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Legal pathways for China's blue carbon conservation: a perspective of synergizing ocean and climate rule of law

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Blue carbon serves as a significant natural carbon sink and presents substantial opportunities for greenhouse gas mitigation actions. This study first elucidates the importance of blue carbon conservation and its basis in international law, and then analyzes the progress and shortcomings of China's efforts in blue carbon protection in the areas of legislation, enforcement, and judicial practices related to ocean governance and climate change mitigation. Finally, from the perspective of coordinating ocean and climate governance, this paper proposes legal pathways to improve blue carbon conservation. In terms of legislation, it advocates for the explicit inclusion of the legal concept of "blue carbon" in the legal frameworks governing ocean and climate governance, and for the clarification of the legal status of "blue carbon credits". In terms of regulatory enforcement, it recommends developing a detailed implementation plan to integrate blue carbon into the China Certified Emission Reduction (CCER) system, designating a regulatory body for blue carbon trading, and establishing a multi-stakeholder governance mechanism involving government, market, and society. In the judicial realm, the paper suggests issuing judicial interpretations to clarify the scope, prerequisites, and implementation of "purchasing blue carbon credit" to prevent such purchases from becoming a "free pass" that could damage marine ecosystems

KEYWORDS

blue carbon, blue carbon ecosystems (BCEs), purchasing blue carbon credits, marine environment protection law (MEPL 2023), China, legislation, enforcement, judicial

1 Introduction

Climate change and ocean governance are common concerns that affect the fate of all humanity, and people are making various positive efforts for global greenhouse gas emission reduction and the protection of marine ecological environments (Chang et al., 2020; Wang et al., 2024). "Reducing carbon emissions" and "increasing carbon sinks" are not only the main goals of the Paris Agreement but also internationally recognized

important ways to mitigate climate change (Le Quéré et al., 2009; Wei and Wang, 2024). Blue carbon refers to the biologically driven carbon fluxes and stocks in all marine ecosystems, especially the carbon accumulation and storage in coastal ecosystems such as seagrasses, salt marshes, and mangroves (IPCC, 2019). These ecosystems exhibit high rates of carbon sequestration, act as long-term carbon sinks (IPCC, 2022a), and present significant opportunities for greenhouse gas mitigation actions (McLeod et al., 2011; Douvère, 2021; Hilmi et al., 2023a). However, due to threats such as land use, agricultural irrigation, eutrophication, and environmental pollution, the carbon sequestration and storage capacity of blue carbon has been greatly reduced, and even releases a large amount of previously sequestered carbon, further exacerbating climate change (Waycott et al., 2009; Pendleton et al., 2012; Hejnowicz et al., 2015).

In light of the dual significance of blue carbon for ocean and climate governance, as well as the significant threats they face, the international community has begun to discuss the inclusion of blue carbon protection in marine and climate law and policy frameworks. First of all, in terms of international law, the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and its REDD+ mechanism all provide an important foundation and possibility for the inclusion of blue carbon in international legal mechanisms (Orford, 2024a; Wei and Wang, 2024). Coastal blue carbon was officially included in the greenhouse gas inventory (IPCC, 2014), which is an important milestone in the international rule of law for blue carbon protection. Since then, parties to the Paris Agreement have increasingly included blue carbon projects in their NDCs (Herr and Landis, 2016; Siriwardana and Nong, 2021; Arkema et al., 2023). The United States and Australia have included blue carbon in their national greenhouse gas inventories for two consecutive times and continue to improve the content of the inventories (Vanderklift et al., 2019; Sapkota and White, 2020). In addition, some scholars have proposed including blue carbon under the Global Environment Facility, the Special Climate Change Fund, and the Adaptation Fund under the United Nations Framework Convention on Climate Change, and strengthening international cooperation (Herr et al., 2019; Feng et al., 2023).

Secondly, there are also studies on including blue carbon in domestic laws to address climate change. Australian scholars have proposed including blue carbon in Australia's Emissions Reduction Fund and integrating the ecosystem services paradigm into environmental law (Parry, 2010; Bell-James, 2023a; Howie et al., 2024); American scholars have proposed including blue carbon in market trading and incorporating it into U.S. federal laws such as the National Environmental Policy Act (NEPA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Clean Water Act (CWA), and the Coastal Zone Management Act (CZMA) (Ullman et al., 2013; Wedding et al., 2021; Orford, 2024a); Scholars from Japan, South Korea, Singapore, New Zealand, Brazil, Germany, and other countries have proposed establishing different levels of blue carbon accounting methods and trading mechanisms from their domestic laws, and including blue carbon in marine protected area legal systems to protect and restore BCEs (Nobutoki et al., 2019;

Um, 2021; Duncan et al., 2022; Soares et al., 2022; Friess et al., 2023; Fink and Ratter, 2024; Stewart-Sinclair et al., 2024).

China has a long coastline and abundant blue carbon ecosystems (BCEs) (Meng et al., 2019; Zhao et al., 2022b), but they have also been impacted by human activities such as land reclamation from the sea and tidal flat reclamation, leading to severe damage to blue carbon sinks and BCEs (Xu et al., 2018; Cinar et al., 2024). Chinese scholars have mainly conducted research and proposed legal and policy recommendations in areas such as integrating blue carbon into the China Certified Emission Reduction (CCER) market (Li and Miao, 2022; Hu et al., 2024), constructing blue carbon market trading models (Cao et al., 2022; Chen et al., 2022; Li et al., 2024), enhancing the marine carbon sequestration capacity of local provinces and municipalities (Mao et al., 2023), and optimizing blue carbon management in China (Yu and Wang, 2023). However, current research predominantly focuses on the legal construction of blue carbon market mechanisms, lacking systemic and synergistic discussion on the significant role of blue carbon in global ocean governance and climate change response. Additionally, there is a scarcity of studies analyzing how the combined efforts of ocean and climate legal frameworks within a country's domestic legislative, enforcement, and judicial systems can protect blue carbon and its ecosystems.

This article proposes pathways and institutional recommendations for enhancing blue carbon protection in legislation, enforcement, and judiciary from the perspective of synergizing ocean and climate legal frameworks. First, we elucidate the importance of blue carbon protection and its international legal basis within ocean and climate governance. Second, we analyze the progress made and the institutional barriers existing in China's blue carbon protection in terms of ocean and climate law. Finally, adopting the perspective of synergistic ocean and climate legal frameworks, we offer legal pathways and suggestions for institutional improvements in China's blue carbon protection concerning legislation, enforcement, and judiciary. We hope our research can also provide a reference for blue carbon protection in other countries and contribute to the advancement of ocean and climate rule of law.

2 Background and basis in international law

Blue carbon is critically important not only for mitigating climate change but also offers numerous other benefits, including improving marine environments, enhancing water quality, protecting biodiversity, and increasing the resilience of coastal areas (Christianson et al., 2022; Bell-James et al., 2023). Consequently, multiple subfields of international environmental law, including the international law of the sea, climate law, adaptation law, pollution law, and biodiversity conservation law, are increasingly emphasizing the protection, restoration, and sustainable management of BCEs (Bustamante Beumer, 2023). However, due to the overlap among these international laws in blue carbon protection (Orford, 2024a) and in line with the focus of this research, this paper primarily concentrates on the role and

significance of blue carbon within international law of the sea and climate law. Moreover, climate change and ocean governance, as the two issues most closely related to blue carbon protection, are currently attracting significant international attention, and their protection and regulation by international law are integral to this topic (Chang et al., 2020).

Mitigating climate change through blue carbon must be based on a healthy marine ecological environment. Although BCEs account for only 0.2% of the global ocean area, they absorb and sequester half of the carbon stored in global ocean sediments (Duarte et al., 2013). Marine organisms capture more than half of the total carbon sequestered by all living organisms (Nellemann et al., 2009). If carbon is transferred from the surface layer to the deep sea (i.e., depths exceeding 1,000 meters), it can be stored and sequestered for at least 100 years (Oostdijk et al., 2022). However, human activities such as tidal flat reclamation, overfishing, and marine pollution not only lead to the loss of BCEs (Macreadie et al., 2019; Lovelock and Reef, 2020; Alongi, 2022) but also reduce the ocean's capacity to absorb and store carbon dioxide (Gruber et al., 2023; Wang et al., 2024), thereby exacerbating global climate change.

