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University of International Business and
Economics, China
Sumedh Lokhande,
Auro University, India

*CORRESPONDENCE

Minna Yu

✉ helloymn@126.com

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Reflections on the reform of multi-tiered sea use right in China

Minna Yu^{1,2*} and Xinkai Yue¹

¹Law School, Ocean University of China, Qingdao, China, ²Institute of Marine Development of Ocean University of China, Qingdao, China

As China's marine economy continues to flourish, the scarcity of offshore marine space has become increasingly apparent. The establishment of multi-tiered sea use right in 2023 represents an effective solution to facilitate the scientific allocation and effective protection of marine resources, thereby promoting high-quality development of marine economy. This paper offers a comprehensive and analytical overview of China's multi-tiered sea use right reform in the context of current status of ocean multi-use research and practice worldwide. China's multi-tiered sea use is an innovative practice of ocean multi-use in western countries. This paper adopts the methods of literature analysis, normative analysis, empirical analysis and case study. On the basis of comparative analysis of multi-tiered sea use in China and ocean multi-use in western countries, benefits and challenges of China's multi-tiered sea use right reform were summarized and analyzed, and suggestions from multiple perspectives are provided for implementing and developing multi-tiered sea use right in China.

KEYWORDS

multi-tiered sea use right, ocean multi-use, sustainable development, marine ecological civilization, marine industry transformation

1 Introduction

1.1 Background

Since building the country into a maritime power was formally designated as a national strategy on the 18th National Congress of the Communist Party of China in 2012 (Hu, 2012), President Xi Jinping has made a series of important statements concerning developing marine economy, promoting marine science and technology innovation, protecting marine environment, constructing the 21st-Century Maritime Silk Road, and building a maritime community with a shared future, etc (National Development and Reform Commission, 2024). Chinese government has implemented a number of effective policies to implement the maritime power strategy, particularly the consecutive *Five-Year Plans for Developing National Marine Economy including the*

12th¹, the 13th² and the 14th³. In 2023, the National People's Congress promulgated the new version of *Marine Environment Protection Law*. In recent years, China's marine industry has maintained rapid growth in general, and marine-related economic activities have continued to improve. In 2023, China's gross ocean production (GOP) was 9,909.7 billion yuan, representing a 6% increase over the previous year, and this growth rate was 0.8 percentage points higher than that of GDP. Furthermore, the GOP accounted for 7.9% of GDP, an increase of 0.1 percentage points over the previous year's share (The State Council, 2024).

However, the scarcity of marine space is becoming increasingly prominent. In response to the demand for sustainable exploration of ocean resources and efficient use of marine space, China's marine industry is currently in a critical period of transformation. Promoting the high-quality development of marine economy and developing the resource-conserving and environment friendly marine industry are key objectives and missions of the reform of China's sea use right (SUR) system. To be more specific, the scientific allocation of marine resources is the foundation for the sustainable development of marine economy. The traditional sea use right system is based on the "single-tiered" model of sea use and administration, which means that there is a single sea use right within the given sea area⁴, which cannot fully leverage the multi-tiered and multifunctional marine space resources, which caused low utilization efficiency of marine space and conflict of interests among different parties (Ministry of Natural Resources of China, 2023). In order to address this issue, some coastal regions in China have been encouraged to explore experiences in multi-tiered sea use and launched a number of pilot projects. Successful local experiences reveal that the multi-tiered utilization of sea area is an effective approach for maximizing the potential of marine resources and resolving the issue of overlapping sea use (The Department of Natural Resources of Hebei Province, 2022).

1 The 12th Five-Year Plan for Developing National Marine Economy was adopted by the State Council on September 16, 2012 and entered into force immediately. The full text is available at the official website of the State Council, https://www.gov.cn/zhengce/zhengceku/2013-01/17/content_2572.htm (in Chinese).

2 The 13th Five-Year Plan for Developing National Marine Economy was adopted by the National Development and Reform Commission and the State Oceanic Administration on May 4, 2017 and entered into force immediately. The full text is available at the official website of the National Development and Reform Commission, <https://zfxgk.ndrc.gov.cn/web/iteminfo.jsp?id=419> (in Chinese).

3 The 14th Five-Year Plan for Developing National Marine Economy was adopted by the National Development and Reform Commission and the Ministry of Natural Resources on December 15, 2021 and entered into force immediately. The full text is available at the official website of the State Council, https://www.gov.cn/zhengce/content/2021-12/27/content_5664783.htm (in Chinese).

4 It is called single use in some scenarios, compared to multi use of the sea.

In November 2023, China's Ministry of Natural Resources issued the "Circular on Exploring and Promoting the Establishment of Multi-tiered Sea Use Right"⁵ (hereinafter "Circular of Multi-tiered Sea Use Right"), which listed Some sea use activities including building bridges, aquaculture, warm drainage, installing submarine cables and pipelines, submarine tunnels, and other activities that have been rigorously demonstrated to be suitable for the establishment of multi-tiered sea use right. Such activities can co-exist and obtain the sea use right certificate in the same sea area as long as they would not impinge upon national defense security, marine transportation security, engineering security, and disaster prevention and mitigation, etc.

All in all, the establishment of multi-tiered sea use right in China represents a significant step in transforming the ocean single use into the ocean multi-use. It is of great significance in promoting intensive use and effective protection of marine resources, advancing sustainable marine economy development, and achieving the goal of China's marine ecological civilization construction (Ren et al., 2024). It also represents China's efforts to promote the achievement of the United Nations 2030 Sustainable Development Goals (SDGs)⁶, particularly the SDG 12 "Ensure sustainable consumption and production patterns" and SDG 14 "Conserve and sustainably use the oceans, seas and marine resources".

