

**미래의 탄소 흡수원,
블루카본(Blue Carbon) 확대 방안 연구**

2024년 7월

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1. 훈련기관 개요

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- 행정학과 개요

- 1947년에 설립되었으며, 1994년에 제 37대 주지사인 Reubin O'D. Askew를 기념하기 위해 학과의 공식 명칭을 “Reubin O'D. Askew School of Public Administration and Policy”로 개칭

- U.S. News에 따르면, 행정학과는 39위를 차지하였음

● 주요 기능 및 연구 분야

- 일반행정, 재무관리, 비영리조직, 위기관리, 지능정보 분야 등에서 학위(학·석·박사) 프로그램 운영 및 연구지원

- 재무관리와 관련, 회계, 예산, 재정관리 및 정책결정 등이 주요 연구 분야로 비용편익분석, 공공조달관리, 재정정책 평가 등 교육

- 최근 사회 변화와 이에 따른 공공관리의 영향, 미국 사회에서 가치 변화에 따른 자원배분과 조직설계 중점 연구

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Chapter 1. Introduction

1. Background and Purpose

Recently, the economic and social damage caused by abnormal climate phenomena is rapidly increasing worldwide, including the spread of large-scale wildfires due to abnormal high temperatures in North America, the flood damage in Pakistan caused by record-breaking heavy rains (approximately more than 1,700 people died from June to September, 2022), the suspension of maritime transportation and power shortage due to drought, and so on. (The Joongang, 2022)

A lot of scientists and meteorologists have analyzed that these abnormal climate phenomena are the result of increased carbon emissions caused by human activities and the resulting of global warming. In the past 10 years (from 2011 to 2020), the Earth's average annual temperature has risen by about 1.09°C compared to before industrialization (from 1850 to 1900). And if global warming continues, the global average sea level is expected to rise by up to 1.01m and sea temperature is expected to rise to 3.7°C by the end of the 21st century. The Intergovernmental Panel on Climate Change (IPCC) also announced in its 6th report in March 2023 that the previous prediction (2018) that the global temperature would rise by 1.5°C by 2040 has been changed before 2040. (IPCC, 2023)

The average annual temperature in Korea is also continuously rising, exceeding the global average temperature increase rate. According to the Korea Meteorological Administration, from 1912 to 2020, the average annual temperature in Korea has increased by 0.2°C per decade, which is around three times the global average of 0.07°C. Over the past 30 years, the global average sea surface temperature has risen by 0.12°C from 18.18°C to 18.30°C, while in Korea, it has increased 0.21°C from 18.32°C to 18.53°C. Accordingly, the public's perception of natural disasters caused by climate change, such as heat waves and heavy rain, is also increasing. Korea's coastal sea level has also risen by an average of 3.12mm per year over the past 30 years, and if

greenhouse gas emissions continue at the current level, it is expected to increase by up to 82 cm by the end of the 21st century. (KHOA, 2023)

This global warming is expected to bring about significant changes to the natural environment and our lives, such as abnormal climate events, coastal erosion and flooding due to sea level rise, depletion of fishery resources, and negative changes, etc. If the Earth's average temperature rises by 1.5°C, approximately 300 million of the world's urban population will suffer from water severe shortages, and if it rises by 2~3°C, about 60% of Earth's creatures are expected to become extinct. (IPCC, 2023) In January 2023, the top four of the 10 most serious risks for the next decade selected by the World Economic Forum (Davos Forum) in its 'Global Risk Report 2023' were also related to climate and environment; Failure to mitigate climate change, failure to adapt to climate, natural disasters and extreme weather events, and loss of biodiversity and ecosystem collapse. (The Hankyoreh, 2023)

As awareness of this climate crisis continues to spread, discussions are actively taking place in the international community to slow global warming as much as possible by minimizing carbon dioxide emissions. Starting with the Paris Agreement (which came into force in November 2016), which was signed at the plenary session of the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change held in Paris, France in December 2015, all countries, including developed and developing countries, were obliged to reduce greenhouse gases, and obligation to set and implement a binding national greenhouse gas reduction goal (Nationally Determined Contribution) to prevent global temperature rise by 1.5°C. The UN plans to inspect the implementation of greenhouse gas emissions and reduction by all parties every two years starting in 2024. After the UN Climate Action Summit held in New York, USA in 2019, as of November 2022, over 140 countries have declared to achieve carbon neutrality by 2050. Developed countries such as the United States and Europe are increasingly strengthening carbon emissions regulations.

As a responsible member of the international community, Korea is also actively participating in the international community's movements by declaring "2050 Carbon

Neutrality” in October 2020 and launching the Commission on Carbon Neutrality in May 2021. Since then, Korea became the 14th country in the world to enact “the Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis”¹ in September 2021, and is further strengthening its carbon neutrality policy, including raising the carbon reduction target by 40%. In March 2022, the Commission on Carbon Neutrality and the Committee on Green Growth were integrated to launch the Presidential Commission on Carbon Neutrality and Green Growth, laying the foundation for implementing carbon neutrality and green growth from a long-term perspective.

In April 2023, the ‘Carbon Neutrality Green Growth National Strategy and 1st National Basic Plan’ was established, which improved the carbon neutrality implementation and management measures of the previous plan. The basic plan also includes reduction measures in the maritime and fisheries sector, including industry-wide carbon reduction plans such as upgrading low-carbon ship technology, developing low-carbon or carbon-free fishing boats, and managing energy for fisheries facilities such as fish farms. In particular, what is noteworthy is that the maritime and fisheries sectors can play an important role in absorbing carbon that has already been emitted beyond reducing existing carbon emissions.

In order to slow down global warming and respond to climate change, it is time to go beyond ‘carbon neutrality’, which means reducing carbon emissions to zero, and aim for ‘carbon negative’, which absorbs carbon that has already been emitted. If the expansion of green carbon absorbed through forests has been the representative means to achieve carbon negatives, from now on, the expansion of blue carbon absorbed by the sea will be a very important and efficient way. Considering the time and space constraints required to create a carbon absorption source, it might be more advantageous

¹ According to the article 1, the purpose of this Act is to strengthen policy measures to reduce greenhouse gases and adapt to climate change for preventing serious impacts of climate crisis, to resolve economic, environmental, and social disparity that may arise in the course of transition to a carbon neutral society, and to foster, promote, and revitalize green technology and green industry for a harmonious development of the economy and environment, thereby improving the quality of life of present and future generations, protecting the ecosystem and climate system, and contributing to the sustainable development of the international community.

to make new seaweed, algae, and mudflats, etc.

Accordingly, the main purpose of this study is to investigate advanced cases such as the United States and France that are expanding blue carbon, which absorbs carbon that has already been emitted, and to study laws, institutions, and systems that can be introduced in Korea.

2. Research Scope and Method

Blue carbon is carbon absorbed by the sea, and the entire marine ecosystem, including marine plants such as seaweed and algae, marine animals like fish, and habitats such as mudflats, acts as a source of blue carbon absorption. Among these, this study focuses on the expansion of seaweed, algae, and so on, which a number of developed countries are making efforts to expand and are subject to international certification. In addition, this study reviews and finds ways to secure certification for mudflats and shells that exist widely in Korea and researches on their carbon absorption effect are actively in progress. Lastly, to research ways to bring about international cooperation to expand blue carbon and for Korea to play a leading role about it is also important topic in this study.

To this end, first, through literature research, the trend and implementation status of blue carbon expansion policies of Korea and abroad are investigated, and comparison and analysis among them are also conducted. Additionally, this study includes the investigation of the East Coast and coastal maintenance project absorption sites, which are representative blue carbon absorption sites in the United States. Listening to the opinions of experts in related fields is conducted through seminars hosted by international organizations or NGOs. In order to understand the administrative system and governance policies of the United States, materials from related classes of the Department of Public Administration at Florida State University are also used.

Furthermore, institutional research to expand blue carbon and measures to improve related laws for domestic introduction and use are also important parts of this study. In particular, this study focuses on discovering a private sector cooperation system that can actively encourage private sector participation for sustainable blue carbon expansion.

Chapter 2. Definition of Blue Carbon and Literacy Review

Carbon sequestration and storage in the natural world is attracting attention as one of the ways to respond to global warming. Carbon absorption in the natural world is mainly caused by the photosynthesis of plants, and is deposited in the soil in the form of dead plants or fallen leaves. In other words, initially, attention was focused on forest conservation on land. (Park et al., 2024)

However, since a report, “Blue carbon: the role of healthy oceans in binding carbon”, jointly published by the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the Intergovernmental Oceanographic Commission (IOC) in 2009 showed that about 55% of all carbon absorbed and sequestered in the natural world was stored in marine ecosystems, interest in blue carbon has grown rapidly and a lot of related researches have been conducted. (Nellemann et al., 2009). In particular, after research results were published showing that coastal wetlands such as mangroves, salt marshes, and seaweed pastures store more than 50% of all blue carbon, and the blue carbon storage capacity of coastal wetlands have three to five times higher carbon storage capacity than forests on land, coastal wetlands as a great absorption source of blue carbon have been noted continuously. (Bertolini and da Mosto, 2021).

Furthermore, interest in blue carbon in the international community has recently gone beyond its typical role as a carbon absorption source to reduce emissions. Considering the various ecosystem services and benefits provided by blue carbon, it is presented as a representative nature-based solution in coastal and ocean areas. (Yoon, 2023)

In line with this trend, blue carbon research has expanded into diverse and cross-disciplinary research through global efforts to reduce greenhouse gases in the atmosphere and support from governments in each country. However, the ambiguity in the definition of blue carbon sometimes causes confusion among researchers. (Park et

al., 2024)

Therefore, in this chapter, let me look at several major domestic and international studies on blue carbon, along with various discussions on the definition of blue carbon.

1. Definition of Blue Carbon

Park et al (2024) organized and analyzed the contents of 23 papers in which the definition of blue carbon was presented. This means that there are a lot of different definitions of blue carbon. In addition, international organizations such as UNEP and IPCC, non-government organizations like the Blue Carbon Initiative, and government agencies such as the Ministry of Oceans and Fisheries in Korea also have defined blue carbon.

