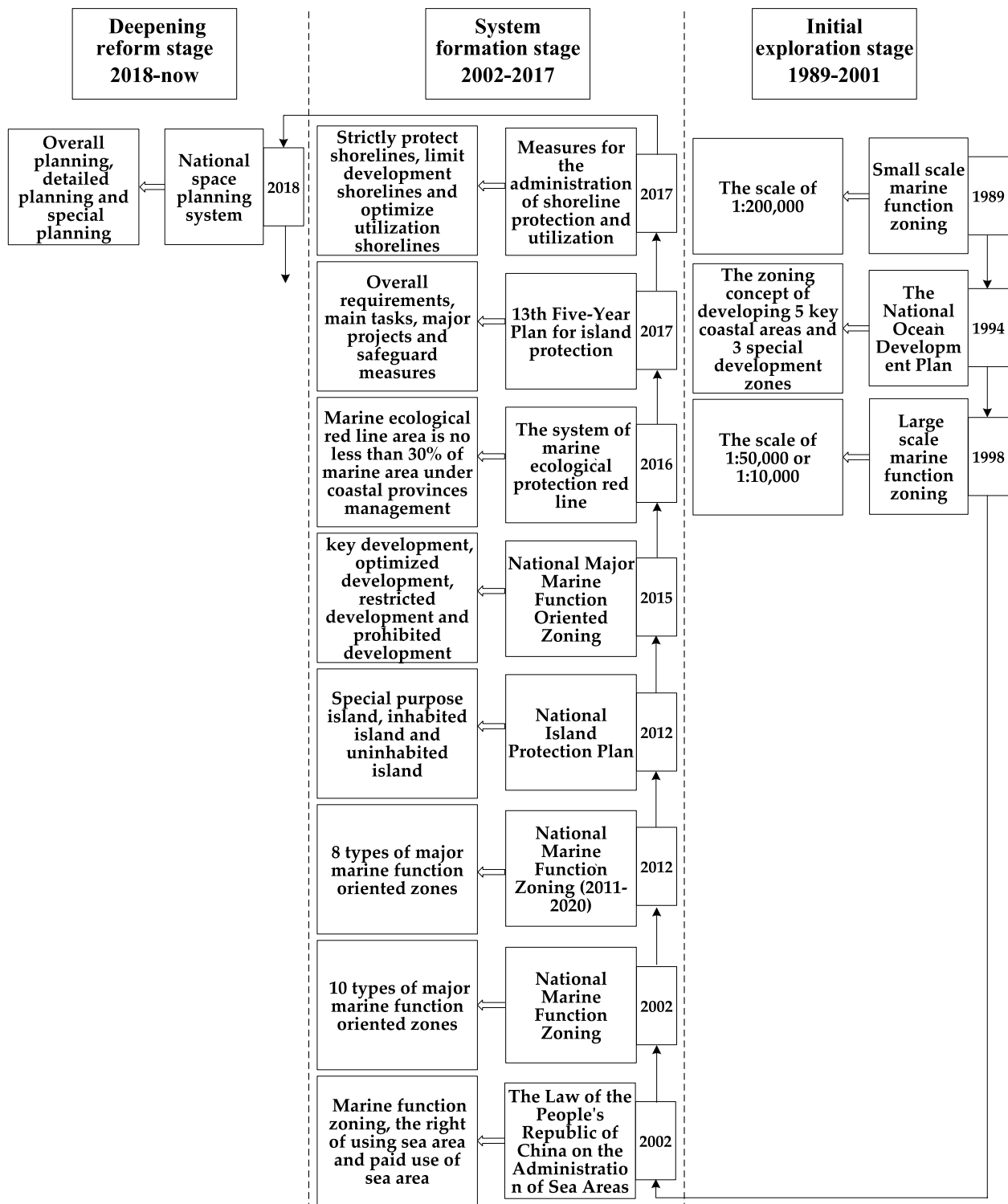


Fig. 1 Development history of marine spatial planning in China

an effective control mode by combining zoning administration and spatial admission. In the first edition of the National Marine Functional Zoning, which was

introduced in the same year, sea areas under Chinese jurisdiction have been divided into 10 types of major marine function-oriented zones, and coastal provinces

and cities have refined their spatial control at varying spatial scales. The National Marine Functional Zoning (2011–2020), which was published in 2012, categorizes the types of marine functional zones. The National Major Marine Function Oriented Zoning, which was issued by the State Council in 2015, divides the sea areas under China's jurisdiction into four types, namely key, optimized, restricted, and prohibited development, which are managed through supporting policies. These types are refined at the provincial level according to administrative units (Zhang et al., 2022). This zoning has become the basic and binding plan for marine spatial development in China. In accordance with the requirements of the Island Protection Law, China has formulated the National Island Protection Plan and the 13th Five-Year Plan for island protection, which form a spatial development and protection pattern and administration mechanism that considers all sea areas and uninhabited islands. At this stage, the State Council and relevant authorities have also formulated and launched the marine ecological protection red line, shoreline protection and utilization, and other spatial management systems. Thus far, China's marine full-coverage and multilevel planning system is basically in alignment with major marine function-oriented zoning, marine functional zoning, and island protection planning as the core, with the marine ecological red line and shoreline protection and utilization systems as important elements.