Incorporating blue carbon into climate and ocean legal frameworks can help alleviate global climate change and severe marine ecological environmental damage (Li and Miao, 2022; Bell-James, 2023a; Wei and Wang, 2024). Firstly, legislation on blue carbon protection aids in clarifying the legal basis for property rights over blue carbon and the protection of BCEs (Porter et al., 2020; Um, 2021; Stewart-Sinclair et al., 2024). Secondly, law enforcement and regulation in blue carbon protection help define the distribution of rights and responsibilities among specific administrative departments regarding the protection of BCEs (Prihatiningtyas et al., 2024) and strengthen the supervision and management of blue carbon trading market mechanisms (Cao et al., 2022; Sidik et al., 2023). Finally, judicial protection of blue carbon provides legal remedies for the loss of carbon sink functions in BCEs and compensation for marine ecological environmental damages (Basu and Mandal, 2022; Zou and Zhang, 2024).

2.1 Blue carbon and international climate law

Although the policy design and implementation specifically targeting blue carbon for climate change mitigation are still in their infancy, international laws addressing climate change have already included provisions for blue carbon protection (Hilmi et al., 2023a).

2.1.1 Blue carbon in the pre-Paris agreement era

Firstly, as the foundational convention of international climate governance, the United Nations Framework Convention on Climate Change (UNFCCC) affirms the importance of marine ecosystems in mitigating climate change. It not only defines a “sink” as any process, activity, or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas from the atmosphere¹, but also includes the anthropogenic emissions by sources and removals by sinks of all greenhouse

gases—including those related to the oceans—within its scope² (UNFCCC, 1992). These provisions have, to a certain extent, laid the international legal foundation for incorporating blue carbon into the climate governance framework.

Secondly, the Kyoto Protocol and its mechanisms of Land Use, Land-Use Change, and Forestry (LULUCF) and Reducing Emissions from Deforestation and Forest Degradation (REDD+) have established international frameworks for the sustainable management of terrestrial carbon sinks. These mechanisms allow Parties to achieve emissions reductions that can be credited through the Clean Development Mechanism (CDM), and provide measurable, reportable, and verifiable (MRV) mechanisms for forest management. They have also established voluntary carbon market mechanisms based on carbon credits aimed at forest protection (Yee, 2010; Ahmed and Glaser, 2016; Wylie et al., 2016). These legal frameworks can be directly applied to blue carbon. For instance, increasing coastal or marine biomass is akin to afforestation, which enhances carbon storage. Restoring ecosystems resembles reforestation and involves similar baseline concerns. Therefore, the Kyoto Protocol offers suitable rules for the creation and exchange of blue carbon credits (Orford, 2024a).

Thirdly, the “2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands”, published in 2014, included blue carbon for the first time by providing standardized methods for measuring and reporting emissions and removals from coastal wetlands (IPCC, 2014). This inclusion enabled countries to systematically account for blue carbon in their national greenhouse gas inventories and integrate it into climate change mitigation strategies. Consequently, blue carbon was officially recognized within the global climate reporting framework, emphasizing its significance in international climate policies and agreements.

2.1.2 Blue carbon in the post-Paris agreement era

Firstly, the 2015 Paris Agreement strengthens the sustainable management and protection of significant carbon sinks and reservoirs of all greenhouse gases, including ecosystems such as oceans and forests³ (IPCC, 2015). Moreover, blue carbon has been incorporated into the fundamental implementation tool of the Paris Agreement—the Nationally Determined Contributions (NDCs) mechanism (Herr et al., 2019; Arkema et al., 2023). Over 60 countries have included blue carbon in their NDCs emission reduction actions (Macreadie et al., 2021).

Secondly, the IPCC's “Special Report on the Ocean and Cryosphere in a Changing Climate” (SROCC) points out that ocean carbon sinks play an important role in addressing climate change (IPCC, 2019). This has led the international community to further recognize the ocean as a critical factor in climate change, gradually bringing the “Ocean-Climate” agenda into the UNFCCC.

1 Art. 1.8 of UNFCCC.

2 Art. 4.1(d) of UNFCCC.

3 Art. 5.1 of Paris Agreement.

Thirdly, the Glasgow Climate Pact explicitly links climate change mitigation with the restoration of marine carbon sink ecosystems and stipulates that the Subsidiary Body for Scientific and Technological Advice (SBSTA) under the UNFCCC will hold regular Ocean-Climate Dialogues annually starting from June 2022 (IPCC, 2021). This marks the first formal inclusion of the ocean in all areas under the UNFCCC (Lennan and Morgera, 2022). The Sharm El-Sheikh Implementation Plan continues to emphasize the role of marine ecosystems as carbon sinks and incorporates them into mitigation efforts (IPCC, 2022b). The UAE Consensus has, for the first time, included ocean issues in the “Global Stocktake” of the Paris Agreement (IPCC, 2023). Additionally, the Glasgow Pact and the Sharm El-Sheikh Implementation Plan have resolved most of the “Rule” issues related to Internationally Transferred Mitigation Outcomes (ITMOs) under the market mechanisms of Article 6 of the Paris Agreement (Jessen and Hill, 2024), providing opportunities for blue carbon credits to be included in voluntary carbon markets (Orford, 2024b).

The elevation of blue carbon’s status in the United Nations climate governance is, to some extent, driven by the governance goals and models established by the Paris Agreement. Firstly, regarding governance goals, the Paris Agreement builds upon the 2°C long-term climate target set by the Convention and further proposes striving to limit the temperature increase to within 1.5°C above pre-industrial levels. This implies that, in addition to intensifying direct emission reductions, more support from carbon sink ecosystems is necessary. Consequently, blue carbon has become an internationally recognized important means of mitigating climate change (Taillardat et al., 2018; Christianson et al., 2022). Secondly, in terms of governance models, the establishment of the “bottom-up” climate governance approach in the Paris Agreement provides an institutional opportunity for Parties to explore and implement blue carbon-based climate change response actions (Herr et al., 2017; Crooks et al., 2018). Under this governance model, Parties have a high degree of autonomy in setting climate change action goals, choosing means, and selecting sectors to participate in climate actions. Therefore, blue carbon—being a solution with multiple effects such as mitigation and adaptation—naturally becomes the focus of attention for most coastal countries worldwide.

2.2 Blue carbon and international law of the sea

2.2.1 United nations convention on the law of the sea

As the “Constitution of the Oceans”, the United Nations Convention on the Law of the Sea (UNCLOS) provides a legal basis for the protection of maritime rights and interests, regulating the maintenance of maritime rights and interests by countries. Although the Convention does not explicitly define blue carbon and its ecosystems, it generally calls for the protection of the marine environment and marine biological resources. For example, it states that a general obligation of parties is to protect and preserve the marine environment⁴. It requires parties to take all necessary

measures, individually or jointly, in accordance with the Convention to prevent, reduce, and control pollution of the marine environment from any source⁵, providing institutional guarantees for the protection and development of blue carbon.

2.2.2 International conventions on the control and prevention of marine pollution

In terms of controlling and preventing marine pollution, preliminary regulations on greenhouse gas emissions and marine environmental governance are in place. Although the UNCLOS does not explicitly address climate change issues, the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention, or LC) and its 1996 Protocol (London Protocol, or LP) regulate ocean dumping. They permit the sequestration of carbon dioxide streams from carbon capture processes in sub-seabed geological formations, marking the first regulation of carbon dioxide storage beneath the seabed (Vivian and Savio, 2024). Additionally, the 2013 amendment to the LP, which is not yet in force, includes a new Annex 4 that uses a “positive list” approach to regulate marine geoengineering techniques such as ocean fertilization. This leaves room for future legal regulation of deep-sea marine carbon sinks (Hilmi et al., 2023b).

2.2.3 International conventions on marine biodiversity conservation

In 2022, the Convention on Biological Diversity adopted the Kunming-Montreal Global Biodiversity Framework (KM-GBF)⁶, which guides parties to “ensure that by 2030, at least 30% of areas of degraded terrestrial, inland water, coastal, and marine ecosystems are under effective restoration, enhancing biodiversity, ecosystem functions and services, ecological integrity, and connectivity” (Convention on Biological Diversity, 2022). This goal is an important foundation for the protection and restoration of BCEs (Bell-James et al., 2024; Fu et al., 2024). The framework also reaffirms the need to strengthen cooperation and coordinated action with existing multilateral environmental agreements, such as the UNFCCC.

Furthermore, the 2023 Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ Agreement) establishes a system of marine protected areas applicable to areas beyond national jurisdiction, including the high seas, and enhances the environmental impact assessment system for marine activities (Chang et al., 2024). These provisions will affect climate intervention activities beyond national jurisdiction and provide a legal basis for the inclusion of blue carbon projects in marine protected areas and for conducting environmental impact assessments.