First, UNEP, which first proposed the concept of blue carbon, defined blue carbon as “carbon captured by marine living organism.” (Nellemann et al., 2009) Since then, blue carbon has been defined by various researchers according to spatial and temporal ranges.² The spatial extent of blue carbon is limited to carbon stored in sediments in mangroves, salt marshes, and seagrass beds, or in some cases, it includes carbon stored in litter and deadwood as well as the roots and stems of plants. The temporal scope of blue carbon has been mostly presented qualitatively, and mainly explained by expressions such as “long-term” and “long timescales” as the meaning of long-term storage. (Park et al., 2024)

² According to Park et al. (2024), some examples are as follows: 1. The carbon stored, sequestered or released from coastal ecosystems of tidal marshes, mangroves and seagrass meadows (Murray et al., 2012) 2. A specific type of offset derived from mangrove, seagrass, and salt marsh restoration and/or preservation where carbon is sequestered both in the soil and in the plants themselves (Kraft et al., 2013) 3. The coastal carbon stock, stored in the biomass and sediment of vegetated ecosystems, such as tidal marshes, seagrass beds and mangroves (Sousa et al., 2017) 4. The organic carbon in oceanic and coastal ecosystems that is captured on centennial to millennial timescales (Geraldi et al., 2019) 5. The long-term storage of organic and inorganic carbon in coastal wetlands such as mangroves, tidal marshes, and seagrasses (Malerba et al., 2022)

On the other hand, the IPCC considers blue carbon as “all biologically-driven carbon fluxes and storage in the marine systems that are amenable to management.” (IPCC Glossary) The Blue Carbon Initiative, an international environmental organization, defines blue carbon as “the carbon stored in coastal and marine ecosystems.” (The Blue Carbon Initiative Official Homepage) In the ‘Blue Carbon Promotion Strategy’ announced by the Ministry of Oceans and Fisheries of the Republic of Korea in May 2023, blue carbon is defined relatively broadly as ‘carbon absorbed and stored by the marine ecosystem through plants living on the coast and sediments.’ (MOF, 2023)

As such, the definition of blue carbon is somewhat different depending on the subject, such as researchers, governments, and international organizations, so a scientific and objective definition is needed. One point to emphasize is that it would be more appropriate to expand to the entire coastal or marine ecosystem, such as non-vegetation tidal flats and benthic sediment, as blue carbon sinks, rather than limiting them to the three blue carbon sinks, mangrove, seagrass, and salt marsh, currently recognized by the IPCC.

2. Literacy Review

The carbon cycle through the ocean has been a big research topic around for nearly 100 years. (Lovelock & Duarte, 2019) However, two reports published in 2009 played a decisive role in raising awareness of blue carbon globally. As seen earlier, the word “blue carbon” was mentioned for the first time in the ‘Blue Carbon: The Role of Healthy Oceans in Binding Carbon’ published by Nellemann et al. (2009), and Laffoley, D. & Grimsditch, G. D. (2009) argued in their report ‘The Management of Natural Coastal Carbon Sinks’ that marine ecosystems play an important role in storing carbon dioxide in the atmosphere. Through these two reports, mangroves, salt marshes, and seagrasses began to receive attention as critical marine carbon sinks, and the conservation and restoration of blue carbon habitats to mitigate climate change have

been emphasized. (Kwon et al., 2022)

In 2013, four years after these reports were published, the IPCC added blue carbon as a carbon sink, allowing blue carbon to be used as a means of reducing carbon emissions. In addition, as coastal wetlands are regarded as the major source of absorption of blue carbon, policy studies have been continuously conducted to calculate the economic value of coastal wetland and preserve it. (Kwon et al., 2022)

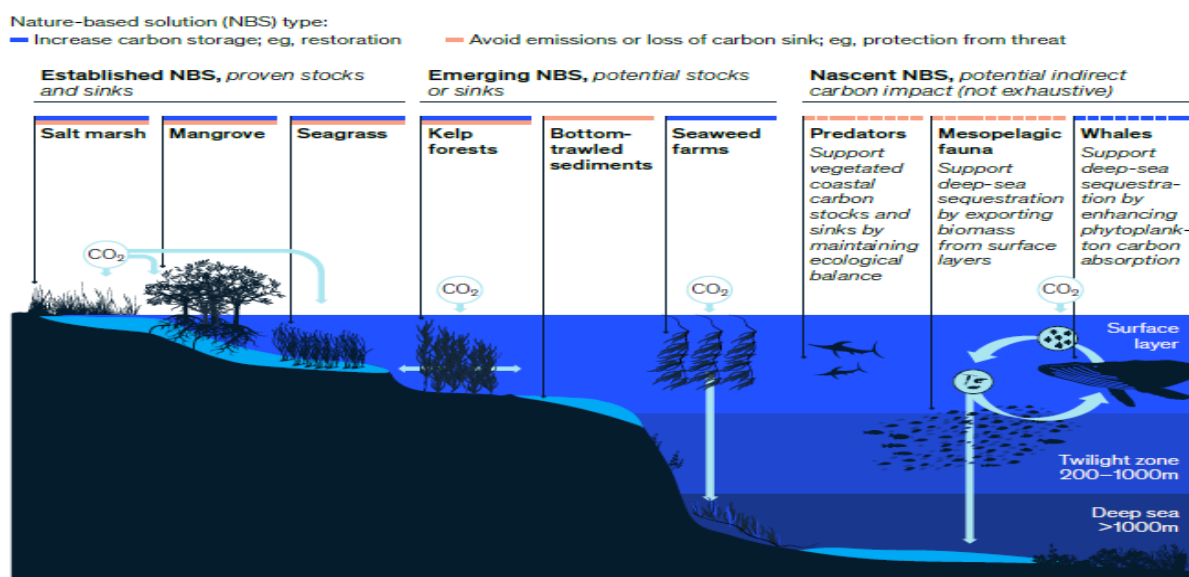
Nellemann et al. (2009) pointed out that, despite the fact that more than half (55%) of all biological carbon captured in the world is captured by marine organism, the contribution of forests in sequestering carbon was very well known, while, in contrast, the critical role of oceans was overlooked. About 93% of Earth's carbon dioxide is stored in and circulated through the oceans. Vegetative habitats of the ocean, especially seagrasses, mangroves, and salt marshes, cover less than 0.5% of the seabed, but they account for more than 50%, probably 71%, of all carbon storage stored in marine sediments. Although they make up only 0.05% of plant biomass on land, they store a similar amount of carbon per year, making them one of the most intense carbon sinks on Earth. Nellemann et al. (2009), therefore, highlighted the ocean's crucial contribution to reducing atmospheric carbon dioxide levels through sequestration and by reducing the rate of destruction of marine and coastal ecosystems. (Nellemann et al., 2009)

Lovelock & Duarte (2019) explained the concept of blue carbon in two ways: one is all organic matter captured by marine life, and the other is how marine ecosystems can be managed by reducing greenhouse gas emissions to mitigate climate change and enhance conservation. The researchers also presented detailed standards for blue carbon as a means of carbon reduction, such as the effectiveness of greenhouse gas removal, long-term carbon sequestration, and the practical management of maintaining carbon stock. In addition, freshwater tidal forests, phytoplankton, calcifying organisms like coral reefs and oyster reefs were suggested as candidates for blue carbon ecosystems, but researchers emphasized that more scientific investigation like whether net carbon dioxide emits or not, should be needed. (Lovelock and Duarte, 2019)

criteria for inclusion as actionable Blue Carbon ecosystems						
	scale of GHG removals or emissions are significant	long-term storage of fixed CO ₂	undesirable anthropogenic impacts on the ecosystem	management is practical/possible to maintain/enhance C stocks and reduce GHG emissions	interventions have no social or environmental harm	alignment with other policies: mitigation and adaptation
mangrove	yes ^{1,2}	yes ³	yes ^{4,5}	yes ^{6,7}	?	yes ⁸
tidal marsh	yes ^{1,9}	yes ⁹	yes ¹⁰	yes ^{11,12}	?	yes ¹³
seagrass	yes ^{1,14}	yes ¹⁵	yes ¹⁶	yes ¹⁷	yes	yes ¹⁸
salt flats (sabkhas)	?	?	yes ¹⁹	?	?	?
freshwater tidal forest	?	yes ²⁰	yes ²¹	yes ²²	?	?
macroalgae	yes ²³	? ²³	yes ²⁴	yes ²⁵	?	yes ²⁶
phytoplankton	yes ²⁷	? ²⁸	?	?	?	no
coral reef	no ²⁹	no	yes ³⁰	no	?	yes ³¹
marine fauna (fish)	no ²⁹	no	yes ³²	no	?	no
oyster reefs	no ²⁹	?	yes ³³	no	yes	yes ³⁴
mud flats	? ³⁵	?	yes ³⁶	?	yes	yes ³⁶

(Source: Lovelock & Duarte, 2019)

Claes et al (2022) classified blue carbon into three categories according to scientific and economic maturity and analyzed its impact, costs, etc. One is established solutions widely known and accepted, such as mangroves, tidal marshes, and seagrass meadow. Other is emerging solutions including the protection and restoration of seaweed forests and the extension of seaweed forests, which have undergone initial review studies to quantitatively assess its potential to reduce CO₂, but still need to address significant scientific uncertainties. The other is nascent solutions that require scientific scrutiny, such as quantifying their impacts and establishing permanence. (Claes et al., 2022)



(Source: Claes et al., 2022)

provided various benefits and solved social challenges, and reviewed whether the domestic blue carbon policy considered blue carbon as a nature-based solution. Then, in order to strengthen and utilize blue carbon as a nature-based solution, Yoon (2023) proposed to establish a comprehensive national strategy for blue carbon, strengthen linkage and cooperation between related policies, projects, and institutions, promote various research and development on blue carbon, and the introduction of a systemic evaluation system.

Lastly, researches examining the possibility of spreading blue carbon in certain areas such as the East Sea, Incheon, and Chungcheongnam-do have also been conducted recently.

Chapter 3. Policy Cases in Korea

1. Carbon Neutral Policy in Korea³

The Korean government is pursuing various policies to realize carbon neutrality more effectively and systematically in accordance with the “Carbon Neutrality and Green Growth National Strategy and the 1st National Basic Plan” (hereinafter referred to as the “Basic Plan”) established in 2023. The Basic Plan sets reduction targets for each sector, such as energy conversion, industries, buildings, transportation, agriculture, livestock, fisheries, waste, hydrogen, and absorption sources, and includes practical and specific measures to implement them. It also includes measures to establish a governance system that induces cooperation across society, not only in the central government, but also in local governments, businesses, and the private sector, and to more systematically manage the carbon-neutral implementation situation.

The Basic Plan was established with the vision of ‘Transitioning to a Carbon-Neutral Society with the Aim of Becoming Carbon-Neutral by 2050 and Promoting Harmonious Development of the Environment and Economy’. And four national strategies were prepared to realize this vision; 1. Responsible carbon neutrality that reduces greenhouse gases in a specific and efficient way, 2. Innovative carbon neutrality and green growth led by the private sector, 3. Carbon neutrality through consensus and cooperation among all members of society, 4. Active carbon neutrality to apply the climate crisis and lead the international community.