2.3 Deepening reform

In 2018, the new-round institutional reform plan of the State Council proposed the establishment of a TSP system and supervised its implementation. The process involved integrating spatial planning (e.g., major function planning, land use planning, urban and rural planning, and marine functional zoning) into a unified system of TSP and realizing multiplan integration, in which MSP is reformed. TSP refers to spatial and temporal arrangements for the development and protection of a nation's space, including overall, detailed, and related special planning. The current arrangement of marine space is mainly reflected in overall and special planning. Special plans refer to unique arrangements for spatial development, protection, and utilization in specific areas (e.g., watersheds) and territorial spaces to highlight specific functions. The overall TSP prepared by the country, province, and city–county includes coastal space, which covers all land and sea territorial spaces under the relevant jurisdiction. CSP at the national and provincial levels is prepared as the major special planning involving marine spatial management. The reform of the MSP system in China is conducted based on its experience with the previous MSP and has been gradually reconstructed

into a relatively well established and integrated planning system with TSP and CSP at the core. The system has three features: macro + meso, coastal + sea areas, and integrated + special.

Under the TSP system, the control mode of land and sea division is no longer suitable for the overall requirements of the land and sea planning system reform. However, the management system and other aspects of land and sea planning, which is an adequate and effective land–sea coordination mechanism, have not been formed due to differences in logic. At present, MSP continues to lack an in-depth connection with the functions and development needs of land and sea, and refined management and control at the scale below the functional zoning has not realized the unification of land and sea, which renders difficult the extraction of the best comprehensive benefits of land and sea. Thus, coordination toward the protection and utilization of land and sea space is hindered.

3 Multiplan integration characterization of MSP in China

3.1 Multiplan integration: Inheritance and development of MSP

The TSP system is evolving from multiple parallel systems, such as traditional major function planning, land use planning, urban and rural planning, and marine functional zoning, into the multiplan integration planning system, which has adapted to the development of the new era. Under the new MSP system, the core of MSP is TSP and CSP, in which TSP pertains to overall planning and CSP pertains to special planning. Table 1 depicts the major similarities and differences between the two plans.

The new MSP system has followed the practices of the original MSP system in China by:

- (1) Following the regional coordination method of providing guidance on development by zoning planning at the macro level. The new MSP continues to follow the original marine functional zoning method of providing regional guidelines and functions based on natural geographic units. Combined with the latest results of marine ecological classification zoning, regional guidelines are developed, and protection priorities are clarified on the basis of the reasonable designation of coastal spatial management areas.
- (2) Drawing lessons from the existing experience of the implementation of functional zoning at the provincial level, MSP is still conducted at the provincial level from the perspective of protecting marine ecology, matching administrative powers, and

Table 1 Main similarities and differences between TSP and CSP

	Territorial spatial planning	Coastal spatial planning
Planning objectives	To promote the formation of the development and protection pattern of full-coverage territories (land + sea)	To achieve the high-quality development of coastal space and improve the industrial layout of land–sea coordination, ecological protection, and restoration
Core content	General layout of territorial development and the development and utilization of major resources	General layout and governance policies for the seaward side and adjacent land areas, among others
Planning scope	Full coverage of land and sea areas	Sea areas, islands, shorelines, and a few adjacent land areas
Spatial control zoning	Marine space: six primary categories and several secondary categories	Marine space: six primary classes and several secondary classes. Identification of integrated zoning and management

smoothly constraining transmission. Provincial CSP is at the core level of national-level CSP.

- (3) Adhering to the defined control requirements for each functional zone or each island in the marine functional zoning and island protection planning. In the new MSP system, the use regulation, control of sea areas (islands) utilizing mode, ecological protection and restoration, and other administration requirements are defined by functional zone or island.
- (4) Inheriting the spatial guidance and control mode of industry management and element management simultaneously (Gao et al., 2023a, b, c, d). The demand for sea use, which is dominated by industrial use, has not fundamentally changed; thus, under the definite protection of the bottom line, the control requirements for available marine space are developed according to the vertical (land area–shoreline–intertidal zone–sea area–island) and horizontal (different industries) direction on a case-by-case basis (Fig. 2).

3.2 Land–sea coordination: Holistic land–sea coordination of protection and utilization of territorial spaces

Land–sea coordination has been the core principle of the current CSP in China (Gao et al., 2022; 2023a, b, c, d), which requires in-depth investigation and implementation from different dimensions and perspectives. The main measures for implementing land–sea coordination include:

- (1) The major land and sea functional positioning and spatial arrangement orientation should be understood based on national major security development strategies.
- (2) The ecological space should be determined, and corresponding protection and restoration activities should be conducted in an integrated manner based on the integrity and connectivity of land and sea ecosystems.

- (3) The spatial demand and scheduling of relevant development and utilization behaviors should be considered comprehensively according to the economic and social development of coastal areas and development characteristics of high-level opening up through links across land and sea.
- (4) The matching and convergence of land and sea management behavior and management capacity must be considered in territorial spatial use control based on the need to respect the differences between land and sea and avoid simple binary split management.