1.2 Literature review

Multi-tiered sea use is not a novel concept. It essentially is the concrete practice of ocean multi-use. Multi-use refers to the intentional joint use of resources in close geographic proximity (MUSES Project, 2020), which represents a radical change from exclusive resource rights towards inclusive resource sharing by one or more users (Zaucha et al., 2017). The concept of multi-use was put forward by American conservationists in forestry management in 1940s, and it was introduced into the maritime realm by western scientists in 1970s (Smith, 1970). The earliest research clarified that human activities increased stress on maritime space and emphasized the importance for new maritime spatial planning policies and new maritime space management models (Sheail, 1986). In 2004, a German research group examined the potential sustainable schemes for ocean multi-use by analyzing the co-existence of open ocean aquaculture and offshore wind farms in the Exclusive Economic Zone of Germany

5 Circular on Exploring and Promoting the Establishment of Multi-tiered Sea Use Right was adopted by Ministry of Natural Resources of China on November 13, 2023 and entered into force immediately. The full text is available at the official website of the State Council, https://www.gov.cn/zhengce/zhengceku/202311/content_6916283.htm (in Chinese).

6 The 2030 Agenda for Sustainable Development was adopted by all United Nations Member States in 2015 to meet the urgent environment, political, and economic challenges that our world faces. Details of SDGs are on the website of United Nations, <https://sdgs.un.org/goals>.

(Buck et al., 2004). In the next two decades, the concept of ocean multi-use was gradually embraced by European marine scientists, planners, and policy makers (Guyot-Téphany et al., 2024). In 2012, the European Union presented the Blue Growth Strategy which emphasized that creating synergies between economic activities and addressing tensions clearly helps in realizing the blue growth potential (Ecorys, Deltares, and Oceanique Development et al., 2012). In 2014, the Directive 2014/89/EU of the European Parliament and of the Council defined maritime spatial planning as a means of identifying and encouraging multi-purpose uses of sea area (European Parliament and of the Council, 2014). In this context, large-scale collaborative projects, such as MERMAID⁷, TROPOS⁸, H2Oceans⁹, and MARIBE¹⁰, funded by European Union through Horizon 2020 (2014-2020) and Horizon Europe (2021-2027) research and innovation funding programmes have worked on analyzing and exploring promising ocean multi-use combinations or models. Based on different levels of connectivity between the involved users and users, scholars summarized four major types of ocean multi-use, namely, multi-purpose, symbiotic use, co-existence, and subsequent use (Schupp et al., 2019).

In China, study related to the ocean multi-use are more recent. Two decades ago, scarcity of offshore marine space and spatial conflicts between different sea use activities in China were gradually manifesting, and some literature focused on discussion of the feasibility of multi-tiered sea use from perspectives of law (Ruan, 2005; Zhang and Li, 2008) and property rights theory (Zhao et al., 2016) emerged. They provided theoretical basis for the establishment of multi-tiered sea use

right. In 2015, the State Oceanic Administration¹¹ solved two cases concerning marine space conflicts between cross-sea bridge and warm drainage of nuclear power plant in Fuding city and Lianyungang city through multi-tiered sea use method for the first time (The People's Government of Fuding City, 2016). The successful practice led to the proliferation of academic research and practical exploration of multi-tiered sea use. Chinese scholars have carried out extensive research on the supporting systems of multi-tiered sea use (Yang et al., 2022; Li et al., 2023; Zhou et al., 2024), including spatial conflict and management (Li et al., 2023), market-based sea use system, and three-dimensional marine cadastre (Cui et al., 2022), etc.

Despite ocean multi-use has gained momentum discussion among marine scientists and planners in the past decade, however, as an innovative practice of ocean multi-use, western academia paid no attention on multi-tiered sea use, and Chinese scholars have not systematically study the newly established multi-tiered sea use right in November 2023.

1.3 Purpose and structure

The principle purpose of this article is to make a comprehensive study on the reform of China's multi-tiered sea use right. The authors firstly adopts the methods of normative analysis and empirical analysis to study the reform process and current status of the multi-tiered sea use right in China. Then, by using the method of case study, authors will seek to examine the practical effects and benefits of multi-tiered sea use right by analyzing the Shuangjiantu Project, Sanmen project, and Guangdong practice. Next, authors outline practical challenges in the implementation of multi-tiered sea use right. Finally, recommendations are provided to better reflect the current requirements for the development of multi-tiered sea use right.

2 Development status of the multi-tiered sea use right in China

2.1 Overview of the sea use management system in China

China, as a State party to the United Nations Convention on the Law of the Sea (UNCLOS)¹², enjoys sovereignty over its internal waters

7 The MERMAID project has explored multi-use offshore platforms through a participatory design process, integrating both technical and visionary perspectives. The project examined innovative combinations of structures and entirely new designs. It focused on multi-use platforms that integrate wind turbines with aquaculture or wave energy generators in the Baltic Sea, the North Sea, the Mediterranean Sea, and the Atlantic Ocean. For details of MARMAID, see (Stuiver et al., 2016).

