PROCEEDINGS OF THE
INTERNATIONAL CARBON NEUTRALITY TRAINEESHIP PROGRAM
Volume.01, Number.1, 2023, 129-133

Marine Carbon Sink Research in China

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Abstract

Since the Industrial Revolution, a large amount of carbon dioxide has been emitted by human activities, which has aggravated climate change and caused a series of environmental and social problems, threatening the sustainable development of human society. The key to dealing with these changes is to achieve carbon neutrality, which includes "emission reduction" and "replenishment". As a large carbon emitter and a developing country, China should try its best to reduce emissions and at the same time increase foreign exchange, that is, develop negative emission technologies and ways. The ocean is the largest active carbon pool on Earth, with abundant carbon sink resources and huge negative emission potential. The theoretical research on China Ocean carbon sink is at the forefront of the world and is expected to play an important role in implementing the national carbon neutrality strategy. This paper introduces carbon sink products such as:coastal wetland and their trading.

Keywords: Carbon sink products; blue carbon; coastal wetland.

1. Introduction

The ocean has efficient carbon sequestration capacity and huge carbon sink potential. It can absorb about 30% of CO_2 emitted by human activities every year, and the carbon storage cycle can reach thousands of years. It is the largest active carbon pool in the world(FRIEDLINGSTEIN P et al.,2020;BOYD P W et al.,2019).In contrast to the concept of a carbon source, a carbon sink is a process, activity or mechanism that removes carbon dioxide from the atmosphere. At present, carbon sinks mainly include two categories, among which terrestrial carbon sinks are carbon sinks increased by terrestrial afforestation, also known as "green carbon"; Marine carbon sinks, also known as "blue carbon", are carbon sinks increased by biological carbon sequestration and storage in oceans, coastal zones, estuaries and wetlands. The concept of "blue carbon" was first proposed by the United Nations in 2009. Compared to "green carbon", "blue carbon" sequesters carbon larger volume, higher carbon sequestration efficiency, longer carbon storage cycle, but the associated carbon reduction methodology is still under construction.

The oceans store about 4 trillion tons of carbon dioxide, the largest carbon sink on Earth. The three major coastal "blue carbon" ecosystems are mangroves, seagrass beds and coastal salt marshes, where carbon dioxide is stored in the sea floor in the form of biomass and biodeposition. Blue carbon has a higher carbon uptake rate and storage

density. Although the biomass of coastal plants is only 0.05% of that of terrestrial plants, they sequester the same amount of carbon every year, removing more than 30% of the carbon dioxide emitted into the atmosphere every year. The storage cycle of "green carbon" is mostly several decades. When terrestrial vegetation dies and Withers, organic matter in the sediment will be microorganism with the participation of oxygen. When it breaks down, the trapped carbon goes back into the air. However, the soil environment of the "blue carbon" ecosystem is usually anaerobic, which is better sealed. Without the help of oxygen, the organic carbon in the sediment is less affected by microbial decomposition, and the "blue carbon" can be buried for thousands of years. In addition to carbon fixation, the lush roots and branches of plants in the "blue carbon" ecosystem can also fix sediments, reduce waves, effectively prevent coastal erosion, mitigate the impact of disastrous weather, cope with sea level rise, and provide fertile ground and habitat for many Marine organisms, which is of great significance for nitrogen and phosphorus removal, Marine ecological protection, and seawater purification.

In general, most of the existing researches discuss the process and mechanism of Marine carbon sequestration from the perspective of natural science and technology, while the researches on economic management focus on the integration of Marine carbon sink as the policy goal and the existing policy framework. In the context of the "dual carbon" goal, Marine carbon sink trading can fully stimulate the value and potential of Marine carbon sinks, and is a positive response to the strategic goals of becoming a Marine power and achieving carbon peak carbon neutrality.

2. Blue carbon research

Coastal wetland is a wetland ecosystem composed of coastal salt marsh wetland and mangrove forest. Due to the impact of periodic tidal inundation of seawater, coastal wetlands have a powerful carbon sink function, which is an important way to reduce atmospheric carbon dioxide (CO_2) concentration and mitigate global climate change (Bonan G B,2008).