3.3 Attention to new issues and demands in marine spatial utilization

Against the background of multiplanning, the MSP is expected to increasingly face the issue of the priority allocation of different demands for sea use in the same marine space (Catarina et al., 2018), which leads to new requirements as follows:

- (1) To formulate MSP, knowledge of the principal contradictions of marine space is necessary for the new era. Current contradictions and conflicts need to be clarified, and solutions and measures need to be proposed in MSP given various problems such as insufficient systematic consideration and correlation requirements of space protection and utilization of land–sea coordination; the deficient refinement of control of marine space use; low level of intensive utilization; over-utilization of offshore space; and under-utilization of deep-sea space, among others.
- (2) The compatibility and three-dimensionality of marine space in MSP need to be fully considered. In recent years, new forms and business models of coastal activities have emerged in an endless stream, which has led to more contradictions in the use of offshore space. However, strategies for using coastal space for various marine activities

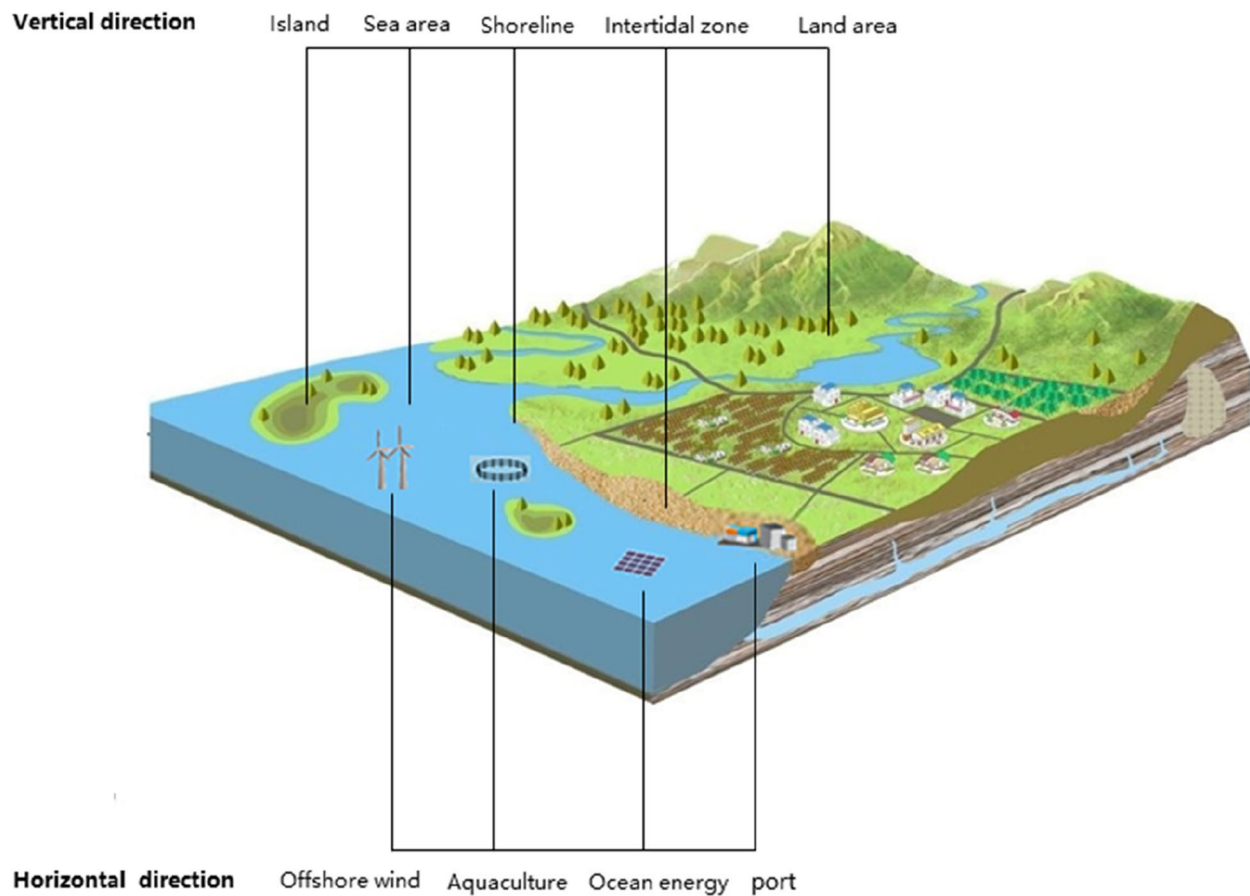


Fig. 2 Schematic of marine space management according to the vertical and horizontal directions

are inconsistent in terms of marine space requirements. Combined with the natural multi-suitability of marine space, it allows the possibility of spatial compatibility between marine activities, such that MSP is no longer limited to the traditional single-purpose management of a single zone. At the same time, marine space includes the sea surface, underwater, seabed surface, seabed bottom, and other different depths and layers, such that sea-area rights and space utilization are not limited to the plane layout; thus, more three-dimensional space will be used.