8 The TROPOS project aims to develop a modular, multi-use platform for deployment in deep waters, particularly focusing on the Mediterranean, tropical, and subtropical regions. These platforms are designed to enhance synergies and compatibility among various uses, including transport, energy production, aquaculture, and leisure activities. For details of TROPOS, see (Quevedo et al., 2013).

9 The H2OCEAN project explores proof-of-concepts for a multi-use ocean platform capable of harvesting and storing energy in the form of compressed H₂, while also integrating multi-trophic aquaculture and bio-waste treatment, alongside drinkable water production. For details of H2OCEAN, see (Urbano and Rocco, 2019).

10 The MARIBE project is on a mission to explore collaboration opportunities for companies that seamlessly merge various sectors within the Blue Growth and Blue Economy domains, adopting the method of tapping into the vast potential of multi-use space in the Blue Economy. Details of MARIBE are on the website of Europe Union, <https://www.maribe.info/>.

11 In 2018, according to the State Council's *Proposal for Reviewing the Reform Scheme of the State Council's Institutions*, the Ministry of Land and Resources, State Oceanic Administration and the National Administration of Surveying, Mapping and Geographic Information, were no longer retained and the Ministry of Natural Resources was established, within which, the function of State Oceanic Administration is maintained. The full text of *Proposal for Reviewing the Reform Scheme of the State Council's Institutions* is available at the official website of the State Council, https://www.gov.cn/gongbao/content/2018/content_5280572.htm (in Chinese).

12 United Nations Convention on the Law of the Sea (UNCLOS), 1833, UNTS 3. This Convention was opened for signature at Montego Bay on 10 December 1982 and it entered into force on 16 November 1994.

and territorial sea. In domestic law, the *Sea Areas Administration Law of the People's Republic of China* (hereinafter “*Sea Areas Administration Law*”)¹³ provides legal basis and regulatory framework of the sea use right in China, which marks the first time when property rights of marine spaces, the paid-use management system, and marine functional zoning system were defined in law (Yang et al., 2020). To be more specific, the *Sea Areas Administration Law* clearly stipulated that “sea area” refers to the interior waters, the surface, body, seabed and bottom soil of the territorial seas;¹⁴ the sea area shall belong to the state; the right to use sea area shall be lawfully obtained by any entity or individual on the paid basis, and the payment are referred to as royalties for using sea areas¹⁵. In 2006, the State Oceanic Administration of China promulgated *Provisions on the Administration of sea use Rights*¹⁶, along with a series of supporting documents, including the *Specifications for Marine Cadastral Surveys*¹⁷, *Technical Specifications for the Compilation and Drawing of Marine Cadastral Charts*¹⁸, and the *Classification of the Use of Sea Areas*¹⁹.

China's sea area management system was established based on these legal documents.

Overall, China's sea area management system consists of two parts: marine spatial planning system and sea use right system. The marine spatial planning system is a top-down spatial management system centered on coastal spatial planning with a combination of zoning and access rules (Gao et al., 2024). Marine spatial planning is formulated by the government *ex officio* and is divided into national macro-zoning and local functional zoning. Marine functional zones and their regulatory requirements delineated in marine spatial planning at the macro level serve as the basis for the sea use right system, which specifically regulates and allocates marine development activities in specific marine spaces at the micro level. The sea use right system is implemented by the administrative authorities, who examine and grant private entities the right to use the sea area. Therefore, the marine spatial planning system and the sea use right system operate independently and in conjunction with each other at the macro-planning and micro-allocation levels.

2.2 Reform process: from pilot projects to department regulation

Over the past decade, increasing types of offshore marine industries have resulted in density of the development and utilization of China's sea area. The prevalence of construction projects such as submarine cables and pipelines, offshore wind power equipment, and cross-sea bridges has grown. The construction of submarine tunnels, bay bridges, and other marine facilities often involves passing through original offshore aquaculture area and other functional zones. The traditional single-tiered sea use right system is inadequate for addressing the growing demand for multi-dimensional use of the sea. Meanwhile, advancements of three-dimensional marine cadastral survey technology have laid foundation for the multi-dimensional development and utilization of sea area. Driven by the economic development demands of the integration and intensification of the marine industry, and guided by the public policy objectives of achieving sustainable development of the oceans and protecting the marine environment, some coastal provinces of China have explored the transformation to multi-tiered marine space utilization and management.

In response to the conflicts arising from the demand for multi-tiered sea use and the absence of legal basis, particularly exacerbated by the overlap between the use of the sea for cross-sea bridges and nuclear power water intakes, Lianyungang, a city in Jiangsu Province, and Fuding, a city in Fujian Province, initiated pilot projects for the multi-tiered use of sea area and the establishment of multi-tiered sea use right in 2014 and 2016 respectively. In Jiangsu Province, through demonstrating the compatibility of cross-sea bridge construction with warm drainage of nuclear power plants, the State Oceanic Administration approved to confer sea use right of different tier of the same sea area to the two companies, specifically, the constructor of the sea-crossing bridge was granted sea use right to the surface, while the nuclear power plant was permitted to use the water body of the same sea area. The Jiangsu

13 Sea Areas Administration Law of the People's Republic of China was adopted at the 24th session of the Standing Committee of the Ninth National People's Congress on October 27, 2001 and entered into force on January 1, 2002. The full text is available at the official website of Ministry of Ecology and Environment of the People's Republic of China, https://english.mee.gov.cn/Resources/laws/environmental_laws/202012/t20201211_812661.shtml.