In order to achieve carbon neutrality in 2050, the mid- to long-term reduction goal was set to achieve a ‘40% reduction in greenhouse gases by 2030’, and various and specific policies for each of the 10 sectors mentioned above were prepared. It aimed to emit 436.6 million tons of carbon dioxide by 2030, up from 686.3 million tons in 2018, and planned to reduce emissions from energy conversion, transportation, and waste by

³ This information was referenced from the Carbon Neutrality and Green Growth National Strategy and the 1st National Basic Plan.

30-50%. What is peculiar is that the absorption source is a major sector that offsets the emissions from other sectors, but it is predicted that the amount of absorption will continue to decrease. This is because it is analyzed that carbon absorption will decrease due to the aging of forest resources.

<Overview of the Basic Plan>



< Reduction Goals by Sector and Year >

(단위: 백만톤CO₂e)

부문	2018 (기준연도)	2023	2024	2025	2026	2027	2028	2029	2030
합계	686.3*	633.9	625.1	617.6	602.9	585.0	560.6	529.5	436.6**
전환	269.6	223.2	218.4	215.8	211.8	203.6	189.9	173.7	145.9
산업	260.5	256.4	256.1	254.8	252.9	250.0	247.3	242.1	230.7
건물	52.1	47.6	47.0	46.0	44.5	42.5	40.2	37.5	35.0
수송	98.1	93.7	88.7	84.1	79.6	74.8	70.3	66.1	61.0
농축수산	24.7	22.9	22.4	21.9	21.2	20.4	19.7	18.8	18.0
폐기물	17.1	15.1	14.7	14.1	13.3	12.5	11.4	10.3	9.1
수소	(-)	3.4	4.1	4.8	5.5	6.2	6.9	7.6	8.4
탈루 등	5.6	5.1	5.0	5.0	4.9	4.8	4.5	4.2	3.9
흡수원	-41.3	-33.5	-31.3	-28.9	-30.4	-29.1	-28.3	-27.6	-26.7
CCUS	(-)	-	-	-	-0.4	-0.7	-1.3	-3.2	-11.2

* 국제사회에 제출된 '18년 총 배출량은 727.6백만톤이나 순배출량 기준으로는 686.3백만톤이며, 모든 연도별 합계는 순배출량 기준(부문별 소수점 첫째자리 아래 절삭)

** 국제감축은 관련 국제기준 확정, 최초 활용시기('26년 예상) 등을 고려하여 연도별 목표를 설정할 예정으로 '30년 목표에만 반영

In addition, policies such as climate crisis adaptation, green growth, just transition, regional leadership, human resources training, awareness enhancement, and international cooperation would be also promoted to further solidify the implementation foundation of the Basic Plan, and a permanent government consultative body, implementation inspection, and evaluation system would be operated.

Another noteworthy point is that the role of the 'private' sector is being emphasized among policy strategies and tasks. Previously, the central government took the lead in realizing carbon neutrality, but in the future, local governments, businesses,

and civil society will play a more important role and participate in the system, and the policies of the basic plan will be implemented based upon the interest and sympathy of the general public. Additionally, the Basic Plan contains a strategy to effectively achieve goals based on technology and secure a global initiative in carbon neutrality through cooperation with the international community.

<Comparison between As-Is and To-Be>

부문	현재	미래	
에너지	<ul style="list-style-type: none"> 화석연료 기반 에너지 생산 	<ul style="list-style-type: none"> 저탄소 신기술 기반 에너지 생산 	<ul style="list-style-type: none"> ·원전 발전 비중 (21) 27.4% → (30) 32.4% ·신재생 발전 비중 (21) 7.5% → (30) 21.6%+α*
산업	<ul style="list-style-type: none"> 탄소 집약적 산업구조 	<ul style="list-style-type: none"> 산업의 저탄소 전환 	<ul style="list-style-type: none"> ·배출권거래제 배출효율기준 할당(BM) (21) 65% → (30) 75%
건물	<ul style="list-style-type: none"> 에너지 다소비 건물 다수 	<ul style="list-style-type: none"> 성능개선을 통한 에너지 효율 향상 	<ul style="list-style-type: none"> ·그린리모델링(누적) (22) 약 7.3만건 → (30) 약 160만건 ·제로에너지 건축물(누적) (22) 2,950건 → (30) 약 47,000건
수송	<ul style="list-style-type: none"> 내연기관 중심 수송체계 	<ul style="list-style-type: none"> 무공해차 중심 수송체계 	<ul style="list-style-type: none"> ·무공해차 등록 비중(전기차 및 수소차, 누적) (22) 1.7% → (30) 16.7% (43만대 보급) (450만대 보급)
농축수산	<ul style="list-style-type: none"> 농작물 재배, 가축 사육과정에서 온실가스 배출 	<ul style="list-style-type: none"> 저탄소 농축산 기술 개발·보급 어선의 연료전환 개선으로 온실가스 ↓ 	<ul style="list-style-type: none"> ·스마트온실 (22) 7,076ha → (27) 10,000ha ·스마트축사 (22) 6,002호 → (27) 11,000호 ·머단저감사료 보급률 (22) 0% → (30) 30%
폐기물	<ul style="list-style-type: none"> 일회용품, 포장재·용기 등 사용으로 폐기물 발생량 증가 	<ul style="list-style-type: none"> 전주기(생산·유통·소비) 원천 감량, 자원순환 활성화로 재활용률 향상 	<ul style="list-style-type: none"> ·생활 폐기물 재활용률 (21) 56.7% → (30) 83% ·사업장 폐기물 재활용률 (21) 84.4% → (30) 92.5%
수소	<ul style="list-style-type: none"> 수소승용차·연료전지 등 제한적 활용, 그레이수소 중심 생태계 	<ul style="list-style-type: none"> 모빌리티 등 수소 활용처 확장, 청정수소 중심 생태계 	<ul style="list-style-type: none"> ·수소차 (22) 29,733대 → (30) 300,000대 ·청정수소 발전 (22) 0% → (30) 2.1%
흡수원	<ul style="list-style-type: none"> 30~40년대생 숲이 전체 산림의 2/3 차지, 갯벌 복원 저조 	<ul style="list-style-type: none"> 산림 순환경영·보전으로 흡수능력 강화, 갯벌 복원 확대 	<ul style="list-style-type: none"> ·송가꾸기 면적 (21) 21만ha → (30) 32만ha ·갯벌 복원(누적) (21) 1.5만 → (30) 10만
CCUS	<ul style="list-style-type: none"> 선진국과의 높은 기술격차 및 투자 미비 	<ul style="list-style-type: none"> 기술혁신을 통한 탄소의 대규모 포집·저장 신산업 창출 	<ul style="list-style-type: none"> ·기술수준 최고국(美) 대비 (20) 80% → (25) 90%

* 태양광 등 청정에너지 확대

The Korean government plans to invest a total of more than 89.9 trillion won over the next five years to achieve carbon neutrality, and will increase the budget by an average of about 11.5% per year. 54.6 trillion won will be invested in mid- to long-term reduction measures for each sector, and the government budget will also be provided to strengthen the foundation for realizing carbon neutrality, such as 19.4 trillion won for climate change adaptation measures and 6.5 trillion won for green industry growth measures.

Implementation of the Basic Plan and government's financial input for this not only contribute to the achievement of carbon neutrality, but also have enormous economic effects such as increasing employment rate by 0.22% annually per year by 2030 and raising the carbon price from 9,200 won/ton in January 2024 to 61,400 won/ton in 2030.

2. Blue Carbon Expansion Policy in Korea




As pointed out earlier, it is planned to absorb 26.7 million tons of carbon in 2030 through absorption sources. However, as the amount of greenhouse gas absorption in the existing forests is continuously decreasing, it is necessary to secure various types of new absorption sources. To this end, the Korean government is promoting policies to identify the absorption power along with the systematic restoration and management of marine absorption sources, a representative forest alternative space. In other words, it is to expand the amount of blue carbon absorbed by the ocean.

First, restore and protect wetlands in damaged coastal areas to increase carbon absorption. By 2050, 30km² of mudflats damaged by discarded salt farms, fish farms, and artificial facilities will be restored to natural mudflats. The types of restoration projects such as restoration of freshwater lakes and reclaimed land will be diversified, and a comprehensive evaluation system will be made to monitor and verify the restoration effects. In addition, through mudflat plantation restoration project like restoring halophyte communities to 660 km² by 2050, the carbon absorption capacity

of existing mudflats will be enhanced. Lastly, the government plans to designate and protect 17,201 km², equivalent to 20% of the inner waters of the territorial sea, as a marine protected area by 2030.

On top of that, the composition of the sea forest, which is a significant source of absorbing carbon in the sea, will be expanded, and the composition method also will be widely diversified. In accordance with the characteristics of each sea area, it is planned to create an additional large-scale colony of seaweed of approximately 230 km² by 2030. After 2030, the government will gradually expand the area of sea forest creation to major coastal islands and make sea forests by selecting seaweed varieties suitable for sea environment and climate change. Furthermore, the government will continuously support to develop eco-friendly sea forest creation techniques, and after making sea forests, it will conduct fact-finding surveys to strengthen follow-up management.

<Blue Carbon Absorption Sources Certified by IPCC>

	<p>(Mangrove) Trees that live in water such as tropical and subtropical riverbanks, estuaries, and beaches</p>
	<p>(Salt Marsh) Wetland with large salinity changes due to seawater flowing in and out</p>
	<p>(Sea Grass Meadow) Angiosperms that grow completely submerged in seawater</p>

Next, the government supports the discovery of new blue carbon absorption sources other than those certified by the Intergovernmental Panel on Climate Change (hereinafter referred to as the “IPCC”), such as mudflats and halophytes, and allows blue carbon statistics to be included national greenhouse gas statistics. By 2026, analysis on the carbon absorption capacity of potential blue carbon candidates such as brown algae, shellfish, subtidal, continental shelf sediments, and microalgae will be conducted. Afterwards, the government plans to strengthen international cooperation and support the revision of the IPCC’s guidelines so that these blue carbon candidates can be included in the official blue carbon recognized by the IPCC.