4 Design of the MSP system in China

In the previous era of marine spatial management, China paid more attention to the guarantee of coastal use for national economic development and the construction of its exploitation order. In addition, it established a top-down spatial management system with marine functional zoning as the core and the combination of zoning and admission rules as the mode. In the new era, China increasingly focuses on land–sea coordination, multiplan

integration, regional coordination, multi-governance, and other new spatial governance requirements. The MSP system is reformed to establish a new system with the overall TSP with CSP as the core (Fig. 3). Meanwhile, marine functional zoning and island protection planning will no longer be formulated. The new system requires marine ecological space with ecological conservation redline and marine utilization space as the layout requirements and the evaluation of resource and environment carrying capacity and territorial spatial suitability as the technical basis.

4.1 Territorial spatial planning (TSP)

TSP serves as a spatial blueprint for sustainable development and a basis for all types of development and protection construction activities. It can operate at national, provincial, municipal, county, and township levels. It is based on assessments of resource and environment carrying capacity and territorial spatial suitability. These assessments define the positioning of major function planning (Ma et al., 2022) and delineate three control lines, namely ecological protection

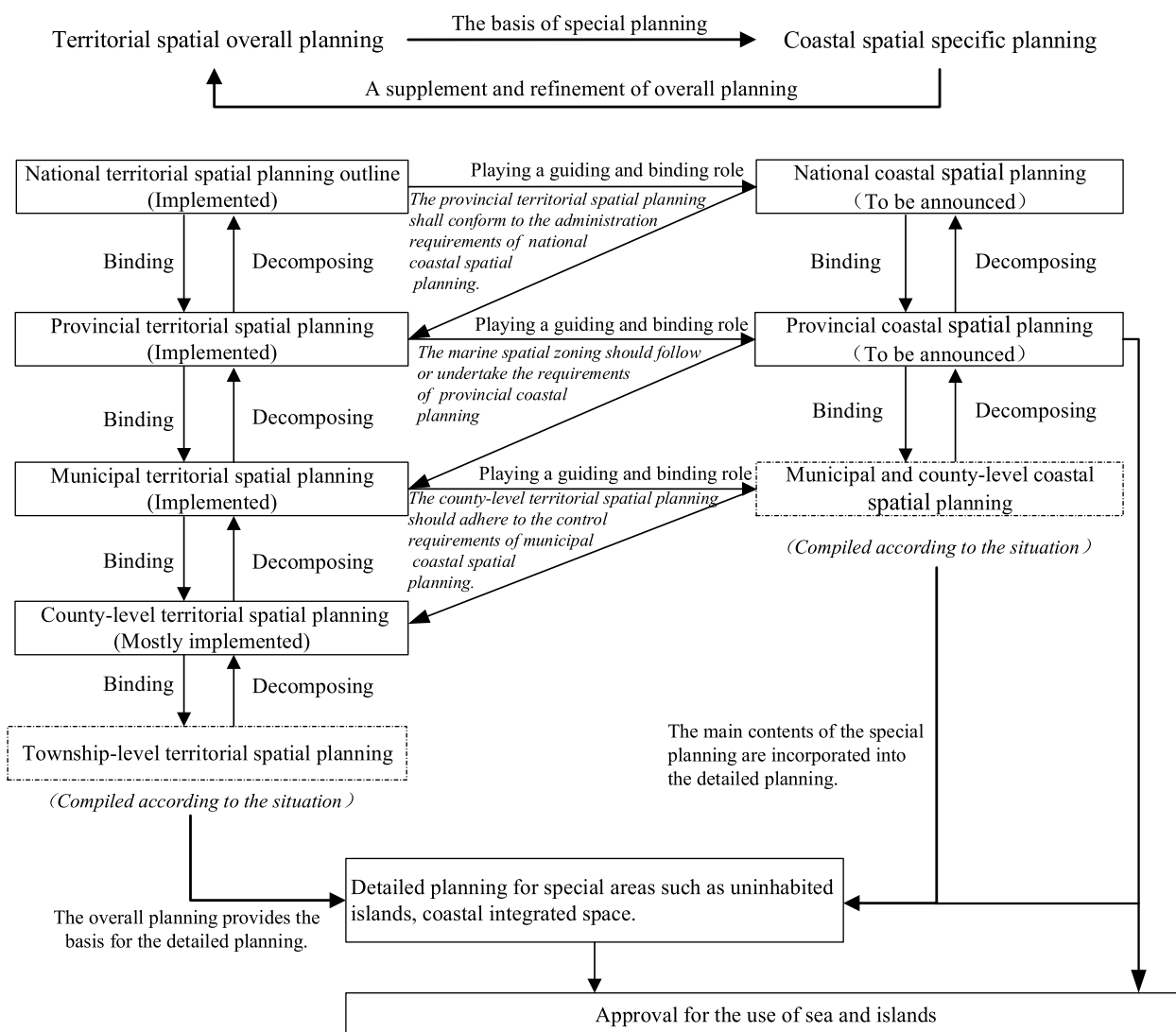


Fig. 3 Schematic of new MSP system. 'Implemented' means that the subordinate planning should implement the requirements and guidelines of the superior planning. 'Decomposing' indicates that the lower planning decomposes the goals and indicators of the upper planning

redline, basic farmland protection area, and urban development boundary. In this manner, it establishes a spatial pattern of ecological, agricultural, and urban areas with all elements in the entire area. TSP designates seven categories of primary zoning and corresponding secondary zoning of each primary zoning at the municipal level. Marine space is divided into ecological protection areas, ecological control areas, and marine development areas. The last category can be further divided into secondary zoning of marine areas for fishery, transportation, industrial and mining communication, recreational marine areas, special-purpose marine areas, and marine reserve areas. TSP emphasizes the control and management of land and sea

territorial spaces in a manner that balances rigidity and flexibility and depicts a unified blueprint for spatial development, resource protection and utilization, and spatial planning and management.