14 Article 2 of Sea Areas Administration Law of the People's Republic of China.

15 Articles 3, 33 of Sea Areas Administration Law of the People's Republic of China.

16 Provisions on the Administration of sea use Rights was adopted by the State Oceanic Administration of China on October 13, 2006 and entered into force on January 1, 2007. The full text is available at the official website of Ministry of Natural Resources of the People's Republic of China, https://gc.mnr.gov.cn/201806/t20180615_1796682.html (in Chinese).

17 Specifications for Marine Cadastral Surveys was adopted by the State Oceanic Administration of China on May 6, 2008 and entered into force on July 1, 2008. The full text is available at the official website of Ministry of Natural Resources of the People's Republic of China, https://gc.mnr.gov.cn/201806/t20180614_1795677.html (in Chinese).

18 Technical Specifications for the Compilation and Drawing of Marine Cadastral Charts was adopted by the State Oceanic Administration of China on May 3, 2016 and entered into force on June 1, 2016. The full text is available at the official website of Ministry of Natural Resources of the People's Republic of China, https://gk.mnr.gov.cn/zc/zxqfwj/202103/t20210326_2618389.html (in Chinese).

19 Classification of the Use of Sea Areas was adopted by the State Oceanic Administration of China on May 6, 2008 and entered into force on July 1, 2008. The full text is available at the official website of Ministry of Natural Resources of the People's Republic of China, https://gc.mnr.gov.cn/201806/t20180614_1795677.html (in Chinese).

practice established a successful precedent and reference for other provinces and cities in China. In 2016, the State Oceanic Administration issued the *Opinions on Further Regulating the Management of Sea Use Right for Offshore Wind Power*²⁰, which encouraged the co-existence of offshore wind power projects and other compatible sea use activities in the same marine space and confirm their rights separately. More pilot projects of multi-tiered sea use right were launched on a larger scale across the country. For example, Guangdong province issued the *Notice of the Department of Natural Resources of Guangdong Province on Promoting the Establishment of Multi-tiered Sea Use Rights*²¹ based on local experience, detailed criteria has been established for examining the compatibility between different sea use activities in the same sea area within Guangdong Province.

Based on the successful practices, in 2019 and 2021 respectively, the General Office of the State Council issued the *Guiding Opinions on Coordinated Reform of the Property Rights System of Natural Resource Assets*²² and the *Overall Plan for Pilot Programs of Comprehensive Reform in Factor Market-based Allocation*²³, which emphasized the importance of the reform of sea use right system and advocated the model of multi-tiered sea use right. Under the guidance of the Central Committee of the Communist Party of China and the State Council, in 2023, the Ministry of Natural Resources issued *Circular of Multi-tiered Sea Use Right*. It contains the technical standard *Guidelines for Defining the Scope of Marine Cadastre for Multi-tiered Sea Use Right in Sea Areas (for trial implementation)* as an appendix. *The Circular* officially confirmed the legitimacy of multi-tiered sea use rights of existed pilot projects,

20 *Opinions on Further Regulating the Management of Sea Use Right for Offshore Wind Power* was adopted by the State Oceanic Administration of China on October 31, 2016 and entered into force immediately. The full text is available at the official website of Ministry of Natural Resources of the People's Republic of China, https://gc.mnr.gov.cn/201806/t20180615_1796693.html (in Chinese).

21 *Notice of the Department of Natural Resources of Guangdong Province on Promoting the Establishment of Multi-tiered Sea Use Rights* was adopted by Department of Natural Resources of Guangdong Province on September 18, 2023 and entered into force immediately. The full text is available at the official website of Department of Natural Resources of Guangdong Province, https://www.gd.gov.cn/zw/gk/gongbao/2023/26/content/post_4262429.html (in Chinese).

22 *Guiding Opinions on Coordinated Reform of the Property Rights System of Natural Resource Assets* was adopted by General Office of the Communist Party of China Central Committee and General Office of the State Council on April 14, 2019 and entered into force immediately. The full text is available at the official website of the State Council, https://www.gov.cn/zhengce/2019-04/14/content_5382818.htm (in Chinese).

23 *Overall Plan for Pilot Programs of Comprehensive Reform in Factor Market-based Allocation* was adopted by General Office of the State Council on December 21, 2021 and entered into force immediately. The full text is available at the official website of the State Council, https://www.gov.cn/gongbao/content/2022/content_5669421.htm (in Chinese).

and promote the implementation of multi-tiered sea use right in China.

At present, some provinces and coastal cities have formulated detailed policies to implement *The Circular* based on the specific conditions of sea area in each province or city. For example, in April 2024, Shenzhen issued a trial version of Notice on Promoting the Establishment of Multi-tiered Sea Use Right for two years. It constitutes a useful supplement for *The Circular* and serves as a useful template for other provinces.

3 Benefits of multi-tiered sea use right reform in China

3.1 Improving intensive utilization of marine space

For the time being, some coastal regions including Shandong province, Zhejiang province, Guangdong province have implemented the multi-tiered sea use right system and accumulated rich experiences. Typical combination of marine development activities have been established in practice, which are “construction of sea-ponds+cables or pipelines”, “aquaculture+photovoltaic power generation” (Figure 1), “cross-sea bridge+aquaculture,” and “photovoltaic power generation+warm drainage”.