4 Art. 192 of UNCLOS.

5 Art. 194(1) of UNCLOS.

6 While the KM-GBF is not an instrument of the international law of the sea per se, it plays a crucial role in the conservation of marine biodiversity and complements the objectives of the international law of the sea.

Overall, international law of the sea frameworks such as UNCLOS have paid less and later attention to climate change-related issues like blue carbon compared to the UNFCCC, which places greater emphasis on blue carbon and BCEs. This may be related to the early signing date of UNCLOS in 1982, as climate change was then an emerging issue (Elsler et al., 2022). Another important reason is the significant challenges in accounting for blue carbon, especially deep-sea blue carbon, which also restricts the development of blue carbon considerations in international law of the sea (Arkema et al., 2023; Liu et al., 2024).

3 Legal progress in blue carbon conservation

3.1 Legislation progress

3.1.1 Ocean legislation progress

The 2023 revision of the *Marine Environmental Protection Law* (MEPL2023) reflects increased emphasis and concern regarding the scope and intensity of protection for blue carbon and BCEs (Huang et al., 2024; Liu, 2024).

Firstly, the focus is on the quality and sustainability of BCEs such as mangroves, saltmarshes, and seagrasses. The MEPL 2023 newly designates “seaweed fields” and “seagrass beds” as “typical and representative marine ecosystems” and stipulates that administrative authorities have the obligation of “priority protection” for these ecosystems⁷. Additionally, MEPL 2023 provides that areas like “important marine ecosystems” are to be included in “national parks, nature reserves, or natural parks and other protected natural reserves”⁸. According to the provisions of the aforementioned Article 33, BCEs such as “mangroves and seagrass beds” should be classified as “important marine ecosystems”.

Secondly, by focusing on marine biodiversity, the protection of BCEs can be strengthened. The MEPL 2023 stipulates that “when marine and coastal zone resources are developed and utilized, important marine ecosystems, biological species, and biological genetic resources shall be effectively protected to maintain marine biodiversity”⁹. BCEs should be recognized as meeting the “important” criterion under this provision and receive effective protection during resource development. Furthermore, MEPL 2023 adds legal provisions for “measures such as placing artificial reefs and planting seaweed fields, seagrass beds, and corals”¹⁰, and explicitly stipulates that “ecological repair” should focus on “improving habitats and restoring biodiversity and basic ecosystem functions”, and that “ecological restoration” should be “based on natural restoration supplemented

with artificial repair”¹¹, thereby making explicit provisions for the repair and restoration of BCEs.

Thirdly, by strengthening the prevention and control of “land-based pollutants”, BCEs are protected. The MEPL 2023 stipulates that “In discharging thermal waste water into sea areas, effective measures shall be taken to ensure the conformity of the water temperature in any adjacent protected natural reserves or fishing area with the marine environment quality standards of the State and the avoidance of any damage to rare and endangered marine life and marine aquatic products by thermal pollution”¹². The inclusion of “protected natural reserves” in this provision is a new addition. As mentioned earlier, since BCEs can be incorporated into the category of “protected natural reserves”, this provision can be interpreted as establishing regulations for preventing thermal pollution in BCEs.

3.1.2 Carbon market legislation progress

Since China currently lacks specific laws and regulations on climate change, the rule of law related to climate change is mainly reflected in the legal system of carbon trading (Shi and He, 2023; Wu, 2023). Therefore, this article mainly focuses on the carbon trading system, exploring the legal aspects of blue carbon in the context of climate change. China’s carbon trading market comprises a mandatory Carbon Emission Allowance (CEA) trading market and a voluntary China Certified Emission Reduction (CCER) trading market. The former is limited to regulated emission enterprises, while the latter includes other societal entities beyond these enterprises and serves as an important supplement to the former (Dong et al., 2024; Li et al., 2024).

Firstly, the publication of the *Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (For Trial Implementation)* in 2023 signifies the relaunch of the CCER market. These new measures revise the scope of application to include “voluntary greenhouse gas reduction projects that are conducive to carbon reduction and carbon sequestration, can avoid or reduce greenhouse gas emissions, or achieve the removal of greenhouse gases.”¹³ This differs from the previous enumeration of CCER projects, which was limited to “renewable energy, forestry carbon sinks, methane reduction, energy saving and efficiency improvement, etc.,” thereby providing a basis for the inclusion of blue carbon sinks in CCER.

Secondly, the *Interim Regulation on the Administration of Carbon Emission Trading*, implemented in 2024 as China’s first carbon trading administrative regulation—elevated from the previous legislative level of departmental rules—provides a clear legal basis for the operation and management of the national carbon market. The regulation stipulates that “key greenhouse gas emission entities included in the national carbon emission trading market

7 Art. 33 of MEPL 2023.

8 Art. 34 of MEPL 2023.

9 Art. 36(2) of MEPL 2023.

10 Art. 37 of MEPL 2023.

11 Art. 42 of MEPL 2023.

12 Art. 54 of MEPL 2023.

13 Art. 9 of Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (For Trial Implementation).

14 Art. 7 of Interim Regulation on the Administration of Carbon Emission Trading.

and other entities that comply with the relevant rules of the state may participate in carbon emissions trading.”¹⁴ Although “comply with the relevant rules of the state” does not explicitly specify which regulations are included, it opens the possibility for carbon credit trading entities, such as blue carbon, to be included in the national carbon emission trading market. Additionally, the regulation allows key emission entities to “purchase certified greenhouse gas reduction volumes to offset their carbon emission allowances”¹⁵, providing a systemic foundation for linking the voluntary carbon market for blue carbon credits with the mandatory carbon market for carbon emission allowances.

3.2 Enforcement progress

3.2.1 Ocean enforcement progress

Firstly, MEPL 2023 consolidates government responsibilities. It stipulates that “the natural resource department of the State Council” is responsible for “the restoration of national marine ecology, coastlines, and islands”¹⁶ and “organizing the survey of marine resources.”¹⁷ Although this content does not explicitly mention blue carbon, as mentioned earlier, mangroves, saltmarshes, and seagrasses and other BCEs belong to “marine ecosystems”¹⁸. Therefore, the new law has mentioned to some extent the competent departments responsible for the restoration and repair of BCEs and the investigation of blue carbon. In addition, the provision that coastal county-level and higher local governments are responsible for the marine environmental protection duties within their jurisdictions¹⁹ also strengthens the legal responsibilities of local governments for blue carbon protection.

Secondly, MEPL 2023 strengthens the regulatory system regarding pollution from construction projects affecting the marine ecological environment. The new law no longer distinguishes between coastal engineering pollution and marine engineering pollution, using a unified standard to regulate construction project pollution, thus improving the efficiency of law enforcement and supervision by local government departments (Bai et al., 2024; Huang et al., 2024). BCEs involve both coastal and marine areas (Oostdijk et al., 2022; Hilmi et al., 2023b), and the above revisions can effectively regulate the loss of BCEs caused by engineering projects such as tidal flat reclamation and land use.

Thirdly, MEPL 2023 increases administrative penalties for actions that damage “protected natural reserves.” As mentioned earlier, according to the provisions of the MEPL 2023, BCEs should

fall within the scope of “protected natural reserves”²⁰. For those “causing damage to protected natural reserves,” the new law stipulates that a fine of “between 1,000 and 10,000 yuan per square meter of the damaged area” shall be imposed²¹, thereby increasing the penalty and enhancing the deterrent effect of law enforcement.

3.2.2 Carbon market enforcement progress

Firstly, the *Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (Trial Implementation)* provides important executive rules for incorporating blue carbon into the voluntary emission reduction market. (1) In the general provisions section, the principle of registration is integrated throughout the entire process of voluntary emission reduction project validation, carbon credit verification, and trading in the voluntary emission reduction market. Through “registration and public disclosure,” a clear basis is provided for the establishment and alteration of blue carbon credits. (2) The measures clarify the connection between the validation of voluntary emission reduction projects and the procedures for carbon credit verification, registration, and public disclosure. By publicly disclosing the compliance, completeness, and the uniqueness of the project owner to the project, they ensure the eligibility of blue carbon credit transactions after acquisition, preventing procedural defects from leading to liability for breach of contract. (3) The measures ensure effective information disclosure and coordination among project registration and trading institutions in the voluntary emission reduction market and allowance trading institutions in the national carbon market, ensuring real-time sharing of ownership changes of carbon credits in the registration systems of both types of carbon markets. For example, in the adjudication of disputes over blue carbon credit transactions, judicial authorities can apply and refer to the procedural rules such as registration and public disclosure outlined in these measures (departmental regulations), using them as the basis for resolving disputes concerning the change of ownership of blue carbon credits, the determination of the eligibility of trading entities, and the allocation of liability for breach of contract.