At the same time, the Korean government is also carrying out a project to build a blue carbon statistical base. Specifically, it plans to establish a database by quantitatively analyzing the current distribution of blue carbon in Korea and the carbon absorption amount of blue carbon. In addition, it will develop national intrinsic coefficients for coastal wetlands and systematically manage statistics of carbon absorption sources in order to meet international standards.

Furthermore, through the policy called ‘Breathing Coastal New Deal’, a redesign project to restore the coast centered on concrete structures with eco-friendly and carbon-absorbing materials is also being promoted. In addition, the government is implementing a project to designate a ‘Sea Arbor Day’ in order to recall the importance of the ocean and raise public awareness of the need to protect the sea. Recently, positive effects are being seen, with some private companies voluntarily participating in creating sea forests through MOUs.

Although the government is pursuing various policies to increase blue carbon based on the Basic Plan, explained above, it seems to be focusing on expanding the area of blue carbon absorption sources. Going one step further, it is necessary to supplement the overall plan from a more macroscopic perspective, such as preparing measures to expand the participation of various social actors like private sectors and local governments, establishing an administrative system that can integrate and manage blue carbon polices, and strengthening cooperation with the international community. For

the continuous expansion of blue carbon absorption sources, a governance system that can raise public awareness and induce the participation of more diverse members of society is needed, and measures to secure government's finances and establish a legal basis should be additionally considered.

Chapter 3. Policy Cases in the International Community

This chapter introduces the international conference to respond to climate change held in September 2023 and the policy cases of major countries such as the United States, France, Japan, and Australia.

1. Trends in the International Community

As previously described in the research background, the international community have recognized the severe problem of global warming and is widely discussing international cooperation and action for this. Among these various action plans, especially carbon neutrality or net zero carbon emissions are considered to be important measures, and more active policies of each country are highly required for this.

In order to search for trends in international discussions, it is necessary to pay attention to the UN General Assembly, the UN Sustainable Development Goals Summit, and the UN Climate Ambition Summit held in New York, USA in September 2023. At the same time, seminars for NGOs and civic groups held in New York also has great significance.⁴ In common, representatives from each country shared the seriousness of climate change and strongly emphasized the importance of immediate and specific actions.

In his keynote speech at the UN General Assembly, President Yoon of Korea also announced that Korea would expand green ODA to close the climate gap, lead the spread of carbon-free energy, and provide an additional \$300 million to the Green Climate Fund (GCF). And he proposed to widely utilize and share high-efficiency carbon-free energy, and form an open platform called ‘Carbon Free Alliance’ for the

⁴ For this research paper, I monitored these meetings online.

spread of it. As in the case of Korea, it is a recent international trend that more practical discussions are taking place on ways to increase interest and participation in each country and encourage the participation of private companies.

Similarly, the Blue Carbon Initiative is now moving beyond the stage of sympathizing with and supporting its need, to the stage of widespread social expansion, policy-making, and implementation.

Lots of countries have been pursuing researches to measure the amount of blue carbon and including blue carbon absorption sources into methods of storing greenhouse gases. They have established coastal management plans that include policies to preserve and protect blue carbon absorption sources and replant them, and have also considered ways to enhance harmonious development with fisheries. For instance, Australia and the United States have begun to include blue carbon in their greenhouse gas storage figures. Furthermore, they have set carbon emission reduction goals in accordance with the IPCC's guidelines and calculated the amount of blue carbon accordingly.

At the 25th Conference of the Parties (COP 25) held in Madrid, Spain in 2019, the 'ocean' was mentioned and emphasized for the first time as part of the global climate system.⁵ At COP 28 held in Dubai, United Arab Emirates in December 2023, discussions on blue carbon took place more actively. The National Oceanic and Atmospheric Administration (NOAA) of the United States emphasized the ocean as a solution to climate change and led discussions on blue carbon on various topics. The Ministry of Oceans and Fisheries of Korea attended the COP 28 and held an expert discussion session on the topic of 'Blue Carbon Research and Policy Direction for Carbon Neutrality.' Lots of experts, including Peter Thomson, the UN Secretary-General's Special Envoy for the Ocean, and Indonesian blue carbon researchers,

⁵ COP is a meeting of the parties held every year to discuss specific implementation plans for the United Nations Framework Convention on Climate Change signed at the United Nations Conference on Environment and Development in 1992 in order to reduce severe and long-term damage caused by global warming. The 1st COP was held in Berlin, Germany in March 1995, and the 25th COP held in Madrid, Spain in 2019 is also called the "Blue COP."

participated in the session to discuss the potential value of blue carbon and the direction of blue carbon policy.

1.1. UN Sustainable Development Goals Summit

UN SDG summit was held on September 18-19, 2023 at the United Nations headquarters in New York, the U.S., and was attended by summits of each country, government officials, and leaders of international organizations, private sector, NGOs, and civil society.

<General Assembly>



(Source: UN SDG Summit 2023 Official Site)

In September 2015, UN member states adopted the ‘2030 Agenda for Sustainable Development’ as a blueprint for peace and prosperity around the world. This included 17 Sustainable Development Goals (SDGs) aimed at ending global poverty and sustainable development for various areas such as society, economy, environment and climate. This meeting was the second UN SDG Summit to be held since the adoption of the agenda in 2015, and was expected to play a significant role in the implementation of the SDGs over the next seven years. The main topics discussed at this meeting are as follows.

First, the 2030 Agenda for Sustainable Development and 17 SDGs were reaffirmed, and their implementation performance was evaluated. While this agenda and 17 SDGs were intended to secure the rights and welfare of everyone on a healthy planet, progress on the goals had stalled or regressed amid the climate crisis, global economic downturn, conflict, and the ongoing impact of COVID-19 pandemic. Therefore, it was evaluated that it would be difficult to achieve the goal ahead of the 2030 deadline.

Next, at this meeting, specific action plans to achieve SDGs over the next seven years were presented and implementation by each country was emphasized. To be specific, various tasks were discussed to achieve SDGs, including emphasizing the importance of multilateralism, reaffirming official development assistance (ODA) and development finance, and advancing SDGs and digital transformation through expansion of ODA .

1.2. UN Climate Ambition Summit

Held at the United Nations Headquarters in New York, USA on September 20, 2023, heads of state and representatives of international organizations and civil society attended and discussed climate change. In the Climate Ambition Summit, methods for implementing carbon neutrality (Net Zero), realizing climate justice, and promoting decarbonization through collaboration were discussed, and the UN Secretary-General emphasized accelerated action by government, business, finance, local governments, and civil society.

This Summit was mainly programmed around three major sessions: Creditability of Net Zero, Delivery Climate Justice, and Accelerating decarbonization, and three clear but interrelated tracks – Ambition, Credibility, and Implementation – were highlighted.

1.3. Climate Group Seminar

The Climate Group Seminar is an annual climate response conference held in New York since 2009 and is operated by the Climate Group⁶ at the same time as the UN General Assembly. Now it is one of the largest climate change response events held around the world.

This Seminar was also held on September 17-24, 2023 in New York, USA, and more than 1,000 leaders and representatives of major businesses, political change makers, regional policy decision makers, and civil society around the world attended. They discussed countermeasures in industries, energy, transportation, food, health, and economy to respond to the climate crisis, and held various street events to draw global attention.

2. Policy Cases of the United States

2.1. Administrative Governance Cases in the United States

As global wicked issues and more complex administrative demands rapidly surge, and situations in which no single actor, such as one team, one department, one ministry, or one government, can solve the problems on their own increase, the government's operational paradigm in each country has also changed in the direction of strengthening cooperation. Efforts to eliminate partitions between government ministries and strengthen communication, sharing, and collaboration, like 'Government 3.0' in Korea, can be said to be representative examples.

The Open Government of the United States can also be said to be in the same

⁶ According to its official website, Climate Group is an international non-profit whose purpose is to drive climate action, fast.

context. The Open Government focuses on transparency, participation, and cooperation. Transparency means sharing data and information, participation refers to gathering opinions from various people and groups, and cooperation means continuously communicating with the public and working together to solve problems. The Open Government originated in the United States after World War II and was used to mean transparency in the Freedom of Information Act enacted in 1966. However, the current Open Government stance has continued since it was established in 2009 under the Barack Obama's administration as meaning an unprecedented level of openness and collaborative governance.

In the United States, various collaborations with the private sector are taking place across all areas of administration, and local communities and civic groups also plays significant roles. Blue carbon creation has also been being carried out integrated within the Sea Grant program, a representative public-private collaboration project. Accordingly, scientific research, blue carbon creation, and budget input are also being progressed in collaboration with various actors in the local communities and the private sectors.

Before looking at the blue carbon policy case, some examples of administrative governance in the United States are introduced below.

2.1.1. Adopt-a-Highway Project⁷

The Adopt-a-Highway project first began in the U.S. state of Texas in 1985, and became known in Korea when Gyeonggi-do introduced it. Afterwards, it influenced the 'Hangbok Holci Adoption Project' by the Ministry of Government Administration and Home Affairs in 2015.

This project, which began in Texas and expanded across the United States and

⁷ This information was referenced from the Texas Department of Transportation.

internationally, has contributed to keeping streets clean by reducing waste and saving taxes. This project was started by James R. Bobby Evans, a young engineer from the San Angelo District. He had been thinking about how to solve this problem since he watched Money to Burn, an educational film that informed the harmful effects of trash thrown on highways. After becoming an engineer of Tyler District in 1984, Evans came up with a way to solve this problem by connecting with the local community.

Concerned that trash collection costs were increasing by 15 to 20 percent each year at that time, Evans persuaded local groups to adopt highways. Although his proposal was not accepted right away, this was where the idea for the 'Adoption-a-Highway' project began. After discussing this idea with Billy Black, the Tyler District's Public Information officer, Evans asked Billy to lead the idea. Billy then designed the initial projects of the highway adoption agencies, including cleaning cycles, volunteer support, signage installation, and so on.

Finally, on March 9, 1985, the Tyer Civitan Club became the first adoption agency to adopt two miles of Highway 69. Then, within a next few months, more than 50 organizations, such as the Garden Club and the Scouting Groups, newly signed up and adopted the road, and this project gradually expanded nationwide in the United States. As The Adaptation-a-Highway project has been recognized as a great example of a successful public-private partnership, more than 90,000 groups from around the world including 49 states in the U.S., Canada, New Zealand, and Japan, have participated.

Currently, about 3,300 organizations are participating in Texas alone, and they adopt state-managed roads to collect abandoned garbage. They have to adopt a 2-mile road for at least 2 years and pick up trash four times a year.