Taking “aquaculture+photovoltaic power generation” model as an example, it reveals the scientific compatibility between two different types of sea area development activities. On one hand, aquaculture and photovoltaic power generation occupy different tiers of sea area, which indicates the spatial compatibility; on the other hand, there is no temporal or spatial conflict between different right holders when using the sea, which suggests a low risk of conflicts of interest. Specifically speaking, photovoltaic power generation projects mainly occupy and use the space above the mean sea level until the upper edge of the photovoltaic panels, while aquaculture projects need to use of the water body of sea area, i.e., the sea areas between the mean sea level and the seabed. Additionally, the supporting columns of the photovoltaic panel would not interfere with the aquaculture located in the same sea area.

Zhejiang province has more than 260000 square kilometers sea area, which ranks top five in China. It promulgated the *Technical Specification for the demarcation of sea area under multi-tiered sea use right*²⁵ (hereinafter “*Technical Specification*”) in January 2024, which is the first local standard at the provincial level. The implementation of *Technical Specification* and related policies has greatly improved the efficiency of marine resource allocation and increased the sea area that could be used. For example, the Daishan Shuangjiantu Project operated by CR Power change the way of

25 *Technical Specification for the demarcation of sea area under multi-tiered sea use right* was adopted by Department of Natural Resources of Zhejiang Province on November 17, 2022 and entered into force immediately. The full text is available at the official website of Department of Natural Resources of Zhejiang Province, https://zrzyt.zj.gov.cn/art/2022/11/21/art_1289924_59009224.html?eqid=a5cead470034a8e300000002647d2e7b (in Chinese).

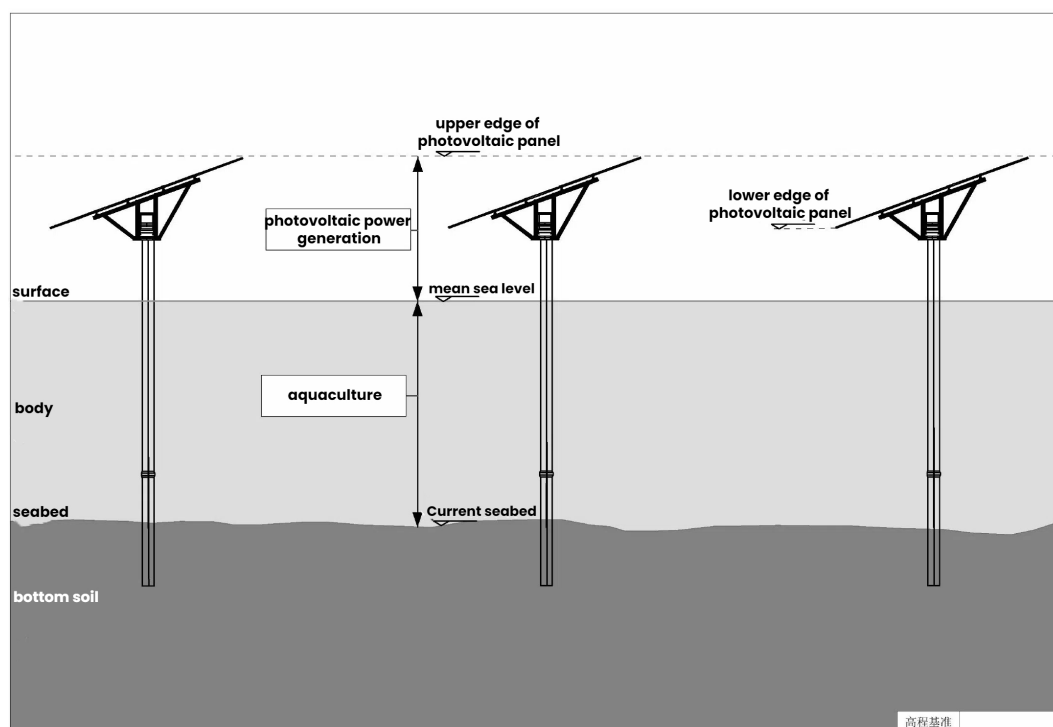


FIGURE 1
Aquaculture + photovoltaic power generation²⁴.

using sea area. The 75.56 hectares sea area used for aquaculture has been transformed to the “aquaculture+photovoltaic power generation” model. The water body of 75.56 hectares remains dedicated to marine aquaculture, while the 69.93 hectare surface of marine space is used for the photovoltaic power generation project. This resulted in an increase of the utilized sea area by 92.5% (The People’s Government of Zhejiang Province, 2024).

3.2 Promoting green transformation of marine industries

Among the typical models of the multi-tiered utilization of sea area, represented by “aquaculture+photovoltaic power generation” and “photovoltaic power generation+warm drainage”, presents a novel approach to integrating photovoltaic power generation, wind power generation, and tidal power generation with traditional marine uses. It promotes the construction of clean and renewable energy infrastructures. The promotion of energy-related multi-tiered utilization of sea areas can help reduce the energy pressure on coastal areas, improve the proportion of renewable energy in China’s energy structure, and accelerate improvements in energy efficiency. This not only satisfies the requirements of the United Nations 2030 SDGs but also contributes to the high-quality development of China’s energy economy.