Secondly, the *Interim Regulation on the Administration of Carbon Emission Trading* strengthens law enforcement supervision and intensifies the prevention and severe punishment of data falsification related to carbon trading²². This also serves as a deterrent and preventive measure against possible fraudulent behaviors, such as data falsification, in the blue carbon trading process.

Thirdly, in 2023, the Ministry of Ecology and Environment (MEE) issued the first batch of four CCER project methodologies, including the methodology for mangrove restoration projects (CCER-14-002-V01). Since only the net increase in carbon

15 Art. 14 of Interim Regulation on the Administration of Carbon Emission Trading.

16 Art. 4 of MEPL 2023.

17 Art. 23 of MEPL 2023.

18 Art. 33 of MEPL 2023.

19 Art. 5,13,14, 18 of MEPL 2023.

20 Art. 33 and 34 of MEPL 2023.

21 Art. 96 of MEPL 2023.

22 Art. 22(2) of Interim Regulation on the Administration of Carbon Emission Trading.

emission reductions generated by projects implemented using approved methods can be traded (Li et al., 2024), the *Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (Trial Implementation)* clearly stipulates that CCER projects applying for registration and their emission reductions should respectively “belong to the fields supported by the project methodologies issued by the MEE”²³ and “comply with the project methodologies issued by the MEE”²⁴. The project methodology serves as the basis for the validation and implementation of CCER projects and for the accounting and verification of project emission reductions, encompassing accounting methods, monitoring methods, and requirements for project validation and emission reduction verification. The release of the mangrove restoration project methodology provides an important basis for the protection and restoration of BCEs and sufficiently demonstrates that blue carbon occupies a significant position in the relaunched CCER market.

3.3 Judicial progress

Judicial practices related to blue carbon can be divided into two types: one involves ecological damage compensation litigation for the destruction of the carbon sequestration and sink enhancement functions of BCEs; the other involves judicial practices where “purchasing blue carbon credits” is used as a means of assuming responsibility in environmental public interest litigation.

3.3.1 Judicial exploration of compensation for the loss of BCEs

MEPL 2023 stipulates the qualifications and order of priority for plaintiffs to bring claims in marine ecological environment damage compensation litigation²⁵, providing a legal basis for further clarifying damage compensation litigation for BCEs (Hu et al., 2024). In fact, even before MEPL 2023 came into effect, environmental public interest litigation cases concerning damage compensation for BCEs had already appeared in China’s judicial practice (See Case 10 from Table 1).

For example, in June 2023, the People’s Procuratorate of Ganyu District, Lianyungang City, prosecuted Chen for the crime of illegal fishing and simultaneously filed a collateral civil public interest litigation. They requested the court to order Chen to bear the cost of restoring marine fishery resources and to compensate for the partial loss of the service function of marine carbon sequestration value by purchasing blue carbon credits. The court held that “the fishing behavior not only caused the loss of marine fishery resources but also damaged the marine ecological environment, resulting in the loss of service functions such as the carbon sequestration cycle of

the marine ecosystem.” The final judgment was that “Chen should bear the cost of restoring marine fishery resources amounting to 310,000 yuan and compensate for the partial loss of the service function of marine carbon sequestration value of 2,808.82 yuan, which was to be used to purchase blue carbon credits” (Wei, 2023).

Another example is the administrative public interest litigation case titled “*Supervision and Protection of the Xianghai Wetland by the Tongyu County People’s Procuratorate of Jilin Province*,” which was released by the Supreme People’s Procuratorate in 2023 as one of the “*Typical Cases of Procuratorial Organs Serving and Ensuring Carbon Peak and Carbon Neutrality*.” In response to the illegal destruction of wetland ecological resources, which led to a decline in the wetlands’ carbon sequestration function and carbon sink potential, the Tongyu County People’s Procuratorate issued the pre-litigation procuratorial recommendation for administrative public interest litigation²⁶. Upon receiving the procuratorial recommendation, the administrative agency responsible for wetland protection conducted on-site investigations. They imposed administrative fines on the violators involved in the case and, based on expert opinions, urged the violators to sow grass seeds over the 7.04 hectares of wetlands involved, thereby completing artificial restoration. Finally, the procuratorate and the administrative agency jointly inspected and approved the effectiveness of the restoration. This case demonstrates the important role of prosecutorial administrative public interest litigation in protecting and promoting the ecological service functions of wetlands, specifically carbon sequestration (The Supreme People’s Procuratorate of the People’s Republic of China, 2023c).

Both of the above cases are environmental public interest litigations filed in response to the destruction and loss of the carbon sequestration capacity of BCEs. These litigations aim to protect not only the marine ecological environment but also ocean carbon sequestration functions.

3.3.2 Judicial exploration of “purchasing blue carbon credits”

“Purchasing blue carbon credits” is a means of assuming responsibility in environmental civil public interest litigation and also serves as an alternative ecological restoration method that implements the concept of restorative justice and follows natural laws. This judicial exploration, which began in coastal cities in China, is currently the primary form of blue carbon judicial practice in the country. The Supreme People’s Court and the Supreme People’s Procuratorate have affirmed the practice of “purchasing carbon sinks” in civil disputes and public interest litigation through judicial interpretations and official documents^{27,28}. In June 2022, the

23 Art. 11(1) of Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (For Trial Implementation).

24 Art. 17(1) of Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (For Trial Implementation).

25 Art. 114 of MEPL 2023.

26 The pre-litigation procuratorial recommendation for administrative public interest litigation is a legal document issued by procuratorial organs to relevant administrative agencies before initiating administrative public interest litigation. Its purpose is to urge these agencies to perform their duties in accordance with the law, correct illegal acts or administrative omissions, and thus protect national interests and social public interests. If the administrative agency fails to accept the procuratorial recommendation, the procuratorial organ may file an administrative public interest lawsuit with the court.

TABLE 1 Major Judicial Cases on “Purchasing Blue Carbon Credits” in China.

No.	Case Type	Cause of Action	Decision Date	Court/Authority	Litigation/Negotiation Request	Responsibility Bearing Method	Judgment/Execution	Source/Case Numbers
1	Public Interest Civil Litigation Collateral to a Criminal Proceeding	Illegal Fishing Crime	2024-07	The People’s Court of Xiangshan County, Zhejiang Province	Pay for ecological function and fishery resource restoration costs USD 6,830	Purchasing blue carbon credits + stock enhancement	Unknown	Criminal Case No. 289 [2024] of Zhejiang Xiangshan Court of First Instance
2			2024-07	The People’s Court of Haidian District, Beijing	Pay for ecological restoration costs of USD 162,693 caused by the infringement	Voluntarily purchasing blue carbon credits as an alternative repair responsibility	Unknown	Criminal Case No. 1 [2024] of Beijing Yanqing Court of First Instance
3			2024-04	The People’s Court of Xiangshan County, Zhejiang Province	Pay for ecological function and fishery resource restoration costs USD 7,868	Purchasing blue carbon credits + stock enhancement	Unknown	Criminal Case No. 125 [2024] of Zhejiang Xiangshan Court of First Instance
4			2023-01	The People’s Court of Rongcheng City, Shandong Province	The defendant restores marine fishery resources through stock enhancement and seaweed farming	Planting eelgrass	The defendant has signed an eelgrass planting commission agreement with a group in Rongcheng (eelgrass planting pilot unit) and has started planting eelgrass	(The Supreme People’s Procuratorate of the People’s Republic of China, 2023b)
5			2023-06	The People’s Court of Guannan County, Jiangsu Province	Compensate for the loss of marine fishery resources and carbon sinks	Purchasing blue carbon credits as an alternative restoration responsibility	The funds will be used for beach garbage cleaning and marine biodiversity protection	(The People’s Government of Guannan County, 2023)
6	Criminal Proceeding	Endangering Endangered Wildlife	2023-09	The People’s Court of Saihan District, Hohhot City, Inner Mongolia Autonomous Region	Pay for environmental damage compensation USD 6,311	Purchasing seawater aquaculture carbon credits through the Xiamen Marine Carbon Sink Trading Platform and obtain a marine carbon sinks verification certificate	Unknown	(The Supreme People’s Procuratorate of the People’s Republic of China, 2023a)
7		Illegal Acquisition, Transportation, and Sale of Endangered Wildlife Products	2024-04	The People’s Court of Hui’an County, Fujian Province	Bear criminal responsibility	Voluntarily purchase to 1,000 tons of ocean carbon sinks and have offset, as an alternative repair for the destruction of the marine ecological environment	Proof of remorse, should be treated leniently	Criminal Case No. 831 [2023] of Fujian Anxi Court of First Instance