The city and state that run this project install 'Adopt-a-Highway' signs with the name of the adoption organization and the scope of adoption, and provide volunteers with safety vests, garbage bags and education. A variety of organizations, including individuals, families, youth groups, large and small businesses, civic groups, non-profit organizations, religious groups, social groups, and schools, are participating, and they

are found to be quite satisfied with their participation in the project. In particular, the sign attracted the participation of many people as the phrase ‘in memory of’ along with the individual’s name and the name of the adoption organization could be included to remember the person who died in an accident on the road.

The efforts of these volunteer organizations and individuals save taxes by reducing waste collection costs. Not only is this a way to make participating organizations more valuable, but it also has the effect of reducing littering by drivers as they see their activities on the road.

2.1.2. Local Food Policy Council⁸

The Food Policy Council or Food Board is an organization that generally supports citizens to influence food policy at the local level. It began in 1982 in Knoxville, Tennessee, when the first council was established to respond to the impact of the economic downturn on the local food supply system.

The Food Policy Council is made up of a variety of stakeholders working to create healthy, local, and sustainable food for people living in certain areas. It connects consumers, producers, NGOs, and the government to find solutions that are appropriate for their region.

When maintaining and ensuring a nutritious food supply, access right to healthy food, and local food economy development become policy issues, social, economic, and environmental factors are well linked to derive detailed policy solutions. Generally, these issues require more comprehensive and integrated planning and policy establishment because public institutions (or departments within the public institution) in charge of each aspect are different and many various interests are complicatedly intertwined.

⁸ This information was referenced from Lee (2020).

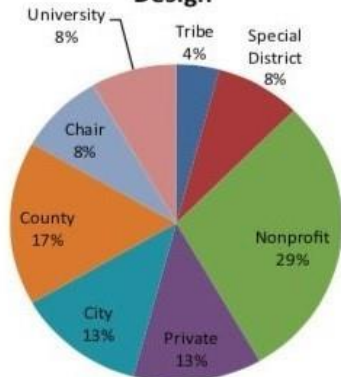
Accordingly, the Food Policy Council formed in each region of the United States is composed of local governments at each level, local councils, civil society groups, non-government organizations, regional universities, private companies, and so on.

<Case of the Food Policy Council>

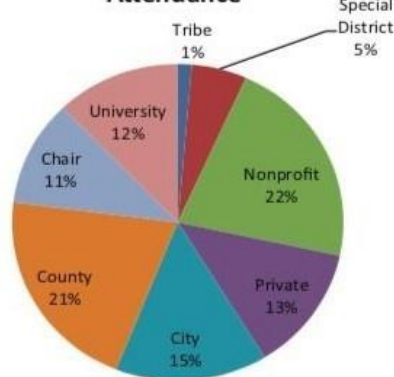
Coding criteria for Organizations Participating in the Food Policy Council.

Organization type	Organization focus
City government	Local department
County government	Local legislature
Nonprofit organization	Economic development
Special district	Community development
Tribe	Food wholesale
University	Resource conservation
Private organization	Health and nutrition
Regional government	Tribe
Council chair	Higher education
	Fisheries
	Resource management
	Grocer
	Food production
	Agriculture
	Nutrition
	Anti-hunger
	Advocacy
	Local food
	Food access
	Regional department
	Extension
	Justice

Council Representation by Design



Council Representation by Attendance



Summary of Council Policy Outputs by Output Activity, Type, and Issues

Council No.	Council Purpose ⁷	Network Heterogeneity (Normalized)	Policy Output Type(s)	Policy Issues Addressed in Policy Outputs
1	Food access	0.69	None	N/A
2	Food access, agriculture, health, economy, environment	5.30	Research and recommendations	Food access, production and retail
3	Agriculture, urban issues, economy, environment	4.39	None	N/A
4	Food access, health, production and retail, local or urban agriculture, economy, education, environment	8.38	Recommendations and full policy	Production and retail
5	Health, local or urban agriculture, economy, education, environment	4.56	Research and recommendations	Local or urban agriculture, economy, food access, schools, production and retail, transportation
6	Food access, agriculture, health, advocacy, production and retail, economy, education, environment, transportation	10.42	Recommendations and full policy	Local or urban agriculture, schools, economy, production and retail, transportation
7	Food access	4.43	Recommendations	Food access, production and retail, health, local or urban agriculture, schools, food waste, economy

Now, let us look at specific examples of activities of each stakeholder. Local governments focus on healthy food nutrition for children, food banks address the problem and solution of food access for the poor, and farmer's markets strive to improve the local economy and connectivity between producers and consumers for local food producers. These activities lead to the planning and policy development of an integrated food system.

2.2. Policies about Blue Carbon in the United States

Recently, the U.S. government is also paying increasing attention to the connection between oceans and climate as using the ocean in order to respond climate has been actively discussed and various limitations on carbon absorption on land, that is green carbon, have been revealed. In 2017, the U.S. Environmental Protection Agency reflected blue carbon in the national greenhouse gas inventory for the first in the world.

The Infrastructure Investment and Jobs Act which is President Joe Biden's flagship infrastructure package, includes funding for coastal habitat restoration. This funding is expected to further strengthen the protection of ecosystems that bring about both mitigation of climate change and adaptation to climate change. President Biden also signed the 'Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies' in April 2022. This executive order addressed the importance of protecting coastal and marine ecosystems, along with it of carbon stored in old forests, and directed to strengthen the approach to nature-based solutions within the federal government.

In addition, the United States joined the Ocean Acidification Alliance⁹ at the 2022 UN Ocean Conference and announced 'the National Ocean Acidification Action

⁹ The Ocean Acidification Alliance is a voluntary to address the cause of ocean acidification, expand research and monitoring, and improve the resilience of coastal communities.

Plan’ during the Conference of the Parties to the UN Framework Convention on Climate Change (COP 28) in December 2023. This action plan included an overview of the U.S. federal government’s marine acidification measures in the past (2009-2023), future OA research, priorities of the U.S. federal government for policy integration, and examples and recommendations for other countries to refer to developing OA action plans. The action plan is a commitment to policy and investment for UN SDG 14.3, and the United States is calling for other countries to make action plans by the 2025 UN Ocean Conference. In other words, the U.S. government is not only promoting activities to prevent marine acidification in its own country, but also inducing the participation of other countries to enhance international cooperation.

Additionally, at the 9th Our Ocean Conference¹⁰ held in Greece from April 15 to 17, 2024, the United States announced that it would provide more than \$508 million for developing marine protected areas, marine security, sustainable blue economy, sustainable fisheries, finding solutions of the ocean coping with the climate change, and preventing marine pollution. This included \$6.5 million to conduct ocean-based scientific carbon monitoring, and \$2.4 million to strengthen the protection, restoration and conservation of important marine and coastal ecosystems such as coral reefs, mangroves, and seagrasses.

In these ways, the U.S. government surely has recognized the importance of the ocean as a response to climate change, has been expanding investment in blue carbon-related policies, and strengthening international cooperation. In particular, in relation to blue carbon, the U.S. is actively progressing policies such as coastal blue carbon protection through habitat conservation, blue carbon statistical projects, research and development for carbon absorption and storage, and carbon market growth linkage for

¹⁰ The Our Ocean Conference is a representative international conference in the maritime sector that brings together about 1,000 heads and ministers from around the world, representatives of international organizations, international companies, and international non-governmental organizations in order to discuss the importance of the ocean that affects humanity and promise concrete action for maritime issues. In particular, voluntary pledges have been announced at Our Ocean Conference, and more than 2,100 pledges registered from 2014 to 2023 amount to \$110.2 billion.

blue carbon.

Among various blue carbon policies, the United States places the highest priority on coastal habitat protection and restoration. This is because damage to coastal habitats causes significant amounts of carbon to be released into the atmosphere. Protecting and restoring coastal habitats is the most basic method, and at the same time, it can be very beneficial by providing habitat for aquatic life through maintaining a healthy coastal environment, making fishing sustainable, managing coastal flood and erosion effectively, and vitalizing tourism. (NOAA, 2023) NOAA Fisheries is in charge of the blue carbon project and related research through coastal habitat conservation. It ensures the participation of local communities and also considers the social and economic benefits that can be provided to the region through the project.¹¹ (NOAA Fisheries, 2023)

The United States has been conducting research and development on carbon storage and absorption to expand blue carbon, while also striving to scientifically prove the social and economic impact of protection and restoration. This can induce voluntary participation from civic groups and the private sector and can be a major premise for public-private collaborative governance. (Yoon, 2023) NOAA Fisheries published reports on the effectiveness of the blue carbon restoration project and conducted research on assessing the effects of blue carbon habitat restoration on flood prevention and fisheries, and ways to minimize the impact of development activities on blue carbon habitats. (NOAA, 2019~2021) These blue carbon studies build partnerships with related organizations and stakeholders and further strengthen their capabilities.

And these blue carbon studies are further increasing their achievements through partnerships with related organizations and stakeholders. For instance, NOAA, Environmental Protection Agency, and Fish and Wildlife Service have jointly formed a

¹¹ For example, the ‘Southern Flow Corridor Project’ implemented in Oregon State was a project aimed at preserving salmon habitat and preventing flooding in the region. This project not only achieved habitat restoration and flood prevention effects, but also secured economic benefits such as increasing the value of surrounding residential areas, improving water quality by reducing sediment, and saving dredging costs to maintain shipping routes.

coastal wetlands working group and have worked together to identify causes of coastal habitat damage and develop methods to solve the problems. Furthermore, they are cooperating with relevant federal agencies to expand information on carbon content in coastal habitats and improve monitoring methods for blue carbon habitats, and are also participating in the Coastal Carbon Research Coordination Network and collaborating with NGOs conducting blue carbon projects. (Yoon, 2023) Cooperative governance comes true by establishing extensive partnerships and networks between government agencies and the private sector.

In addition to the Infrastructure Investment and Jobs Act mentioned above, the Inflation Reduction Act included a legal basis for creating and investing government budget for the conservation and restoration of blue carbon, and here too, contained protecting coastal ecosystems and promoting the interests of local communities. In other words, this act intends to enhance resilience responding to climate change and extreme weather events and improve management of marine resources by providing financial support for projects aimed at protecting and restoring coastal habitats, recovering fisheries resources, and strengthening local community resilience. NOAA plans to spend approximately \$832 million over five years under this act. (Yoon, 2023; NOAA, 2023)

As a result of an overview of the United States' blue carbon policies, it can be seen that in the process of executing the conservation and restoration of blue carbon sinks, local communities are involved and social and economic benefits are maximized. More actors are encouraged participating in R&D not only scientific and technological fields but also quantitative and qualitative effects related to blue carbon. Lastly, the United States enacted related act in order to secure the basis for systematic project promotion and finances based on this. Below more specific policy cases related to blue carbon will be introduced.