Take the typical combination of “photovoltaic power generation +warm drainage” as an example, which has yielded positive outcomes. CNNC Sanmen 200MW beach photovoltaic project realized the first grid-connection of 100MWp capacity, marking the first “nuclear light storage multi-energy coupling” in China and the first independent development and construction of CNNC beach photovoltaic project officially connected to the grid. The project uses the thermal drainage area of Sanmen nuclear Power plant to build a photovoltaic project, which provides a demonstration for subsequent “nuclear +” development model, and promotes the management mode of the sea area from “plane” to “three-dimensional”, which is of great significance for promoting the economical and intensive utilization and effective protection of marine resources and promoting the high-quality development of the marine economy. The multi-energy coupling of nuclear energy+photovoltaic+energy storage has been formed at the power supply end of the regional power grid, which has a demonstration role in the construction of a power system with the basic characteristics of clean and low-carbon, safe and controllable, flexible and efficient, intelligent and friendly, open and interactive, supported by the interaction of charge and storage of the source network and multi-energy complementarity (CNNP Rich Energy Co. LTD, 2023).

3.3 Supporting sustainable development of marine economy

There is an old saying in China, “take from the sea, use to the sea.” It has been fully reflected in the evolution of China’s sea use

²⁴ Department of Natural Resources of Zhejiang Province (2023). Technical Specification for the demarcation of sea area under multi-tiered sea use right. Available at: https://zrzyt.zj.gov.cn/art/2022/11/21/art_1289924_59009224.html

right system, especially in the management of the royalties for using sea area. The *Sea Area Administration Law* explicitly stipulates that China practices the system of using sea area on the paid basis. In other word, the sea area use royalties should be paid by the users, which is based on the experience of other countries, such as the Republic of Korea, Japan and the United Kingdom. Notably, core consideration of the market-based sea use right system is the sustainable development of marine economy, which means ecological environment has been placed at least on the same important position with economic development.

The collection of sea area use royalties is an important element in improving the public revenue system. Taking Guangdong Province, a major maritime province in China, as example, the financial collections of sea area use royalties during the Eleventh Five-Year Plan period reached to 2.641 billion yuan, of which 704 million yuan was collected in 2010, a year-on-year increase of 28%, or 22 times the 2006 revenue (Ministry of Finance of China, 2011). In the past decade, with the reform process of multi-tiered sea use right, some coastal regions are exploring adaptive ways of the management of sea area use royalties. In 2022, Guangdong province released the amended *Criteria for Collection of Sea Area Use Royalties in Guangdong Province*, aiming at promoting the sustainable development of marine economy with the regulatory role of sea area use royalties (Department of Finance of Guangdong Province, 2022). For instance, lowering the royalties of sea area used for aquaculture, and the Guangdong standard is the lowest criteria now in China. Undoubtedly, it promotes the construction of sea farms in Guangdong Province and is beneficial for the transformation of fishery industry. Besides, the expenditure of sea area use royalties are mainly on the protection and restoration of marine ecology environment. In 2009, the Ministry of Finance and the State Oceanic Administration jointly decided that the funds collected from sea area use royalties would be included in the budget and used for the management and protection of sea area (Ministry of Finance, and The State Oceanic Administration, 2009). Specifically, The sea area use royalties collected in the current year will be arranged for use in the budget of the following year by the Ministry of Finance. The specific scope of use includes making policies, regulations, and standards for the sea area use management; formulating marine spatial planning; conducting surveys, surveillance, monitoring, and management of sea area use; upgrading maritime law enforcement equipment and information system; classifying and evaluating sea area resources; regulating, restoring, and protecting sea areas, islands, and coastal zones; constructing the technical support system for sea area utilization and management; collecting and administering sea area use royalties; and undertaking other projects related to the protection and management of sea areas as determined by the Ministry of Finance and the State Oceanic Administration.

To sum up, China's multi-tiered sea use right reform has made achievements in improving the efficiency of sea area utilization, alleviating scarcity of marine space, and under the premise of sustainable development, the economic benefits of marine space have been fully brought into play. The multi-tiered use of sea area and the reform of sea use right in China adhere to the principles of

conservation, intensiveness, and prioritization of ecological protection. It considers the carrying capacity of marine environment, the actual requirement of multi-tiered development of sea area and potential impacts on marine ecology. It divides sea area into multiple tiers, and establishes different types of sea use right on different tiers based on different features of marine development activities. The compatibility of various types of sea use rights could be ensured by the rigorous investigation, demonstration and examination procedure. Besides, the market-based sea use right system puts a big spotlight on ecological protection, which is conducive to optimizing marine industrial distribution and promoting marine economic integration, and improving the efficiency of marine resource utilizing.

4 Challenges faced by multi-tiered sea use right reform in China

4.1 Relevant laws and regulations lags behind

There is a lack of detailed regulatory framework of relevant laws and regulations on multi-tiered sea use right. The reform of multi-tiered sea use right has lasted over ten years, and adopted the approach of bottom-up. Existing laws and regulations need to improve to adapt to the needs of current status and future development of multi-tiered sea use right.

The *Sea Areas Administration Law* has applied for 22 years, and it does not have specific regulations on multi-tiered sea use right. For example, the *Sea Area Administration Law* provides that the entities or individuals applied to use sea area should submit the sea area use demonstration report, which is the scientific basis for approving the application and transferring of sea use right. Ministry of Natural Resources has issued a series of legal documents to standardize the management of sea area use demonstration. The applicant should formulate the sea area use demonstration report following the principles of justice, science and good faith, and relevant laws and regulations, technical standards and norms of sea area use demonstration (Ministry of Natural Resources of China, 2021). The demonstration of sea area use shall be based on a detailed survey of the ecology, development and utilization of marine resources in the area where the project is located, and guided by the principle of ecological priority, conservation and intensification. Specifically, it should cover the scientific and objective analysis of the necessity of the project, the rationality of site selection and scale, the impacts on marine resources and ecology, and the coordination of stakeholders, etc. China has established sea area use information platform²⁶ to increase the

26 Details of the sea area use information platform are on the official website of Ministry of Natural Resources, <https://www.hysylz.org.cn> (in Chinese).

disclosure of sea area use demonstration information, and strengthen the supervision over the sea use activities. However, there is no clear provision in these legal documents concerning the management of sea area use demonstration of multi-tiered sea use.