(Continued)

TABLE 1 Continued

No.	Case Type	Cause of Action	Decision Date	Court/Authority	Litigation/Negotiation Request	Responsibility Bearing Method	Judgment/Execution	Source/Case Numbers
8	administrative enforcement	Illegal Electric Fishing	2022-07	Fuzhou Marine and Fisheries Law Enforcement Brigade	Negotiate specific ecological environment damage compensation methods	Fisheries enforcement+ purchasing blue carbon credits	Completed	(Fuzhou Municipal Bureau of Ocean and Fisheries, 2024)
9	Environmental Civil Public Interest Litigation	Illegal Fishing with Prohibited Fishing Gear During the Closed Season	2024-03	The People's Court of Ningbo City, Zhejiang Province	Pay aquatic biological resources damage compensation USD 884	Purchasing marine fishery carbon sinks for the restoration of the damaged ecological environment	Unknown	(Ningbo Maritime Court of P.R.C., 2024)
10		Illegal Seabed Mining	2022-06	The Maritime Court in Xiamen	Pay ecological restoration costs exceeding USD 95,372	Purchasing blue carbon credits	To be fulfilled over 3 years, the defendant has purchased the first installment of 2,400t blue carbon sinks as agreed	(Fujian Court Website, 2022)

Supreme People’s Court issued a judicial interpretation permitting the “purchase of forestry carbon sinks”²⁹. In August 2023, the Supreme People’s Procuratorate released a document stipulating that “in situations where ecological functions cannot be restored or are difficult to restore in the short term, ecological functions can be restored in public interest litigation through the form of purchasing carbon sinks.”³⁰

The author has searched for trial cases related to “purchasing blue carbon credits” through China Judgments Online and the official websites of local courts. As shown in Table 1, cases involving the “purchasing of blue carbon credits” are primarily civil public interest litigation collateral to criminal proceedings, environmental civil public interest litigation, and marine ecological damage compensation lawsuits. In these cases, the defendant is required to fulfill one of the alternative restoration responsibilities after damaging the marine ecological environment and the carbon sequestration function of BCEs. A few cases are criminal proceedings where the defendant voluntarily purchases blue carbon credits to express remorse and seek leniency (See Case 7 from Table 1).

4 Existing issues in blue carbon conservation

China has made numerous efforts in the protection and management of blue carbon, providing a “Chinese solution” for global ocean governance and climate change mitigation. However, as an integrated and relatively new field of research that encompasses climate change and ocean governance, influenced by various aspects such as law, politics, economy, technology, and society (Hu et al., 2024), there are still many shortcomings in the legislation, law enforcement, and judiciary aspects of China’s blue carbon protection.

4.1 Legislation issues

4.1.1 Ocean legislation issues

Firstly, the legal concept of blue carbon has not been clearly defined. The absence of explicit provisions of “blue carbon” and

27 Article 21 of Interpretation by the Supreme People’s Court of Several Issues Concerning the Application of Law to the Trial of Cases of Civil Disputes over Forest Resources.

28 Article 2(2) of Opinions on the Establishment and Improvement of a Collaborative Mechanism between Forestry and Grassland Administrative Law Enforcement and Procuratorial Public Interest Litigation.

29 Art. 21 of the Interpretation by the Supreme People’s Court of Several Issues Concerning the Application of Law to the Trial of Cases of Civil Disputes over Forest Resources.

30 Art. 2(2) of the Opinions on the Establishment and Improvement of a Collaborative Mechanism between Forestry and Grassland Administrative Law Enforcement and Procuratorial Public Interest Litigation.

BCEs in MEPL 2023 may lead to the following issues: (1) It is not possible to clearly define the scope of protection for BCEs. For instance, it is unclear whether the protection extends to deep-sea carbon sinks and fisheries carbon sinks in addition to coastal blue carbon. The uncertainty of the scope also affects the accuracy of marine carbon sink monitoring, statistics, and accounting data. (2) It is challenging to determine the locations and boundaries of blue carbon marine protected areas, national parks, and other blue carbon protected natural reserves. Since the primary conservation objective of blue carbon marine protected areas is carbon storage, the indeterminacy of the blue carbon concept affects the concrete implementation of this system. (3) It is insufficient to reflect the emphasis and attention of marine law on climate change solutions. The absence of “blue carbon” in marine law makes it difficult to ensure that marine law takes climate change issues into account during its implementation.

Secondly, the property rights and legal attributes of blue carbon are not clearly defined. Coastal BCEs are mostly distributed along the coastlines and are governed by national laws; deep-sea carbon sinks and fisheries carbon sinks are mainly concentrated in the open ocean and deep sea, governed by international public law (Hilmi et al., 2023b). MEPL 2023 does not provide a clear definition of the coastal zone, leading to legal disputes over whether the coastal zone is state-owned or collectively owned. The unclear legal attributes of blue carbon lead to the following issues: (1) In the context of property rights conflicts or unclear definitions, the value of a significant portion of blue carbon resources will be severely underestimated, leading to the destruction of BCEs and the loss of carbon sink functions, and consequently, the tragedy of the commons (Stewart-Sinclair et al., 2024); (2) The lack of clear property rights definition hinders the implementation of blue carbon project incentive plans. For example, the unclear legal attributes of blue carbon credits may severely affect the division of responsibilities among regulatory agencies and also affect the operation of the blue carbon trading market mechanism, making it difficult to ensure the rights of all parties involved in the transaction. (3) Unclear legal attributes of blue carbon are also an important source of legal conflicts and disputes in judicial practice, and they also affect the legality of the responsibility-bearing methods for “purchasing blue carbon credits”.

4.1.2 Carbon market legislation issues

Firstly, the inclusion of blue carbon in the carbon market lacks a clear legal basis. (1) China lacks specific climate change legislation, making it difficult to provide a higher-level legal basis for the carbon trading market. The *Interim Regulation on the Administration of Carbon Emission Trading*, which came into effect in 2024 (an administrative regulation), and the *Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (For Trial Implementation)*, announced in 2023 (departmental rules), have provided a certain institutional space for the inclusion of blue carbon in the carbon market, but neither explicitly mentions blue carbon. This will lead to certain disputes over blue carbon in specific market transactions and judicial practices (Stewart-Sinclair et al., 2024); (2) The inclusion of blue

carbon in the China Certified Emission Reduction (CCER) lacks a legal basis. According to the Law of the People’s Republic of China on the Administration of Sea Areas (2002), the use of sea areas is premised on compliance with the marine functional zoning and the acquisition of sea area usage rights by the user³¹. Therefore, obtaining sea area usage rights within the project boundary is the legal basis for social forces to develop coastal blue carbon CCER projects (Li and Miao, 2022). However, since blue carbon projects have not been included in the national marine functional zoning, project owners cannot enjoy exclusive rights to blue carbon resources within the project boundary, which in turn affects the protection of rights for both parties involved in blue carbon transactions.

Secondly, there are obstacles to blue carbon data and its monitoring and accounting. The core issue of blue carbon trading is statistics and accounting (Christianson et al., 2022; Bennett et al., 2024). In 2022, the Ministry of Natural Resources issued the *Marine Carbon Sink Accounting Method (HY/T 0349-2022)*, which systematically clarified the technical, methodological, content, and procedural aspects of China’s marine carbon sink accounting, filling the gap in industry standards in this field and providing methodological support for the quantification of China’s marine carbon sink resources. However, this accounting method does not include fisheries carbon sinks, leading to a lack of methodological basis for the inclusion of fisheries carbon sinks in CCER. At the same time, due to the lack of a clear administrative agency responsible for the installation and management of the near-sea data collection system (Chang et al., 2022), China has not yet fully grasped the basic data on the quantity, quality, distribution, ownership, protection, and development and utilization status of blue carbon resources, which affects the development of the blue carbon market.

4.2 Enforcement issues

4.2.1 Ocean enforcement issues

Firstly, MEPL 2023 has not clearly specified the competent authorities and their jurisdictions for monitoring blue carbon storage and carbon flux. Although the conservation and restoration of BCEs, as well as the investigation of blue carbon resources, may fall under the responsibility of the natural resources department³², marine-based blue carbon supervision involves multiple aspects, including quantifying the current total and net carbon storage of BCEs, establishing a database of blue carbon storage and flux, valuing the carbon sequestration services of damaged BCEs and including them into the ecological damage assessment system, and regularly reporting data related to BCEs. The aforementioned blue carbon supervision also urgently needs legislative clarification. In addition, there is a lack of consistency in

³¹ Art. 17 of the Law of the People’s Republic of China on the Administration of Sea Areas.