The implementation of TSP is based on the five-level and three-category system, which is mainly reflected in six aspects:

- (1) Indicator and zoning control: the implementation mechanism of spatial transmission is constructed in accordance with the vertical sequence of TSP at each level or zoning unit.
- (2) The transmission mechanism of special planning is planned and implemented to transfer the core and

compulsory contents of TSP to special planning to realize the entire process of transferring special elements from the whole to the plot.

- (3) The lifecycle management of planning will be implemented, which will be operated through preparation, review, implementation, monitoring, evaluation (Gao et al., 2017; 2019; 2023a, b, c, d), forewarning, and other aspects to guarantee the strict implementation of planning.
- (4) Laws, regulations, and technical standards concerning planning should be improved.
- (5) The legal status of TSP needs to be determined.
- (6) Strict spatial control is achieved through technical guidance, such as instructions for the compilation of provincial TSP and the compilation of municipal TSP.

4.2 Coastal spatial planning (CSP; spatial planning of coastal and offshore areas)

Implementing the spatial governance of zones is an important reform in the process of establishing the TSP system. CSP refers to specialized TSP for land–sea coordination, which supports and guarantees the high-quality development of coastal areas under the reform of multi-plan integration. It is also the core plan for guiding and restraining the development and protection of marine space in the new era. Planning focuses on coastal spaces, especially offshore ones, with the objective of achieving the economical and intensive use of spatial resources and the scientific and rational organization of development and protection activities. It puts forward guidance on planning and control requirements in terms of ecological protection and restoration, industrial layout optimization, improvement of the human living environment, and disaster prevention and mitigation. It also promotes the implementation of integrated ecosystem-based management of coastal space and accelerates the modernization of the spatial governance system and governance capacity of coastal space.

4.2.1 Operational mechanism of CSP

The CSP is incorporated into the TSP system, which constitutes a zig-zag mode of transmission and provides a special guide for marine spatial development and protection. Its research and planning scope mainly focuses on coastal space and offshore areas and is specifically refined and implemented according to the corresponding guidance and requirements of TSP at all levels. From the perspective of land–sea coordination, MSP portrays a rational layout of production–living–ecological space at the national and provincial levels in which the municipal level can be incorporated as required. At the same time, CSP deepens and refines the design of coastal space

under the TSP system and adopts specific means, special policies, and certain precise means for establishing a planning mechanism that adapts to coastal space on the basis of use control requirements and policy measures related to coastal space.

4.2.2 Key points of CSP

On the basic premise of strictly ensuring the natural ecological security boundary, CSP identifies differences across types of development and protection activities in terms of attributes, intensity, and even spatial and temporal order. In this manner, it considers the spatial needs of a coastal space in a comprehensive manner and formulates overall planning and order of spatial protection and development patterns. It puts forward guidance on planning and control requirements in terms of ecological protection and restoration, industrial layout optimization, improvement of the human living environment, and disaster prevention and mitigation to promote the implementation of a scientific, refined, ecosystem-based integrated management of coastal space. As an important backstop for the implementation of land–sea coordination in the TSP, CSP mainly deepens three aspects, namely national strategy, industrial development, and the integrated management of coastal space.

Implementation of national strategies CSP can be viewed as the overall blueprint for the protection and development of coastal space. The marine space-related requirements established in the major strategies, decisions, and arrangements of the Central Committee and the State Council should be reflected and implemented in planning in an appropriate form.

- (1) The strategic tasks, development orientation, and protection requirements, which are targeted by major national regional strategies in China, should be incorporated into planning.
- (2) Efforts should be exerted to support the new development pattern, improve the spatial layout of land–sea collecting and distributing system, maintain smooth coastal transportation to and from the country, classify and adjust the industrial layout of coastal space, promote the formation of new growth points, and improve green industrial development.
- (3) Work should be conducted to implement the strategic deployment of the Central Committee and the State Council to achieve carbon peak and carbon neutrality, promote carbon emission reduction from the perspective of safeguarding the sustainable development of offshore wind power, and enhance carbon sinks from the perspective of the protection and restoration of typical marine ecosystems.