Some coastal and local governments have noticed the problem of existing laws and regulations lags behind the development of multi-tiered sea use right, and have been exploring to make targeted policies to make up the shortages of relevant laws and regulations. In conclusion, relevant laws and regulations require improvements to adapt to the needs of multi-tiered sea use right.

4.2 Conflicts of marine spatial planning and multi-tiered sea use right

Marine spatial planning system and sea use right system constitute China's sea area management system. With the reform and implementation of multi-tiered sea use right, the highly flexible and practical sea use right system may conflict with the stable marine spatial planning system.

Firstly, the current marine spatial planning in China is based on the plane management mode of sea area, making it challenging to meet the practical requirements for establishing multi-tiered sea use right. Specifically, marine spatial planning uses the traditional industry-oriented planning method, which divides sea area into various functional zones and confirms their dominant use. The multi-tiered utilization of marine space, to a large extent, depends on the evaluation and demonstration of private entities, namely, the applicant. A rigorous review process would be needed to ensure that the compatible marine uses that differ from the dominant marine uses in the sea area would not affect its dominant function. The demonstration and examination process is cumbersome and involves high invisible costs (Ciravegna et al., 2024). As a result, private entities tend to use the functional areas exclusively and independently according to the designated dominant use, rather than adopting multi-tiered utilization for compatible development.

Secondly, marine spatial planning is a form of macro-planning that lacks precision and specificity. Marine spatial planning mainly serves public policy objectives, such as marine sustainable development and marine environment protection. It needs to be considered based on overall planning, so its spatial scale is larger and the details are rough. However, this is not completely consistent with the objectives of multi-tiered sea-use rights, which aim to achieve specific spatial arrangements that consider the economic demands of all interested parties in a particular area.

Thirdly, marine spatial planning is a long-term planning with insufficient timeliness and flexibility. In China, the coastal spatial planning usually takes place on 15-year cycle. But with the rapid development of marine technology and constant emergence of marine industries, marine uses show the trend of diversified development. the implementation of multi-tiered sea use right can respond to the diverse market demands arising from rapid changes in the marine sector. Comparatively, the marine spatial planning system cannot respond well to the development trend because of its pursuit of stability.

5 Suggestions for implementing multi-tiered sea use right in China

5.1 Improve relevant laws and regulations

To promote the implementation of multi-tiered sea use right, the government should strengthen the top-level design of multi-tiered sea use and improve relevant laws and regulations. Due to the development model of bottom-up, the multi-tiered sea use right reform to some extent guided by local governments. Lacking uniform standards of supporting management system and technical standard present serious obstacle to the development of multi-tiered sea use. Therefore, The government should update existing legal documents or formulate new ones based on existing practical experience.

Take the sea area use demonstration report of multi-tiered sea use right as an example, in local practice, Zhoushan requires the applicant to bear the obligation of demonstrating the compatibility of different sea use activities in the same sea area. An extra chapter is required to be added in the sea are use demonstration report, focusing on the necessity and feasibility of the establishment of the multi-tiered sea use right. The applicant should specify the types of sea use activities, the scope of each kind of sea use activity, and overlapping scope of marine space, and prove the compatibility of different sea use activities and its compliance with the requirements of marine spatial planning. If the application involves the sea area where exists original sea use right, to avoid potential conflict, an agreement should be reached between the original right holder and the new applicant to specify their separate types of sea use activities, geographical range, overlapping scope, limitations of rights, and period of each sea use right, etc (Zhoushan Natural Resources and Planning Bureau, 2023). The government should enact new regulations or amend existing legal documents to unify the standard of sea area use demonstration report of multi-tiered sea use right.

5.2 Adopt marine spatial detailed planning

Marine spatial detailed planning can be regarded as an approach to coordinate the conflicts between marine spatial planning and multi-tiered sea use. Pilot projects are underway in three cities, Shenzhen, Sanya, and Qingdao (First institute of Oceanography of Ministry of Natural Resources, 2022). Marine spatial detailed planning serves as a system between the marine spatial planning and sea use right system, and it incorporates elements of both systems. By cross-dealing with the conflicts and contradictions between marine spatial planning and sea use right system, marine spatial detailed planning aims to achieve the goal of system coordination and has stronger feasibility. Specifically, the Natural Resource Administrative authorities should be responsible for formulating and releasing marine detailed planning, which would further divide the function zone determined by marine spatial planning, and pre-planning various compatible marine uses in the same sea area. The marine spatial detailed planning should be formulated based on marine geology, resource

distribution, and marine environment carrying capacity of specific sea area. Finally, the Natural Resource Administrative authorities would draw the boundaries of marine spaces, enabling their allocation through applications by private parties, tender and auction.

With the implementation of China's multi-tiered sea use right, the marine spatial planning system is also undergoing a new series of reforms. Practical exploration of marine spatial detailed planning is currently in its nascent stage of development and requires further refinement at least in the following two key aspects.