³² Art. 4 and 23 of MEPL 2023.

blue carbon supervision, for example, fisheries carbon sinks and coastal carbon sinks belong to different regulatory departments, and the lack of coordination between departments can lead to overlapping and contradictory rules and responsibilities, thereby affecting the overall realization of the service functions of blue carbon ecosystem services (Bell-James, 2023b).

Secondly, clear restoration measures for the carbon sequestration function of BCEs are urgently needed. Although MEPL 2023 stipulates “ecological restoration” for “damaged” marine ecosystems and “primarily natural restoration, supplemented by artificial restoration”³³, it does not clearly define the degree and standards of “damage”, nor does it specify the applicable conditions and specific measures for “ecological repair” and “ecological restoration”. For example, in addition to the direct restoration measures such as “planting seaweed fields, seagrass beds, and corals” stipulated by the law³⁴, does “ecological restoration” include alternative restoration measures such as “purchasing blue carbon credits”? In addition, when taking “ecological restoration” measures, are “carbon storage potential” and biodiversity functions considered? Because only when biodiversity and ecosystem functions and services are strengthened will ecological restoration work be effective (Bell-James et al., 2024).

Finally, the administrative penalties for damaging BCEs need to be further clarified. MEPL 2023 has increased the penalties for illegal acts that damage “protected natural reserves”. Although according to the “textual interpretation” method (Chong, 2024), damaging BCEs can be subject to administrative penalties as acts of damaging protected natural reserves, according to the “the legality principle”, administrative authorities need clearer legal provisions as the basis for administrative penalties (Cai, 1996). In addition, although China’s local provincial and municipal fisheries law enforcement agencies have already explored the fisheries law enforcement model of “purchasing blue carbon credits” as an alternative to “administrative fines” (Fuzhou Ecological Environment Bureau, 2022), the legal basis, applicable conditions and scope of “purchasing blue carbon credits” still need to be further clarified.

4.2.2 Carbon market enforcement issues

First, the regulatory authority for blue carbon trading is unclear. According to the *Interim Regulation on the Administration of Carbon Emission Trading*³⁵ and the *Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (For Trial Implementation)*³⁶, the regulatory department for carbon trading is the Ministry of Ecology and Environment. However, according to MEPL 2023, the competent department responsible for marine

ecological restoration and resource survey is the Ministry of Natural Resources³⁷. That is, if blue carbon can be included in the carbon market, the department responsible for monitoring, reporting and verifying data of blue carbon is the Ministry of Natural Resources, and such data is the basis for blue carbon to engage in carbon trading. However, whether the regulatory department for blue carbon trading is the Ministry of Natural Resources or the Ministry of Ecology and Environment, there is currently a certain regulatory loophole that urgently needs to be further clarified.

Second, the enforcement and supervision of blue carbon trading urgently need to be strengthened. Although the *Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (Trial Implementation)* provide important rules for incorporating blue carbon into the voluntary emission reduction market, many issues remain in practice. For example, in the practice of marine carbon sink trading in areas such as Fujian, China, the “registration and public disclosure” process of some trading projects is missing (Dong et al., 2024). This may lead to unclear project boundaries, insufficient additionality demonstration, incorrect baseline scenario settings, and low feasibility of monitoring and reporting (Li and Miao, 2022), resulting in the failure to meet net carbon sink standards. This could undermine the core principles of blue carbon trading and potentially lead to “greenwashing” in blue carbon transactions. The root cause of these issues may lie in the fact that blue carbon trading is still in the exploratory stage, with underdeveloped market regulation and penalty mechanisms.

Finally, the mechanism for public participation in blue carbon trading is insufficient. Public involvement in environmental enforcement can reduce the costs for administrative departments in monitoring violations and their impacts, and alleviate some of the burden of prosecuting violators (Siedenfeld and Nugent, 2004). Additionally, social supervision, through its diversity of participants and methods, can partially compensate for the limitations of government regulation in terms of tools and effectiveness (Cao and Chang, 2023). However, due to inadequacies in data access, information disclosure, and public education, the ways in which the public can participate in the oversight of blue carbon trading remain unclear, with pathways obstructed.

4.3 Judicial issues

4.3.1 Insufficiency of compensation for the loss of BCEs

Firstly, the accounting and quantification of blue carbon function losses lack a unified standard. Although there are existing environmental public interest litigation cases related to the loss of blue carbon sequestration functions, local courts do not have clear guidelines or a unified consensus on how to calculate the value of carbon sequestration losses. The lack of standardized and normalized accounting methods results in a mismatch between the amount of “purchasing blue carbon credits” by parties and the actual degree of ecological damage they have caused. The *Marine Carbon Sink Accounting Method* provides some basis for the valuation of carbon sinks, but this method does not include fisheries carbon sinks. In judicial cases where the carbon

33 Art. 42 of MEPL 2023.

34 Art. 37 of MEPL 2023.

35 Art. 4 of Interim Regulation on the Administration of Carbon Emission Trading.

36 Art. 5 of Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading (For Trial Implementation).

37 Art. 4 and 23 of MEPL 2023.

sequestration function of fisheries carbon sinks has been damaged due to “illegal fishing of aquatic products,” the determination of facts and remedies for compensation often rely almost entirely on scientific assessment reports, with no clear legal norms or standards. Although scientific assessment reports provide expert insights into the extent of damage, causation, and potential remedies, they cannot serve as the sole basis for legal judgments because they do not establish legal norms or standards. Due to the lack of clear legal definitions and accounting standards for “fisheries carbon sinks”, different courts may interpret scientific appraisal reports differently, leading to potentially different judgments in similar cases. Meanwhile, law enforcement agencies and judicial authorities face significant challenges in holding violators legally accountable due to the absence of adequate legal framework.

Secondly, the subject responsible for litigation regarding compensation for the loss of blue carbon sequestration function remains unclear. The MEPL 2023 stipulates that the entity responsible for claiming compensation for marine ecological damage is the department exercising marine environmental supervision and management authority³⁸. Under the traditional legal framework, this “government department” typically referred to the State Oceanic Administration. However, since the issuance of the *Plan for Deepening Party and State Institutional Reform* by the Central Committee of the Communist Party of China in 2018, the State Oceanic Administration was abolished, and its responsibilities for marine environmental regulation were divided between the newly established Ministry of Ecology and Environment (MEE) and the Ministry of Natural Resources (MNR). At the central level, the specific department responsible for the marine ecological damage compensation function previously held by the State Oceanic Administration has not been clearly defined, resulting in unclear government claims authority and a stalemate where various departments act independently.

Finally, the legal standing of public interest organizations in litigation is lacking. Existing legislation and judicial interpretations have yet to explicitly mention that environmental organizations can serve as qualified plaintiffs in marine environmental civil public interest litigation. Furthermore, there is no clear provision regarding the order of priority and coordination mechanisms between various potential claimants, such as government departments, procuratorial organs, and environmental organizations. This regulatory “gap” inevitably creates confusion in judicial practice, urgently requiring further refinement and clarification through future legal developments.

4.3.2 Unclear conditions for the application of “purchasing blue carbon credits”

Firstly, the types of cases where “purchasing blue carbon credits” can be applied are unclear. While there are existing judicial interpretations and official documents that stipulate the application of “purchasing blue carbon credits” in civil disputes and environmental public interest litigation³⁹, there are no laws, regulations, or policies that clearly define its application in

criminal proceedings and administrative enforcement cases. In accordance with the principles of “legality of crime and punishment” and “rule of law in administration,” the application of “purchasing blue carbon credits” in criminal and administrative cases urgently requires judicial interpretation to provide clarity. Otherwise, the misuse of “purchasing blue carbon credits” could undermine the punitive nature of criminal sanctions and potentially reduce “purchasing blue carbon credits” to a “free pass” for those who damage the marine environment (Xia, 2024).

Secondly, there is a lack of a well-established blue carbon trading mechanism. The key issue lies in whether the standards for purchasing blue carbon credits and the associated fees can achieve effective alternative restoration. Due to the current absence of a widely accepted, scientifically sound, and universally applicable basis for blue carbon accounting, the number of carbon credits “purchased” by parties often does not correspond to the extent of the damage they have caused to the marine ecological environment. For example, in judicial practice, alternative restoration is mostly carried out through “voluntary purchases,” which significantly limits the standardized and objective application of “purchasing blue carbon credits” in cases of marine ecological damage.