2.3. Policy Cases

In the United States, several departments within NOAA, such as the National Marine Fisheries Service, National Ocean Service, and Oceanic and Atmospheric Research, are in charge of blue carbon research and policies. The National Marine Fisheries Service is responsible for protecting the habitat of coastal organisms and improving scientific technology and management capabilities, and the National Ocean Service has been preparing and publishing a Blue Carbon Performance Report every year since 2015. The NOAA Blue Carbon Inventory Project is being done centering on the Climate Program Office within the Oceanic and Atmospheric Research. And blue carbon is also being emphasized in the Sea Grant project that has been maintained for more than 50 years.

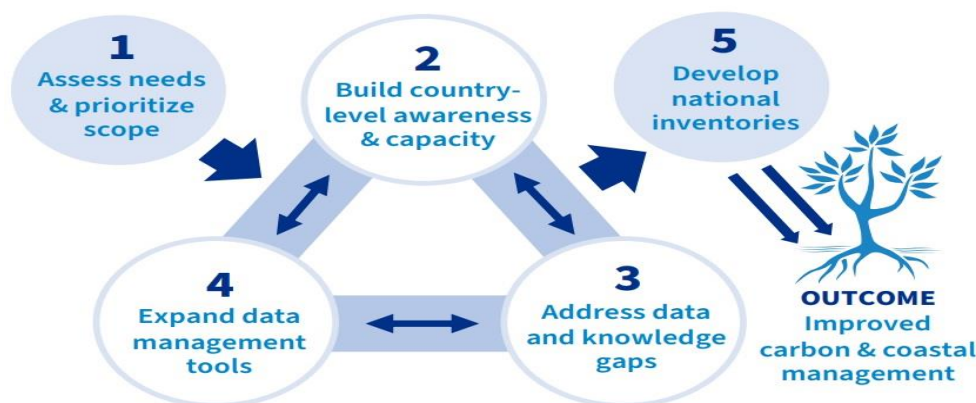
In the states with coastal areas, restoration projects and scientific research are also actively underway along with local universities and experts. Additionally, producing and trading blue carbon credits are briskly taking place around an NGO called Verra.

2.3.1. Blue Carbon Inventory Project¹²

The Blue Carbon Inventory Project is a project designed and done by the NOAA Climate Program Office in cooperation with the Department of State the U.S. This project was implemented from September 2020 to March 2024. Under the Paris Agreement, countries are required to report the National Greenhouse Gas Inventory. (hereinafter referred to as the “NGGI”) In 2013, the IPCC issued amended guidelines allowing wetlands to be included in the NGGI, but only some countries did so due to technical difficulties. Accordingly, the Blue Carbon Inventory Project aimed to help partner countries and regions include blue carbon in the NGGI and ultimately improve the common benefits of the coastal ecosystem.

¹² This information was referenced from the Blue Carbon Inventory Project website of NOAA.

This project featured the inclusion of mangroves and potentially other coastal blue carbon ecosystems in NGGI, as well as the long-term and ongoing management of coastal blue carbon ecosystems in the context of marine space and resilience planning. Focusing on the above two topics, the United States supported technology for partner countries to include blue carbon information in the NGGI. Specifically, to this end, workshops and education at the national and local level, webinars, P2P participation, mentoring and experiential learning were provided. For a more effective push, NOAA collaborated with the National Aeronautics and Space Administration (NASA) to map coastal land cover changes and also developed tools to assess and track the quality of Earth’s soil and biomass blue carbon data with the Smithsonian Environmental Research Center (SERC).



NOAA’s Blue Carbon Inventory Project is part of the broader U.S. program, the Transparency Accelerator for Greenhouse Gas Inventories, and it is expected to contribute to the improvement of greenhouse gas inventories across the United States, as well as to the growing the number of countries including blue carbon in NGGI. This project also fertilized the development of strategies that reflected the value of coastal ecosystems through mitigating gas emissions, managing coastal resources, and storing and sequestering carbon. Furthermore, the network built by the Blue Carbon Inventory Project will protect coastal communities from storms, waves, erosion and flooding, maintain biodiversity, manage water quality, and promote sustainable and regenerative tourism.

2.3.2. National Sea Grant College Program¹³

The National Sea Grant College Program was founded in 1966 by the U.S. Congress and operates to create and keep a healthy coastal environment and economy. The Sea Grant Network consists of a federal/college partnership between the NOAA and 34 university-based programs in all coastal and Great Lakes states, Puerto Rico, and Guam. The network leverages the expertise of more than 3,000 scientists, engineers, public support professionals, educators, and students to help citizens better understand, conserve, and utilize coastal resources of America.

The program is run in collaboration with NOAA's National Sea Grant Office (NSGO), the National Sea Grant Advisory Board (NSGAB), and the Sea Grant Association (SGA), an NGO. The NSGO funds universities through funding competitions and evaluates program operations. The NSGAB advises program priorities through the federal Advisory Committee, and the SGA is comprised of the directors of 34 sea grant programs and several network leaders.

The National Sea Grant Program is conducted in the following stages: 'Research → Education → Extension', with a focus on four areas: 1. Healthy Coastal Eco System, 2. Resilient Communities & Economics, 3. Sustainable Fish and Aquaculture, and 4. Environmental Literacy & Workforce Development. According to NOAA, in 2022, the federal government invested \$89.5 million and was estimated to have generated an economic effect of \$802.03 million. Additionally, 2,120,592 acres of habitat were restored or protected, and 1,601 related businesses and 9,659 jobs were created or sustained.

Blue carbon research through the Sea Grant program is also increasing. In addition to scientific research such as measuring and evaluating blue carbon storage and

¹³ This information was referenced from the National Sea Grant College Program website of NOAA.

expanding and restoring coastal habitats, studies like responding to legal issues that may arise during the project process and assessing marketability were also conducted. Specific examples are as follows.

- i. Quantifying Carbon Burial Rates as a Critical Ecosystem Service in the Mississippi Delta (Louisiana Sea Grant, 2022)
- ii. Factors Influencing Carbon Stocks and Accumulation Rates in Eelgrass Meadows Across New England, USA (MIT Sea Grant, 2020)
- iii. Oregon’s Blue Carbon Ecosystems: State of the Science, a summary of the current understanding of the climate mitigation potential of Oregon’s coastal and marine habitats (Oregon Sea Grant, 2022)
- iv. Legal Issues Affecting Blue Carbon Projects on Publicly-Owned Coastal Wetlands (Rhode Island Sea Grant, 2020)
- v. Emerging Understanding of Seagrass and Kelp as an Ocean Acidification Management Tool in California (California Sea Grant, 2018)
- vi. Carbon Market Opportunities in Virginia: Eelgrass, Marshes, Soils, and Forests (Virginia Sea Grant, 2020)
- vii. North Carolina’s Ocean Economy: a first assessment and transitioning to a Blue Economy (North Carolina Sea Grant, 2017)

2.3.3. Establishing a Blue Carbon Network for the Gulf Coast Project¹⁴

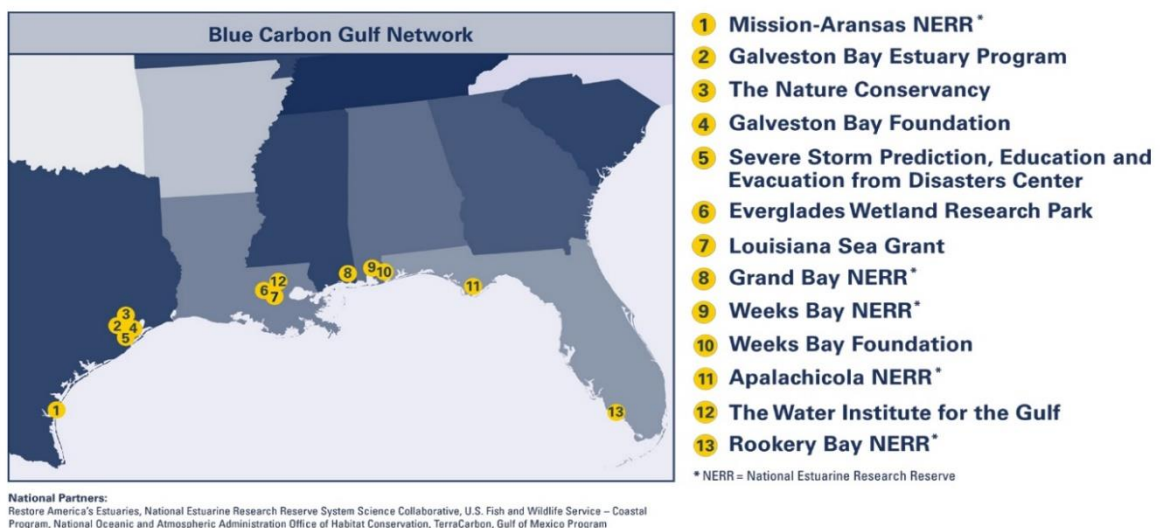
The Gulf Coast has been losing coastal wetlands at an alarming rate. This inevitably has a negative impact on water quality, coastline stability, habitat protection, and greenhouse gas sequestration. In particular, when coastal wetlands are devastated

¹⁴ This information was referenced from the Establishing a Blue Carbon Network for the Gulf Coast Project website of NOAA.

and destroyed, carbon stored in seagrass, mangroves, and salt marshes, that is blue carbon, is released into the atmosphere. As part of countermeasures against this problem, the Gulf Coast National Estuarine Research Reserves selected blue carbon as a priority topic.

The project developed the Gulf Coast Blue Carbon Network, a platform for sharing information on the Gulf Coast region and cooperation necessary to develop projects. The end users of this project are protected area staff, local government restoration practitioners, researchers at local academic institutions, non-profit organizations, resource managers, and people involved in habitat protection and restoration in the Gulf Coast region. Through this project, ideas were discovered to improve local awareness of blue carbon, and a pilot project to utilize blue carbon was implemented.

This project was carried out from September 2015 to August 2017, with several regions including the Apalachicola National Estuarine Research Reserve, the Grand Bay National Estuarine Research Reserve, the Mission-Aransas National Estuarine Research Reserve, the Rookery Bay National Estuarine Research Reserve, and Weeks Bay National Estuarine Research Reserve. 11 organizations such as NOAA’s Office of Habitat Conservation, the Restore America’s Estuaries, the U.S. Fish and Wildlife Service Coastal Program, the Weeks Bay Foundation, and so on, participated as partners in the project.