Promotion of industrial development

- (1) The construction of major infrastructure, as determined by the state and local authorities, should be implemented with an emphasis on ports. Combined with national strategies and development priorities and reliance on the regional economic development levels of the hinterland, the spatial integration of port resources should be strengthened, the division of labor and layout of coastal ports should be reasonably clarified, and integrated planning should be conducted for the transportation system in coastal space (Guo et al., 2019).
- (2) On the basis of technology interrelatedness, the marine industry should extend along a longitudinal direction of sea and land, and the relationship between resources, environment and economy should be coordinated. The spatial layout of the land and sea industrial chain can be coordinated from the industrial perspective, and reasonable allocation should be made for the industrial scale of industries that can be developed on land and sea. Regional industrial clustering heights should be built from the perspective of layout, and the direction of regional land and sea industrial development should be coordinated. Through spatial resource allocation and other means of macro regulation and control, the scale and layout of industries between land and sea should be reasonably guided. For example, the layout of non-marine-based industries adjacent to the shoreline needs to be restricted to alleviate regional conflicts in the use of sea areas and improve the efficiency of shoreline utilization.
- (3) The spaces of sea-related industries that use land and sea areas should be optimized. Moreover, efforts should be exerted to accurately understand the land and sea spatial governance of related industrial development in an overall and connected manner. Synchronous design, planning, supply, and control of land, sea, and island spaces should be realized, and the establishment of a development order that integrates land and sea spaces into one should be facilitated.

Implementing the integrated management of coastal space

- (1) The overall ecosystem-based protection of land and sea areas should be implemented with a focus on the entire watershed–sea ecosystem. Work can be conducted to promote the closed ecological protec-

tion management of watersheds and sea areas, build a joint prevention and control mechanism, and explore the establishment of an ecological environmental protection system for land–sea coordination within the same bay, watershed, and sea area.

- (2) On the one hand, the strategy of major function planning should be implemented, and the functions of both sides of land and sea need to be coordinated. Resource elements (spatial resources such as sea areas and physical resources such as water and energy) that support high-quality development need to be provided with rational and effective guarantees. On the other hand, the total amount and the temporal and spatial distribution of land and sea resources for development and utilization should be reasonably organized. Moreover, a development order that integrates the land–sea space should be established, and effective measures should be implemented to limit the degree of development within the bearing capacity of resources and the environment. In this manner, the organic unity of resource protection, element integration, structure optimization, efficiency enhancement, and right equity of land and sea spaces can be realized.
- (3) Improving the amenity quality of coastal space with the objective of achieving harmony between people and the sea is another important consideration in implementing the integrated management of coastal space. The people-oriented approach should be taken as an important link in the implementation of sea–land coordination planning and management in coastal space. On the one hand, overall coordination should be made for land–sea spatial layout, infrastructure construction, and landscape control on the basis of ecological units. The coordinated protection of beaches, wetlands, bays, natural landscapes (Guilherme et al., 2022), coastal protection forests, and other high-quality tourism resources in coastal space should be conducted. Moreover, natural landscape and cultural resources, such as history and folklore, in coastal space should be integrated (Pikner et al., 2022) to promote the integrated control of high-quality spatial quality in land–sea linkages. On the other hand, coastal disaster prevention and mitigation measures should be incorporated into CSP and management, and coastal space disaster zoning, monitoring, forecasting and risk assessment should be improved (Hou et al., 2022). Lastly, various response actions, such as protection, setback, and adaptation, should be taken.

4.2.3 Control modes of CSP

Macro zoning and regional guidelines in national CSP Macro zoning based on the abovementioned difference considers the natural geography, ecosystem background characteristics, and actual conditions of a large-scale space while considering its economic and social development conditions. Toward this end, spatial unit identification, spatial structure setting, and spatial zoning layout without the constraint of administrative regions can be implemented (Yang et al., 2022), differentiated systems and policies can be formulated, and the strategic guidance and regional guidelines of one policy for one region can be implemented. The principles of macro zoning for coastal space are as follows.

- (1) A macro zoning plan is proposed by elucidating the types and patterns of coastal spatial ecosystems, ecological issues, ecological sensitivities, and types of ecosystem service functions (Laura et al., 2020; Galparsoro et al., 2021; Jing et al., 2023) across the regions of the country. Moreover, their spatial distribution characteristics combined with actual management situations and the requirements of national regional strategies and territorial spatial development patterns should be clarified.
- (2) An oversized regional scope renders difficult the reflection of regional heterogeneity and leads to more management contradictions. Alternatively, an extremely small regional scope could make matching the national planning scale difficult, which cannot play a fundamental and guiding role in the national CSP. Therefore, an appropriate zoning scale should be selected to meet the needs of national economic and social development and the macro management of ecological protection work.
- (3) Each zoning unit should reflect the normal internal relationships among energy, material, and information flow and the law of species migration. Moreover, it should focus on the integrity of the network structure, which is composed of transmission and exchange, to ensure its functional coordination, stability, and self-regulation ability.

Delineation of functional zoning in provincial- or municipal- and county-level CSP Functional zoning refers to micro-level spatial zoning based on functional units under macro zoning and regional guidelines. It is mainly applicable to the spatial division of specific units or plots and is a preceding phase of use control. It serves as a guide for planning permission and approval for the use

of land and sea areas. Toward this end, the core content and requirements of planning and zoning at the higher levels and the downward transmission of principle control requirements should be refined and implemented. Functional zoning in the MSP refines the spaces in accordance with the zoning and classification method (An et al., 2022; Gao et al., 2023a, b, c, d). To effectively connect with TSP, the planning scope is identified using the approach of the full coverage of sea areas and related land regions.