Marine blue carbon is believed to store carbon at different time scales mainly through physical solubility pump (atmospheric CO_2 dissolves into seawater), biological pump (plants absorb and transform CO_2 through photosynthesis and deposit it to the seabed), and Marine carbonate pump (Marine organisms such as shellfish and coral reefs absorb, transform and release carbon) (Tang Jianwu et al.,2018). According to the assessment of the United Nations (Nature,2016), half of the carbon held by living organisms in the world's oceans is located in the coastal blue carbon ecosystem. As a kind of important coastal blue carbon ecosystem(Lovelock C E&Duarte C M,2019), coastal wetland has a huge carbon absorption capacity(McLeod E et al.,2011). It belongs to the practice category of "nature-based solutions" and is one of the important ocean-based climate change governance means. Coastal wetlands can bring economic and social benefits to coastal countries and the world at large while mitigating greenhouse gas emissions. Studies show that the annual carbon buried per square kilometer of coastal wetland is expected to reach 0.22 Gg C, which is equivalent to the CO_2 emitted by 3.36×10^5L gasoline combustion(Davis J L et al.,2015). Coastal wetland is an important way to achieve the goal of carbon neutrality.

3. Carbon emission trading

Blue Carbon, jointly published by the United Nations Environment Programme (UNEP), the Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO) and the Food and Agriculture Organization of the United Nations (FAO) in 2009 The Assessment Report on the Sequestration of Carbon in Healthy Oceans used the term "blue carbon" for the first time to clarify the role of Marine ecosystems in climate change and carbon cycle(NELLEMANN C et al.,2009). In 2010, the International Union for Conservation of Nature (IUCN), IOC/UNESCO and Conservation International (CI) jointly launched the Blue Carbon Initiative, which aims to mitigate global climate change through the restoration of coastal ecosystems and the sustainable use of Marine ecosystems by setting up scientific and policy working groups. IOC/UNESCO and the United Nations Development Programme Organization jointly issued the Blueprint for the Sustainable Development of Marine and Coastal Areas, confirming to strengthen cooperation with the existing international carbon market, formulate and implement a global blue

carbon market plan, set up a blue carbon transformation fund, and explore a monitoring and certification standard system. In 2013, the Intergovernmental Panel on Climate Change (IPCC) released the IPCC National Greenhouse Gas Inventory Guide: Supplementary Wetlands, which listed the important type of "coastal wetlands", marking that blue carbon was officially included in the emission reduction mechanism of the United Nations Framework Convention on Climate Change(Bai Y & Hu F,2021;Zhao P & Hu X D,2019). The signing of the Paris Agreement in 2016 confirmed the status of "Reducing Greenhouse Gas Emissions by Reducing Deforestation and Degradation" (REDD) mechanism from the perspective of international law, laying a foundation for the development of mangrove carbon sinks in blue carbon ecosystems. In response to the policy call of Marine carbon sink, the international community has tried to establish a methodology system of Marine carbon sink and carried out practical exploration. According to different emphases, the standards or methods of Marine carbon sinks can be divided into national greenhouse gas inventory preparation, carbon stock investigation and monitoring, and carbon trading methodology (Zhao P et al.,2019). The IPCC Guidelines for National GHG Inventories: Supplementary Wetlands provides the methods for the preparation of GHG inventories for three blue-carbon ecosystems, namely seagrass beds, mangroves and coastal marshes. Coastal Blue Carbon: Assessment Methods for Carbon stocks and Emission Factors in Mangroves, coastal salt marshes and seagrass beds released by the Blue Carbon Initiative working group introduced the scheme design for field investigation of carbon stocks in three major blue carbon ecosystems, and methods for investigation, analysis and monitoring of carbon stocks in sediment and biomass pools and annual carbon sequestration rates.
In the carbon trading market methodology, Afforestation and Reforestation of Degraded Mangrove Habitats (AR-AM0014) and Small-scale Afforestation and Reforestation Project Activities on Wetlands (AR-AMS0003) belong to the CDM methodology system and involve the development conditions of mangrove projects. Methodologies for the Construction of Coastal Wetlands (VM0024) and Methodologies for the Restoration of Tidal Wetlands and Seagrass (VM0033) belong to the VCS methodology system and stipulate the conditions for the development of carbon sink projects in coastal wetlands. In practice, the United States, Australia, Kenya and other countries have explored Marine carbon sink trading, among which the most instructive strategy is the "three-step" strategy proposed by the US state of Georgia in 2015 for the construction of Marine carbon sink trading market, that is, clarifying the legal status of blue carbon, issuing blue carbon accounting standards, and reviewing the investors in carbon sink projects that meet the requirements. Provides experience for constructing the framework of Marine carbon sink trading market(PAN X B,2018).