Finally, there is a lack of follow-up supervision during the enforcement phase of judicial decisions. To ensure that funds from “purchasing blue carbon credits” are effectively utilized for marine ecological restoration and blue carbon sequestration, courts should exercise “judicial activism” (Kmieć, 2004) to monitor the implementation of blue carbon transactions, thereby ensuring that these funds genuinely contribute to marine ecological restoration. In current blue carbon judicial practice, cases are concluded once the parties have purchased blue carbon credits. Publicly available information from several courts shows that after the case is closed, it is recorded as “transaction completed and carbon credits written off.” However, there is no way to determine whether the parties have subsequently achieved effective alternative restoration after purchasing the blue carbon credits. In other words, current judicial innovations in blue carbon focus more on the formality of “purchasing blue carbon credits,” while the full process of how this approach achieves alternative restoration has yet to be thoroughly explored.

5 Suggestions for improving blue carbon conservation

5.1 Legislation suggestions

5.1.1 Marine legislation

Firstly, the concept of blue carbon should be clearly defined in the *Marine Environment Protection Law* (MEPL). Consider

³⁹ Art. 21 of Interpretation by the Supreme People’s Court of Several Issues Concerning the Application of Law to the Trial of Cases of Civil Disputes over Forest Resources. Article 2(2) of Opinions on the Establishment and Improvement of a Collaborative Mechanism between Forestry and Grassland Administrative Law Enforcement and Procuratorial Public Interest Litigation.

³⁸ Art. 114(2) of MEPL 2023.

embedding the dual-carbon goals into the legislative objectives of this law. As the legislative purpose clause reflects the core values and goals of a law, it signifies the social objectives the law seeks to achieve. It is recommended to amend the first article of the legislative purpose by adding a provision to “enhance marine carbon sink capacity to address climate change.” In Article 33, under “Marine Ecological Protection,” a provision should be added to “enhance the carbon sequestration and storage capacity of blue carbon sinks.” Additionally, this provision should clearly define the concept of blue carbon sinks.

We recommend defining blue carbon as the carbon storage and carbon flux within all marine ecosystems that can be measured, verified, and reported. On the one hand, this definition encompasses coastal blue carbon ecosystems such as mangroves, seagrass meadows, and salt marshes. This inclusion is justified because numerous methodologies for coastal blue carbon have been published (Macreadie et al., 2021; James et al., 2024; Liu et al., 2024), and the legal policies on blue carbon from major international organizations and some countries like Australia and Indonesia predominantly adopt the coastal blue carbon definition (IPCC, 2022a; Bell-James et al., 2023; Prihatiningtyas et al., 2024). On the other hand, this definition also leaves room for the future inclusion of fisheries carbon sinks and ocean carbon sinks under “blue carbon”, because these types have greater carbon sequestration potential, and relevant monitoring and verification methodologies are currently being researched (Gruber et al., 2023; Jia et al., 2023).

Secondly, the legal rights of blue carbon project owners should be protected. Clearly defined and legally recognized land tenure is crucial for the successful restoration of BCEs (Fu et al., 2024; Stewart-Sinclair et al., 2024). If blue carbon projects are to obtain rights to use marine areas, it is necessary to ensure their location within marine protected areas⁴⁰. Additionally, in light of the significant benefits of marine protected areas in enhancing carbon sequestration and mitigating climate change, many scholars have suggested incorporating blue carbon into marine protected areas and clearly defining protection objectives, boundaries, and management practices (Howard et al., 2017; Macreadie et al., 2021; Fu et al., 2024). Therefore, this paper recommends that MEPL explicitly define BCEs as “important marine ecosystems,” thereby integrating them into the system of marine protected areas and other protected natural reserves⁴¹. Moreover, before restoration or protection projects commence, conflicts over unclear boundaries and legal rights should be resolved through transparent contractual arrangements (Bell-James et al., 2023).

5.1.2 Climate change legislation

Firstly, climate change legislation should be enacted to ensure the legality of blue carbon trading and clarify the carbon sequestration and storage functions of BCEs (Zou and Zhang, 2024). For instance, Fiji’s Climate Change Act of 2021 and Chile’s Framework Law on

Climate Change both recognize the functions of blue carbon sinks (Keuschnigg and Higham, 2023). In addition, the legal nature of blue carbon credits needs to be clearly defined. Since blue carbon credits in market transactions must comply with the CCER requirements for project methodology, project boundaries, and additionality (Li and Miao, 2022), blue carbon credits can be defined as units that are tradable after being verified, representing a certain amount of carbon dioxide absorbed and stored from the atmosphere through the protection and restoration of BCEs by project owners. The project owners possess the rights of ownership, use, benefit, and disposal of these credits. Currently, there is debate surrounding the legal nature of blue carbon credits, including the “public right theory,” “private right theory,” and “dual-stage theory” (Hu et al., 2024). To ensure the smooth exercise of rights such as trading, guaranteeing, and pledging blue carbon credits, it is advisable to define them as “quasi-property rights” under private rights, as they differ from general property rights but can undergo property rights changes through “registration and public disclosure.”

Secondly, the MRV system for blue carbon data should be improved. China should increase investment in fundamental research and technological innovation in blue carbon science, engage in international cooperation (Chang, 2022), and jointly conduct marine scientific research on blue carbon to enhance the global recognition of China’s marine carbon sink theory and the practical operability of its monitoring and accounting methods. At the same time, leveraging modern technologies, a comprehensive marine carbon sink monitoring system should be established, utilizing remote sensing monitoring, fixed station detection, mobile monitoring, digital twins, and blockchain technologies (Dam et al., 2024; Zhao et al., 2022a). This system should be supported by digital mapping to build a BCEs database (Endris et al., 2024), as well as blue carbon stock and flux databases, enabling policymakers to conduct dynamic monitoring and assessment of BCEs across the country. Additionally, the timelines, content, and responsibility allocation for blue carbon data reporting and verification should be clearly defined. The potential of the blue carbon credit market should also be explored, and a theoretical framework and implementation plan should be developed to incorporate blue carbon into the national greenhouse gas inventory and China’s Nationally Determined Contributions (NDCs) (Arkema et al., 2023).

5.2 Enforcement suggestions

5.2.1 Marine enforcement

Firstly, enhance the regulatory authority and mechanisms for BCEs. Given the importance of blue carbon monitoring and data for effective regulation (Mengis et al., 2023), it is essential to designate a competent authority responsible for monitoring blue carbon storage and flux, and to clearly define its regulatory authority. Moreover, according to existing laws, departments such as the ecological environment department, the natural resources department, and the maritime police department hold partial enforcement and regulatory authority over blue carbon within their statutory powers. Therefore, an enforcement coordination

40 Art. 17 of Law of the People’s Republic of China on the Administration of Sea Areas.

41 Art. 34 of MEPL 2023.

mechanism between different departments should be established to create an efficient model for BCEs protection and pollution control. At the same time, public participation in the supervision of blue carbon protection and pollution prevention should be enhanced. Public participation is an important approach to marine environmental governance, and mechanisms for information disclosure, reporting, and public oversight of blue carbon protection enforcement should be improved.

Secondly, the principles and methods for ecological restoration measures should be clearly defined. Ecological restoration must focus on the integrity and connectivity of ecosystems (Bell-James et al., 2024). Conversely, restoring ecosystems in isolation can result in “the improvement of one ecosystem service at the expense of reducing another” (Yang et al., 2018). For instance, a decision to reintroduce tidal flows to drained wetlands may lead to the loss of freshwater bird habitats (Bell-James and Lovelock, 2019). Therefore, restoration measures must ensure that actions taken go beyond isolated attention to individual ecosystem services and instead adopt a holistic ecological approach, systematically planning restoration activities.

Finally, the conditions under which “purchasing blue carbon credits” may be applied in administrative penalties should be clarified. Since “the types of administrative penalties cannot be arbitrarily created,”⁴² “purchasing blue carbon credits” cannot be directly used as a form of administrative penalty. It is suggested to explore alternative pathways for its application. Specifically, based on the damage caused by the violator to the BCEs, a fine should first be imposed according to clear accounting standards. Then, through administrative negotiations, the violator can be encouraged to voluntarily purchase blue carbon credits. This “voluntary” purchase, which indirectly restores the ecosystem, aligns with the principle that “the party has actively eliminated or mitigated the harmful consequences of the illegal act⁴³,” allowing for the legal reduction or mitigation of administrative penalties. This method not only differs from the traditional “fine-only” enforcement approach but also indirectly protects BCEs, while providing educational and incentivizing benefits to the violator.