On one hand, the natural resource administrative authorities should play a leading role in investigating whether there is scientific compatibility and practical feasibility of implementing the multi-tiered sea use right for which the dominant function have already been specified by marine spatial planning. If it is appropriate to implement multi-tiered sea use right system, marine spatial detailed planning should be formulated accordingly to identify other compatible marine uses and boundaries for different marine uses should be delineated. In other word, the Natural Resource Administrative authorities rather than private entities should play the leading role in investigating and determining the sustainable combinations of different demands of sea use in the same area. By reducing the burden of private entities and reducing transaction costs, the multi-tiered sea use right would be able to develop. On the other hand, in sea areas reserved for development in the marine spatial planning, demonstration area for multi-tiered utilization should be established according to marine spatial detailed planning (Gao et al., 2024). It is obvious that the approach differs from directly designating functional areas and their dominant uses through the marine spatial planning (Bocci et al., 2019). Notably, based on the responsibility of the natural resource administrative authorities and other government departments for supervision, the market has become a decisive force in the process of allocating marine space. Therefore, in the process of formulating marine spatial detailed planning, opinions of private entities should be taken into consideration.

Based on above analysis, marine spatial detailed planning should be promoted in order to fill in the gaps between marine spatial planning and multi-tiered sea use right. Timeliness, pertinence, multi-dimension should be crucial factors of the marine spatial detailed planning. Market-oriented allocation of sea area and marine resources under the supervision of government would be the feasible path.

5.3 Promote marine environmental benefits

Promoting marine environmental benefits is the key objective and core consideration of multi-tiered utilization of sea area. China's exploration and practice of multi-tiered sea use is insufficient, and more possible combinations should be developed.

On one hand, investment and support in scientific research should be increased. Multi-use of sea is not exclusively better than single-use of sea. It is important to carefully consider local

conditions when making a decision whether to favor single or multi use in a given location and what combination should be the best choice (MUSES Project, 2020). But now in China, there is insufficient scientific survey both on coastal marine environment and on sustainable combination of marine utilization activities. On the other hand, development of renewable energy and relevant combinations should be promoted. Analysis of China's pilot projects on multi-tiered sea use reveals that renewable energy including wind, solar, wave, and tidal energy is the driving sectors for multi-tiered sea use in China in the near future. It is therefore reasonable that multi-tiered sea use is strengthened around the renewable energy. In this perspective, renewable energy-based combination should be the focus of multi-tiered sea use in China and renewable infrastructure should be preferably paired with other marine uses.

5.4 Foster synergistic effects

Synergies refer to the mutually beneficial utilization of the same sea area or marine resources, but equally to shared infrastructure, technology or human resources. A key driver for synergy between sectors is the expected efficiency gains and mutual benefits, so that the effect arising from the combination of uses is greater than the sum of their individual effects (ICES, 2023). Currently, China's multi-tiered sea use is in the stage of co-existence of different marine utilization activities in the same area and have not achieved the synergistic effects. In the future, more efforts should be made to promote positive interaction of different activities, and achieve the comprehensive benefits of "1 + 1 > 2".

Multi-purpose platforms (MPP) could be a solution in practice. Achieving synergies through MPP, which build offshore platforms that serve the needs of multiple offshore industries, such as energy and aquaculture, and manage the tensions arising from their co-existence (Abhinav et al., 2020). Specifically, the natural resource administrative authorities shall, through the marine spatial detailed planning, assess in advance the types of marine activities that have synergies with the dominant functions of the sea area, and give priority to the granting of sea area use right for such sea use activities. As for the sea area reserved for development, the natural resource administrative authorities should, through the marine spatial detailed planning, plan the establishment of MPP in advance according to the needs of market players, and encourage the construction of a fully integrated MPP. During the process of planning and constructing MPP, experience from Europe can be drawn upon. For instance, in the multi-use combination of "wave energy+aquaculture", aquaculture farms and wave energy can be combined, either physically connected, or shared side by side, so that wave energy is directly used in aquaculture. Similarly, in the combination of "offshore wind+marine renewable energy generation", offshore wind energy can be jointly deployed with wave energy and tidal energy as part of the same physical platform, or indirectly connected through the same cable array, by promoting the synergistic effect between the different marine projects, so as to improve the comprehensive benefits of sea area development.

6 Conclusion

Ocean multi-use was proposed by western scholars as an economic tool, which aims to alleviate the scarcity of marine space and improve utilization efficiency of sea area. The concept of multi-tiered sea use right proposed by China is an specific innovative practice of ocean multi-use, which marks a significant transition from a single-tier approach to a multi-tiered one in the spatial planning, utilization, and management of coastal sea area. Sustainable development of marine economy is the core objective of China's multi-tiered sea use right reform, rather than mere economic goal. To date, China's multi-tiered sea use right reform and implementation has been undergoing rapid development. A series of practical problems and challenges are emerging, such as the inadequate supporting legal system, conflicts between marine spatial planning system and multi-tiered sea use right system, insufficient experience and scientific research results, etc. In the future, with more pilot projects launched, Chinese government should improve compatible legal framework and management regimes, adopt the approach of marine spatial detailed planning to coordinate the conflicts between marine spatial planning system and sea use right system, develop more possible combinations of sea use activities to promote marine environmental benefits and achieve synergistic effects.

Author contributions

MY: Conceptualization, Formal analysis, Funding acquisition, Methodology, Supervision, Writing – review & editing. XY:

Conceptualization, Formal analysis, Investigation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

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