Carbon sequestration products refer to the development of carbon sequestration products from forests, grasslands, wetlands, farmland, oceans and other ecosystems into recordable and managable carbon sequestration products through a set of nationally recognized accounting, testing and management methodologies for the subsequent carbon market, carbon finance and other value realization mechanisms. At present, the methodology is mature and incorporated into the Chinese Certified Emission Carbon sinks under the Reduction (CCER) mechanism mainly include afforestation carbon sinks, forest management carbon sinks, bamboo afforestation carbon sinks, bamboo forest management carbon sinks, sustainable grassland management carbon sinks and conservation farming carbon sinks, which are in urgent need of development of wetland carbon sinks, farmland carbon sinks, grassland carbon sinks, Marine carbon sinks, and other types of forest carbon sinks.

The realization of the value of carbon sink products is to convert the social benefits or social costs of the carbon sink production and development system into private benefits or private costs through market trading or policy means, which is an important means to solve market failures and protect the ecosystem. The value realization mechanism of carbon sink products mainly includes investigation and monitoring, development and transformation, operation and development, value realization guarantee, value realization promotion and other conversion mechanisms. The value realization path of carbon sink products includes trading, mortgage, compensation, etc., to promote the conversion of carbon sink products into economic benefits. As carbon sink product is a special kind of public goods, in order to reduce the "free rider" behavior, solve the problem of market failure, and realize the effective allocation of resources, market and sum are needed.

The government should work together to establish an effective mechanism for realizing the value of carbon sequestration products and an efficient path for realizing the value of carbon sequestration products.

There are three major "blue carbon" ecosystems in China: mangroves cover an area of about 25,000 hectares, mainly in the waters south of Zhejiang; Seagrass beds cover an area of about 20,000 hectares and are distributed in the coastal areas of China. The area of coastal marsh is about 12,000 ~ 34,000 hectares. China's "blue carbon" development has achieved initial results. China's policy on "blue carbon" started early. In 2011, the Shandong

Peninsula Blue Economic Zone Development Plan was the country's first national strategy for the development of Marine economic regions. After 2015, requirements for the construction of Marine carbon sinks began to appear in the national policy system. At the same time, the state has issued a number of documents to establish a Marine carbon sink mechanism, carry out the Marine ecosystem carbon sink pilot, establish a Marine carbon sink standard system and trading mechanism. Since September 2022, when China proposed the goal of achieving peak carbon neutrality, the emphasis on Marine carbon sinks has been increasing. Hainan Province, a large Marine resource province and a national ecological civilization pilot zone, registered and established the Hainan International Carbon Emission Trading Center (hereinafter referred to as the "Sea Carbon Center") in July 2022. The Sea Carbon Center will become the first Chinese carbon market mainly characterized by internationalization and the connecting point of domestic and foreign carbon markets, promote the marketization of "blue carbon" products, promote Hainan's "blue carbon" methodology to become an internationally recognized standard, and strive to be included in the international Marine governance system.

International "blue carbon" methodology certification provides technical support for the construction of national "blue carbon" standard system. In terms of "blue carbon" trading, China's first mangrove carbon sink trading project was completed in Zhanjiang, Guangdong Province, in June 2021, and the initial trading of 380 hectares of mangrove forests reduced carbon dioxide emissions by 5,880 tons. In July 2021, Xiamen, Fujian Province set up China's first Marine carbon sink trading platform, and completed the first carbon sink trading, which resulted in 2,000 tons of carbon dioxide emission reduction. In January 2022, Lianjiang County, Fuzhou City, Fujian Province, completed the 15,000 tons of mariculture and fishery Marine carbon sink trading project.

In a short,“Blue carbon”plays an important role in carbon neutralization,and can improve related economy.

4. Discussions

In the future, it is urgent to strengthen the scientific research of coastal wetland, protect the integrity of its ecosystem structure and service function, stop destructive coastal wetland development activities, avoid the rapid loss of its blue carbon function, promote the ecological restoration of coastal wetland, rebuild and build new coastal wetland ecosystem, restore and enhance its blue carbon function, and benefit from the carbon sink gain while protecting nature. Let coastal wetland blue carbon make greater contribution to carbon neutral strategy.

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