The zoning configuration is optimized for marine space on the basis of the idea of marine functional zoning, and integrated zoning is implemented in an appropriate form at ports, mariculture, coastal tourism, and other land-sea related spaces that require special attention. Based on three zones and three lines, marine utilization space, and marine ecological space with marine ecological protection redline, the delineation of CSP connects the zones of municipal TSP.

Implementing spatial control CSP implements spatial and use controls based on functional zoning. These controls can be divided into zoning, specific industry, specific spatial, special area, and mode controls to propose corresponding contents or initiatives of use control.

For the zoning control of the first category, based on original mature management experiences and existing applicable policies of marine functional zoning, CSP implements spatial control by adopting the combination mode of zoning and admission rules for the seaward side and develops the management requirements for sea use control, the type of sea use control, and ecological protection and restoration based on functional units and local conditions.

For the specific industry control of the second category, specific requirements of spatial layout are established for coastal ports, offshore wind power, mariculture, nuclear power, and other important industries to use sea areas while elaborating relevant spatial rules such as functional zoning and control line requirements.

For the specific spatial control of the third category, control requirements are clarified for islands, shorelines, intertidal zones, land areas adjacent to the shoreline, and other spatial types, as well as reclamation, structure, and linear sea use and modes of sea use, in combination with national control policies and development orientation.

For special area and mode controls of the fourth category, issues, such as the marine ecological protection redline, integrated land-sea space, and compatible and three-dimensional sea use, are considered to establish a control system that is applicable, operable, and can solve real contradictory problems.

5 Future development direction of MSP in China

5.1 Implementation of compatible and three-dimensional sea use management

With the rapid development of various marine industries under the opportunities of the blue economy, the limited availability of marine space will likely result in more conflicts. MSP will increasingly rely on spatial sharing, and the future will see a gradual shift in sea use from two-dimensional and exclusive to three-dimensional and compatible. Toward this end, MSP in the new context should pay more attention to the priority allocation of different demands of sea use in the same marine space, which points out the need for MSP to pay more attention to the compatibility issue. Mixed compatible and three-dimensional configuration is also of significance to the alleviation of the shortage of offshore areas and the solution to the problem of cross- or overlapping coastal utilization space.

First, the principles of MSP should be shifted from incremental to stock utilization. The general policy of marine resource management in the new era is to highly prioritize the conservation of resources, protection of the environment, and promotion of its natural restoration. Marine space in China is facing three sets of problems, namely, the carrying capacity of resources and the environment is close to their limits, the retention rate of the natural shoreline is beyond its limit, and a large gap exists in the proportion of protected space. The available space in the future is extremely limited, which means that the redevelopment and re-exploration of coastal areas will be the new norm. Therefore, the priority of MSP under the new scenario will be gradually shifted from using new space to meet the needs of coastal and marine utilization in the past to seeking in-depth development of exploited space to integrate the needs of marine utilization. MSP should focus more on revitalizing the stock, comprehensively tapping the potential, and optimizing the layout.

Second, the layout of marine space utilization should be shifted from two-dimensional and exclusive to three-dimensional and compatible. Space sharing is a general trend of MSP, which indicates seeking an added integrated and three-dimensional use of limited marine space. Efforts should be exerted to improve the ways and means of using a single-purpose division in traditional marine functional zoning by introducing the concept of mixed land use and the compatible management of land space planning (Han et al., 2022) to exploit new marine space with complex utilization. The composite use of marine space can be strengthened from two aspects. The first is from a two-dimensional perspective, advocating the MSP concept of priority right rather than sole right of coastal area industrial utilization. In the same marine space, access is granted to subsidiary functions without

compromising the dominant function and the right of use; for instance, offshore wind farms can be compatible with marine tourism. The second is from a three-dimensional perspective, exploring the rights of coastal use and space utilization from different degrees and levels, such as air and sea, sea surface, underwater, seafloor surface, and seafloor bottom.

5.2 Promoting marine spatial detailed planning

On the basis of the responsibility of the government for supervision and special space protection, the market has become a decisive force in the process of allocating coastal space elements. This scenario makes the construction-oriented CSP subject to much uncertainty, because providing precise forecasts for the development of each urban land and sea to be used is impossible for any planning.

The resource allocation of marine space has always been implemented in accordance with functional zoning and the use control approach, which could initially meet the access and other control requirements. However, this aspect is insufficient for improving spatial efficiency, coordinating the contradictions in using the same coastal or marine space, and strengthening ecological protection, among others. This notion indicates that marine functional zoning with a 10-year cycle can no longer fully adapt to the MSP and use control requirements. To strengthen the rigidity of planning while reflecting operation flexibility, the white land planning concept in Singapore could be considered a potential model, which reserves space for development in the MSP for the development of complex sea areas and islands in a centralized and three-dimensional manner. As such, the fine control and guidance of resources through multiple rounds of detailed planning can be realized. The construction of marine spatial detailed planning can draw lessons from the control requirements of land spatial detailed planning to enable operational arrangements on the specific use as well as the development and construction intensity of coastal blocks and to implement spatial use control as the basis for approving project access.