The main activities of the project included workshops on blue carbon, written evaluations of the needs and opportunities of blue carbon, and production of the “Blue Carbon in Practice” webinar series for audiences in the Gulf Coast region and nationwide. Several Gulf Coast reserves proposed new blue carbon pilot projects and research topics, such as a blue carbon feasibility study for mangrove restoration at the Rookery Bay Reserve and a science collaboration project at the Mission-Aransas Reserve that explores blue carbon outreach and communication.

This project created and strengthened relationships between stakeholders who knew very well about the Gulf Coast protected areas and blue carbon. Not only did this project help them improve their understanding of blue carbon and market concepts, but it also affected future blue carbon outreach plans for stakeholders.

2.3.4. Blue Carbon Cooperation Program in Chesapeake Bay¹⁵

Chesapeake Bay is the largest estuary in the United States, spanning Maryland State and Virginia State, with a total area of 11,601 km². The project was centered around Maryland, which was due to its characteristics. Maryland enacted its own Greenhouse Gas Reduction Act with very aggressive greenhouse gas reduction goals and was looking for creative solutions to the problem. Maryland also had a geographical advantage, given that most of the global carbon cycle occurs through the ocean, and coastal habitats account for half of the total carbon sequestered in marine sediments. Maryland has over 3,500 miles of coastline and is rich in two (245,840 acres of salt marshes and 59,000 acres of seagrasses) of the three most productive blue carbon habitats, making the state a suitable place for blue carbon research and project implementation. In other words, Maryland had an ideal policy environment for using blue carbon as a solution to the carbon problem.

¹⁵ This information was referenced from the Blue Carbon Cooperation Program in Chesapeake Bay website of NOAA.

First, Maryland has demonstrated outstanding leadership in land-based practices that help sequester carbon through improved management of existing forests and farms to capture and retain more carbon in trees and soil. This has extended to shorelines, not just on land. The Maryland Commission on Climate Change selected blue carbon as a priority, and Maryland's Department of the Environment and Department of Natural Resources selected the following tasks:

- i. Review current algorithm for calculating blue carbon sequestration in Green House Gas Inventories and propose enhancements if necessary;
- ii. Better understand the quantity and spatial distribution of methane emissions associated with wetlands in the Chesapeake Bay and its watersheds
- iii. Create opportunities to connect agency staff with researchers working on blue carbon in Chesapeake Bay;
- iv. Identify standards for data collection, quality control and archiving if the Maryland's Department of the Environment algorithms are to be upgraded;
- v. Enhance understanding and appreciation for the intersection of blue carbon, Chesapeake Bay restoration, and maintaining a healthy ocean ecosystem;
- vi. Explore innovations in funding/financing/valuation systems, including methods to assess blue carbon co-benefits as part of project selection processes;
- vii. Identify and seek solutions to ongoing challenges or barriers;
- viii. Highlight connections between blue carbon, living shorelines and ocean health including spotlighting successes.

Next, cooperation with private institutions was strengthened. Blue carbon is a complex subject that is affected scientifically, ecologically, sociologically and financially. And a lot of work about blue carbon is done internationally and domestically. Therefore, making good use of expert knowledge is very important in effectively and quickly promoting the above blue carbon-related policies. For example, there are COMPASS and Restore America's Estuaries (RAE) that value blue carbon as a nature-

based solution. COMPASS provides basic scientific knowledge on blue carbon that is easily accessible to policy makers. Not only has RAEs been continuously involved in coastal and estuary restoration, but it also has strengths in the work of quantifying the benefits of blue carbon.

If Maryland, RAE, and COMPASS work together¹⁶ around Chesapeake Bay, the largest estuary in the United States, various goals related to blue carbon can be realized. It is expected that these programs will enhance to collaborate among institutions, the private sector, and NGOs to produce success stories and spread throughout the United States.

2.3.5. Verified Carbon Standard Program

The Verified Carbon Standard Program (VCS program) is a program operated by a non-profit organization called Verra. Verra was founded in 2007 by environmental leaders and entrepreneurs who recognized the need to strengthen quality assurance in voluntary carbon markets. It currently serves as manager of the VCS program, a global voluntary carbon market program.

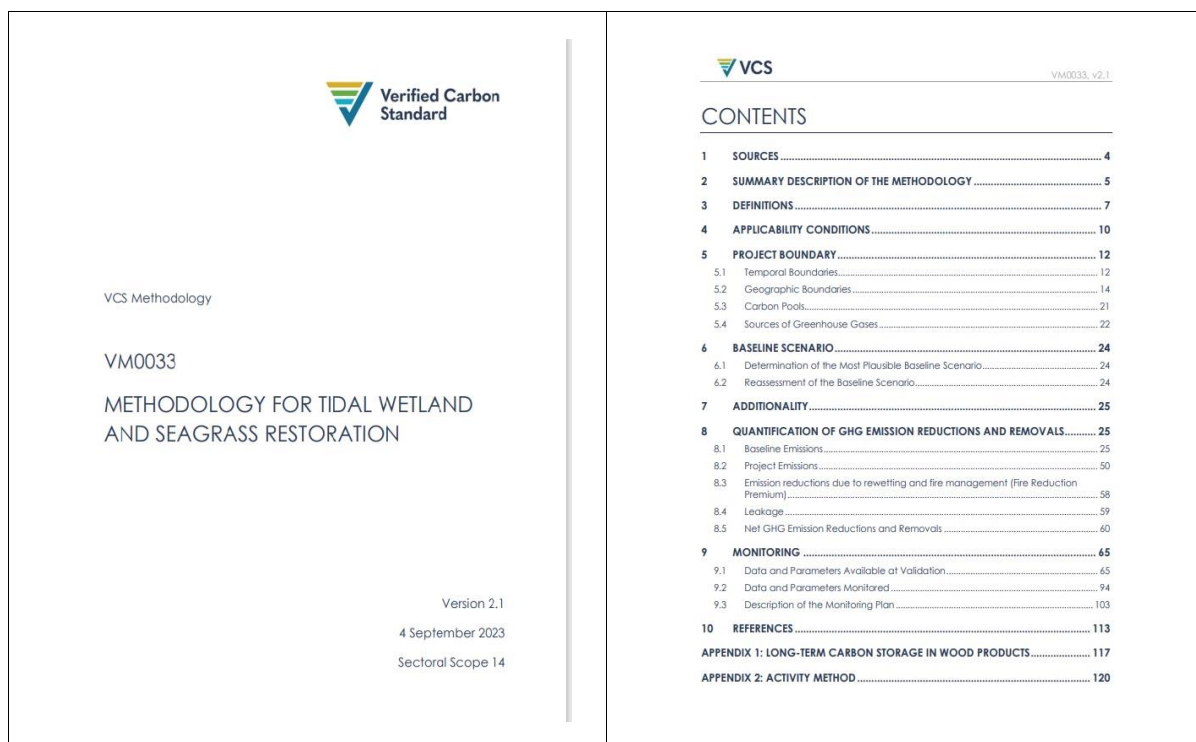
In a situation where regulations on carbon trading were not agreed upon at COP 28 in December 2023, the VCS program is still acting as an important mechanism for voluntary carbon regulation between companies and countries. It is the world's most widely used greenhouse gas credit program. This reduces or eliminates carbon emissions and redirects finances toward activities that improve lives and protect nature. The VCS program has reduced or removed more than 1 billion tons of carbon and other greenhouse gas emissions from the atmosphere.

It is realistically difficult for each individual, company, or organization to

¹⁶ Webinar: Accounting for Maryland's Blue Carbon / Webinar: Environmental Finance Mechanisms for Enhancing Maryland's Blue / Workshop: Living Shorelines in Practice - Enhancing Coastal Resilience

completely reduce greenhouse gas emissions in a short period of time. Instead, purchasing credits from the voluntary carbon market through the VCS program can offset the inevitable emissions at this point. This mechanism may seem to simply require companies that have no choice but to emit pollutants to pay for the emissions, but in reality it is much more than that. This is because the money paid by the company is used to provide medical services, good education, and other sustainable development benefits that can improve the quality of life in the communities where the project takes place.

By operating the VCS program with sincerity and transparency, Verra makes credit buyers have confident that their purchases have had the intended effect, i.e., carbon offsetting and reducing greenhouse gases, beyond simply purchasing carbon emissions.



As the quality of the VCS program has been certified, carbon credit sellers who want a quality-guaranteed carbon market have also chosen the VCS, allowing Verra to continue to secure a solid buyer pool. The VCS program has also been approved by the International Carbon Reduction and Offset Alliance (ICROA) because it conservatively

estimates performance for carbon that actually exists and can be measured according to the quality assurance principle and independently verifies it and even assigns a unique number. Furthermore, the VCS program has strict rules and requirements and quickly adapts to new science, technology, and regulatory development. In addition, related information is publicly provided in the Verra registry. It means that the VCS program is run transparently.

Blue carbon was approved in 2012 by this VCS program, and since then, transactions have been taking place in the market. Currently, Verra is operating a program targeting mangroves, salt marshes, and seagrass which are certified as carbon sinks by the IPCC. Verra developed a wetland and seagrass restoration module using a methodology called REDD, which was applied to terrestrial forests. Individual companies apply this to the conservation and restoration projects they undertake, quantifying the benefits of reducing and eliminating carbon emissions and issuing Verified Carbon Units that can be sold on the voluntary carbon market.

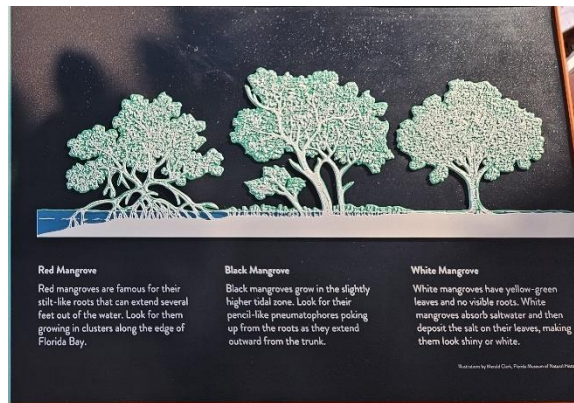
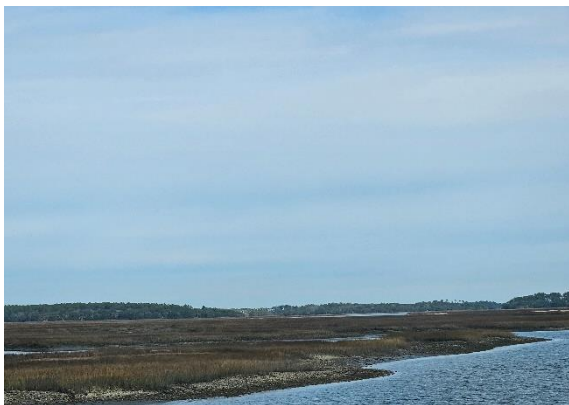
Additionally, Verra formed the Blue Carbon Working Group¹⁷ in early 2020 to study challenges and develop solutions for coastal wetland restoration and conservation. The working group provides advice on how the VCS can be used to encourage blue carbon activities. Even though marine activities related to the marine ecosystem, such as seaweed farming, kelp forest restoration, and seabed management, also serve as blue carbon sinks that sequester and store carbon, there is currently no methodology to support this in the VCS program. Verra is helping the scientific community conduct research more quickly to find the way and is looking for how to expand the VCS program.