5.2.2 Carbon market enforcement

Firstly, the regulatory mechanism for blue carbon trading should be clearly defined. The government can establish a department specifically responsible for regulating the blue carbon market, or authorize a specialized third-party agency to carry out related oversight tasks. Climate change-related legislation should systematically establish the regulatory framework for the blue carbon trading market, with the climate change regulatory authority formulating substantive and procedural implementation rules for the market’s regulatory system. Furthermore, the scope of regulation should be clarified, including the registration and disclosure of

project details such as additionality, permanence, project crediting periods, and environmental impacts. Additionally, measures should be established for the verification of emissions reductions, information disclosure related to trading, on-site inspections, market access, and MRV oversight to ensure the authenticity and legality of blue carbon trading, thus preventing “greenwashing”.

Secondly, a multi-stakeholder governance system should be established for supervision. The government, as the main regulatory body for blue carbon trading, should supervise and manage the operation of blue carbon projects and the trading of verified emissions reductions. Third-party verification agencies can enhance the scientific rigor of the regulatory activities for blue carbon projects, while government regulatory bodies and the private sector can collaborate through specific arrangements. Additionally, the supervisory role of market entities and social organizations should be emphasized (Fink and Ratter, 2024). For instance, during project design, public opinions should be fully considered through information disclosure and public hearing procedures, with timely feedback provided on public input. Furthermore, an expert pool system should be established, where expert opinions are issued on project validation and emissions reduction assessments for blue carbon projects. In summary, a transparent and credible system involving the participation of all stakeholders is needed to manage the blue carbon trading market (Hilmi et al., 2021).

5.3 Judicial suggestions

5.3.1 Improvements in “compensation for the loss of BCEs”

Firstly, legal recognition should be given to cases involving compensation for damages to blue carbon sequestration functions. To ensure the legality of the lawsuit, it is recommended that judicial interpretations be issued to explicitly classify “causing damage to the carbon sequestration and storage functions of blue carbon” as an illegal act of “destroying the marine ecosystem.”⁴⁴ Additionally, detailed provisions should be made to specify the types of damage to BCEs, the extent of the losses incurred, and the specific methods of measurement and accounting standards.

Secondly, the entities entitled to claim compensation should be clearly defined. Given the complexity of compensation cases for blue carbon sequestration losses, it is recommended to improve the intergovernmental coordination mechanism. Specifically, the ecological environment department could serve as the primary claimant, while other departments such as the Ministry of Natural Resources, transportation, maritime affairs, fisheries, forestry, and grassland, as well as local governments at the county level and above⁴⁵, would provide coordination and support. Additionally, since such damage compensation lawsuits may overlap with administrative penalties and other administrative regulatory powers, based on the principle of “judicial restraint,” it is suggested that administrative agencies exhaust all administrative control measures before filing a lawsuit for blue carbon ecological

42 Art. 16 of Law of The People’s Republic of China on Administrative Penalty (2021 Revision).

43 Art. 32(1) of Law of The People’s Republic of China on Administrative Penalty (2021 Revision).

44 Art. 114 (2) of MEPL 2023.

damage compensation. Moreover, the supplementary role of the procuratorial organs in filing lawsuits should be clarified—only when the administrative agencies fail to fulfill their duties and do not initiate compensation claims should the People's Procuratorate be allowed to support the lawsuit⁴⁶.

Finally, the legal standing of social organizations in litigation should be clearly defined. As an important component of the modern environmental governance system, environmental organizations should play their proper role in marine environmental protection. Granting environmental organizations, the right to sue would also help foster a mindset that encourages and supports social organizations and the public in jointly participating in blue carbon protection. Additionally, from the perspective of role division, the identity of environmental organizations as “non-regulators” means that they can only initiate environmental civil public interest litigation when both government departments and the procuratorial organs fail to bring compensation claims.

5.3.2 Regulating “Purchasing Blue Carbon Credits”

Firstly, the prerequisite for application should be the inability to directly restore the damage. According to judicial interpretations, “alternative restoration methods may be permitted when complete restoration is not possible”⁴⁷; furthermore, judicial documents state that, when “ecological environmental damage cannot be restored,” the liable party should “undertake alternative restoration under the premise of complying with relevant ecological restoration regulations, policies, and plans, to achieve equivalent restoration of the ecological environment and its services.”⁴⁸ Based on these provisions, after a party causes damage to BCEs, their primary responsibility is to carry out direct restoration. Only when “complete restoration is not possible” or the party is unable to bear the responsibility for direct restoration should “purchasing blue carbon credits” be applied as an alternative restoration responsibility.

Secondly, the scope of application should primarily focus on marine-related cases. Ensuring that “purchasing blue carbon credits” occurs in marine-related cases guarantees that the object of ecological restoration is aligned with the type of ecological environment impacted by the harmful behavior, maintaining type correlation, functional substitution, and geographic proximity. On the one hand, this ensures efficiency and convenience for administrative departments and judicial authorities during enforcement and adjudication. On the other hand, it helps violators better understand the service functions of marine ecosystems, thereby maximizing the educational effect.

45 Art. 4 and 5 of MEPL 2023.

46 Art. 114 (3) of MEPL 2023.

47 Art. 20(1) of Interpretation of the Supreme People's Court on Several Issues Concerning the Application of Law to the Trial of Environmental Civil Public Interest Litigation Cases (2020 Amendment).

48 Art. 9 of Regulations on the Management of Compensation for Ecological Damage(2022).

Finally, the implementation plan for “purchasing blue carbon credits” should be clearly defined. In terms of standards, the process should follow the technical guidelines issued by the Ministry of Natural Resources, incorporating authoritative opinions from third-party organizations and blue carbon experts. This would allow for case-by-case evaluation of the extent of damage to blue carbon sequestration functions and the calculation of carbon sinks value, ensuring that the amount of blue carbon credits purchased matches the damage caused to the marine ecological environment. During the purchasing process, transactions should be conducted with the witness and support of an authoritative local carbon emissions trading platform, ensuring smooth coordination between judicial enforcement and the blue carbon trading platform. This will ensure that the “purchasing blue carbon credits” process is legal, compliant, efficient, and transparent. In terms of tracking and supervision, it is important to enhance oversight of the funds used for alternative environmental restoration. If the funds are not fully and promptly utilized, the receiving institutions should be urged to implement corrective actions.

6 Conclusion

Blue carbon is a crucial medium that integrates ocean governance with climate change mitigation. It not only provides essential support for a healthy marine ecosystem and biodiversity but also helps mitigate global climate change through its powerful carbon sequestration capabilities. International frameworks on ocean governance and climate change mitigation have, to some extent, included provisions for blue carbon protection. This study first explains the significance of blue carbon protection and its basis in international law. It then analyzes the progress and shortcomings of China's efforts in blue carbon protection in the areas of legislation, enforcement, and judicial practices related to ocean governance and climate change mitigation.

In terms of legislation, MEPL 2023 has, to a certain extent, strengthened the protection of BCEs. However, it does not explicitly define the legal concept of “blue carbon” or the legal attributes of “blue carbon credits.” In terms of enforcement, while the relaunch of the CCER market has provided a potential institutional foundation for blue carbon trading, there are still issues such as delayed regulatory enforcement of the blue carbon market and an incomplete monitoring and accounting system. On the judicial front, “purchasing blue carbon credits” as a form of assuming responsibility in environmental public interest litigation is a major innovation in China's blue carbon judicial practice. However, there are concerns about the legality and effectiveness of this method of legal responsibility.

To address these issues, this paper proposes a legal pathway for improving blue carbon protection from the perspective of coordinating ocean and climate governance. In terms of legislation, it is recommended to clarify the legal concept of “blue carbon” and the legal attributes of “blue carbon credits” in both ocean and climate governance regulations. In terms of regulatory enforcement, a detailed implementation plan for incorporating blue carbon into the CCER should be formulated, clearly defining the

regulatory agencies for blue carbon trading and establishing a multi-stakeholder governance mechanism involving the government, market, and society. In terms of judicial practice, it is suggested that judicial interpretations be issued to clarify the scope, prerequisites, and implementation plan for “purchasing blue carbon credits” to prevent it from becoming a mere “free pass” for those who damage marine ecosystems.

Author contributions

HL: Conceptualization, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing, Data curation, Formal analysis. YL: Data curation, Investigation, Writing – review & editing, Methodology.

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Conflict of interest

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