However, marine spatial detailed planning differs from land detailed spatial planning because it requires a classified and distinct preparation. Realizing the full coverage of coastal space in detailed planning is unnecessary but requires the determination of several categories of areas that require detailed planning. The first category is integrated land and sea areas, which refer to coastal tourism, ports, and other integrated land and sea spaces, including land area and related sea and island spaces. Work should be conducted to elucidate the spatial layout within the region and the control requirements for development and utilization intensity, nature of land and sea use, and other

indicators of each control unit or plot. The second category denotes areas identified for development and utilization in CSP as well as those oriented toward protection but with low-intensity utilization or restoration plans. Use classification based on CSP should be clearly defined, which refines the coastal use space to small categories, conducts further detailed zoning and fine control on the basis of zoning development guidelines, and establishes clear requirements for the spatial control of marine activities and support of infrastructure construction. The third category is the three-dimensional and compatible sea use area. Detailed planning should be prepared by zone and in sequence according to TSP, CSP, and the recent needs of coastal spatial use in a compatible or three-dimensional coastal use manner.

5.3 Exploring the protection and utilization of deep-sea space

As offshore space utilization becomes saturated and resource and environmental problems are constantly emerging, the general trend is to shift attention to the deep sea and utilize the exclusive economic zone and continental shelf space (Wang et al., 2022; Zaucha et al., 2022). With the strategic objectives of pursuing steady economic growth, protecting the offshore ecosystem, and promoting carbon peak and carbon neutrality, China is facing a rapidly growing demand for the development and utilization of the exclusive economic zone and continental shelf and for the acceleration of the implementation of intensive planning and projects of deep sea wind power and mariculture. However, administration measures or MSPs that cover waters beyond the territorial sea for deep sea projects are unavailable; thus, establishing a spatial administration system and promoting the preparation of spatial planning for the exclusive economic zone and continental shelf in due time is urgent.

To establish the abovementioned spatial administration system, addressing the following types of related problems and potential conflicts is important:

- (1) The demands for prioritizing protection need to be enforced in the deep sea. Relevant protection areas (Namhee et al., 2023) will be delineated, and spatial control measures will be defined for the exclusive economic zone and continental shelf to protect typical ecosystems, species and their habitats, and to prevent the disorderly layout of construction projects and development and utilization activities.
- (2) The entity rights of the use of sea areas need to be protected in the exclusive economic zone and continental shelf. From the perspective of implementing ownership and market entity rights, China should elucidate the ownership relationship, management mode and paid use requirements of the exclusive economic zone and continental shelf. Meanwhile, China needs to pay more attention to a quantified, stable, and standard-

ized property rights system and market mechanism. China will promote the sustainable utilization of deep-sea spaces and resources under the premise of safeguarding national and ecological security.

- (3) The conflicts that may emerge from sea use should be coordinated and reduced. With the increased intensity of deep sea use, the situation of the overlapping demands of sea use among industries and subjects cannot be ruled out, especially since the United Nations Convention on the Law of the Sea grants all countries the freedom of navigation, overflight, laying cables and pipelines, and other internationally legal uses in their exclusive economic zone. China should also consider the abovementioned activities of other countries when using the deep sea.

6 Conclusions

China is and will continue to integrate and develop TSP, CSP, and other special sea-related planning under the framework of the multiplan integration and with the deepening of the TSP system reform. CSP will build the basic pattern for coastal ecological spaces with the ecological protection redline and coastal utilization space, gradually define the preparation of various categories of plans at all levels, and focus on the adoption of ecosystem-based integrated coastal administration measures to establish a set of planning concepts and tools to adapt to the new development period.

However, after the multiplan integration, the MSP continues to face a series of problems and challenges to be resolved in the future.

- (1) The relationship between the transmission mode of CSP and project approval needs further clarification. The formulation of provincial CSP lags behind territorial spatial overall planning at the provincial, city, and county levels, thus further straightening out their relationship and forming a smooth transmission sequence of the overall provincial TSP, including provincial CSP and overall TSP at the city and county levels, are necessary aspects.
- (2) MSP has been unable to effectively navigate the *last mile* of use control. The functional zoning and use control strategies implemented in MSP can only determine the use suitable for the space, and providing detailed guidance and constraints on the specific arrangement of sea use projects in key industries is difficult. Without determining the specific use of space in functional zoning, a gap remains in directly guiding the project implementation and controlling and safeguarding the specific needs of sea use in the industry.

- (3) The role of guiding and constraining the spatial layout of the industry is insufficient in MSP. The major utilization body of MSP is mainly various sea-related industries; typically, the industry has relevant planning. In the formulation, implementation, and adjustment of MSP, MSP is frequently subject to relevant industry planning, its proposed functional spatial layout is influenced by industry planning, and the control function is weak because its formulation lags behind industry planning and professionalism.
- (4) The overall layout and control of land–sea continue to lack operational requirements. The demarcation between land–sea integrated protection and utilization space lacks corresponding technical and methodological guidance. Implementing control after its demarcation and connecting with various management policies and functional zoning control requirements of relevant land areas lack unified requirements, which makes reflecting the original intention and due role of the demarcation of integrated space difficult.

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