2.4. Field Trip

¹⁷ Verra, Silvestrum Climate Associates, Blue Marine Foundation, the Blue Carbon Initiative, Oceans 2050, and so on participated to form the Seascape Carbon Initiative (SCI).

I conducted a Blue Carbon field trip focusing on the Florida Peninsula. Due to the nature of the climate, mangrove forests are widespread on the Florida Peninsula. In particular, the Everglades National Park area located in Southern Florida has various coastal wetlands and mudflats in addition to mangrove forests.

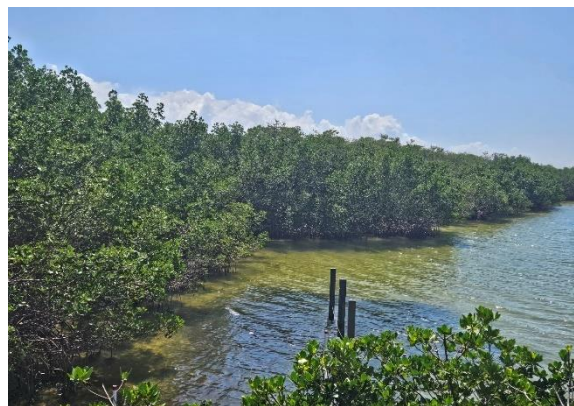
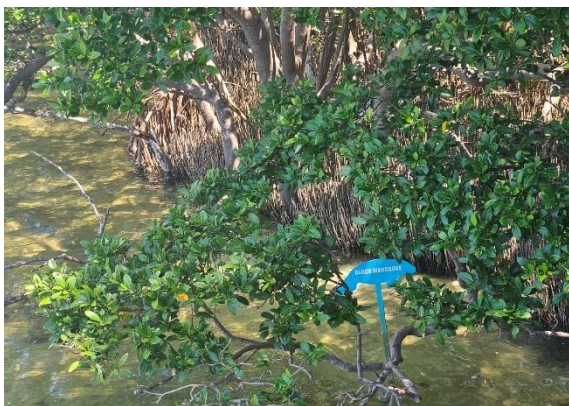
<The Everglades National Park Located in Southern Florida>



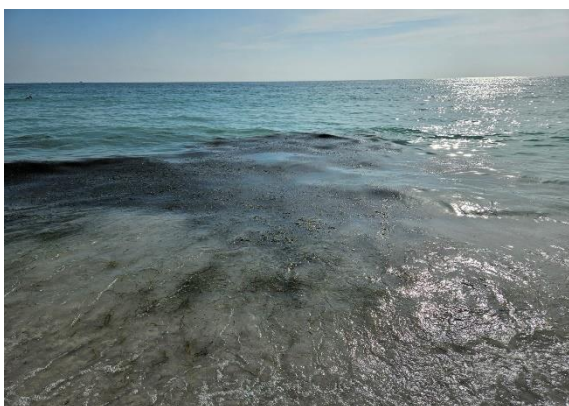
The U.S. federal government has designated the Everglades area as a national park since 1947 to limit development and preserve its ecosystem. There are red, white, and black mangroves, and their root types are distinguished depending on the proximity

to the coast. Wetlands or mudflats adjacent to the coast are also well-preserved. They serve as a final link for groundwater flowing from the Florida Peninsula to flow into the sea.

<Gulf Coast in Western Florida>



<The East Coast of Florida State and Georgia State>



On the eastern coast of the Florida Peninsula bordering the Atlantic Ocean, groups of seagrasses form naturally on the sea and often wash up on the beach. The U.S.

government recognizes the importance of seagrasses and only removes those that washes up on beaches where it can affect people and animals. In addition, NOAA is taking the lead in constantly monitoring seagrass beds formed in the middle of the ocean and observing their amount and movement trends. Areas that serve as major habitats for fish are designated as ‘essential fish habitats,’ and all activities conducted in these areas are required to consultation with NOAA. Meanwhile, the U.S. government prohibits the harvest of seagrass in all federal waters south of the North Carolina-South Carolina border.

3. Policy Cases of Japan¹⁸

Current blue carbon-related policies have passed the necessity recognition stage and have moved into the social diffusion, policy decision-making, and implementation stages, and each country is making efforts to measure the amount of blue carbon and reflect it in the national plans.

Following this international trend, central government, local governments, and regional communities of Japan also began to recognize the importance of blue carbon and make efforts toward social implementation. Local governments, private companies, individual managers and engineers are showing high interest in future socioeconomic development of the preservation and recovery of the blue carbon ecosystem as a new business opportunity. Japan clearly stated that it would expand blue carbon as a carbon dioxide sink in the “Long-Term Strategy as a Growth Strategy Based on the Paris Agreement” approved by the Cabinet in 2019.

Like many other countries, one of the most efficient and effective ways to respond to climate change is the implementation of emissions trading systems (ETSs). In relation to forests, private voluntary carbon emissions trading is widespread, and agricultural carbon sequestration credits, such as NORI, established in 2017, are also

¹⁸ This information was referenced from Kuwae et al. (2022).

being traded. However, Japan also still lacks scientific knowledge and policy experience regarding blue carbon in the ocean, and plans to generate blue carbon credits are being discussed.

Below, let us take a look at some examples of blue carbon credit projects recently progressed in Japan, such as seagrass colonies, large-scale seagrass farming, and so on.

3.1. Yokohama Blue Carbon Project¹⁹

In the ‘Yokohama City Action Plan for Global Warming Countermeasures’, Yokohama City set a goal of reducing greenhouse gas emissions by 7% by 2021 and 30% by 2030 compared to 2013. Additionally, Yokohama City is a member of the C40 Cities Climate Leadership Group, an international network of cities actively responding to climate change, and the Local Governments for Sustainability. In 2015, it was named the only Asian member of the Carbon Neutral Cities Alliance. Like these, Yokohama City is playing a leading role in responding to climate change.

Yokohama City’s Blue Carbon Project, which started in 2014, aims to create synergies between the environment, society, and economy by promoting active measures against global warming, such as water purification and biodiversity conservation. The project introduced the concept of ‘blue resources’ in addition to blue carbon, which refers to customized resources that effectively use abundant marine energy, food, and biomass resources to reduce CO₂ emissions. Also, the concept of ‘Friendly Ocean’ is being used to encourage citizens’ cooperation in marine development, environmental education, and awareness.

Under Yokohama Blue Carbon Project the amount of greenhouse gases absorbed or reduced by blue carbon or blue resources is certified as credits, and this

¹⁹ This information was referenced from Kuwae et al. (2022).

ensures that carbon emissions are reduced through the transaction of these credits. Since 2014, the initial point of this project, the credits created and the number of users using credits have been increasing every year.

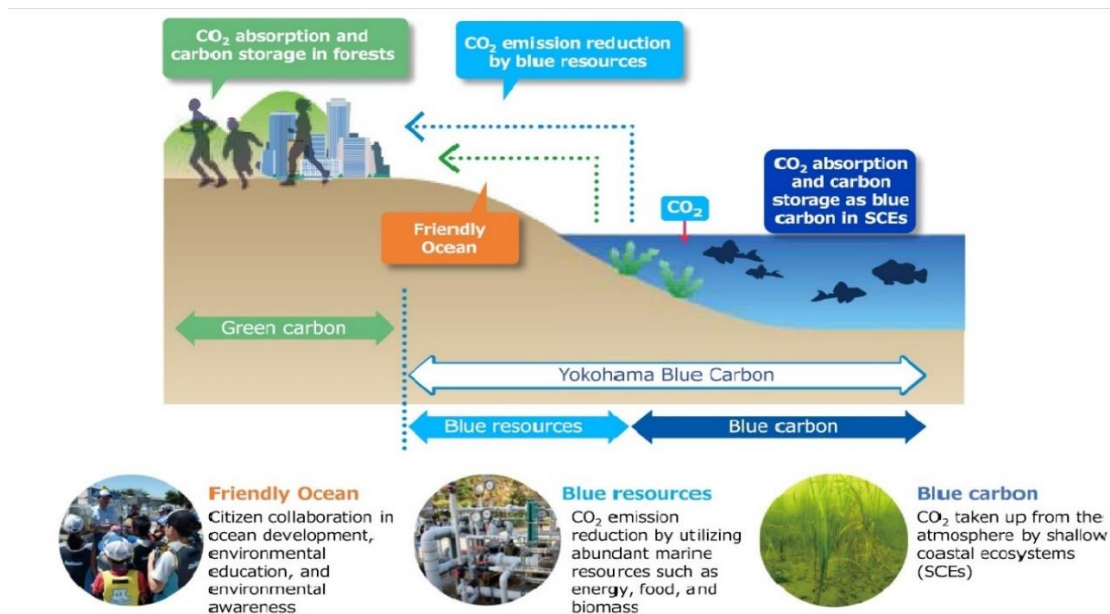


Fig. 1. Framework of the Yokohama Blue Carbon Project. Modified from [55].

One interesting thing to note is that despite this increase, until 2018, all credits came from blue resources not blue carbon. In order to improve this situation and revitalize the project, the city of Yokohama introduced a blue carbon certification and offset system in 2019. Blue carbon credits are basically calculated using IPCC guidelines and methods made by experts.²⁰ Using this, it is possible to measure the carbon storage capacity of giant algae layers and tidal flats as well as blue carbon ecosystems across Japan. Although this project began as a social experiment and specialized in Yokohama City, it has significant meaning as the world’s first case of issuing credits from carbon dioxide storage in seagrass forests, macroalgae beds, and seagrass farming.

Initially, this system primarily targeted blue carbon and blue resources within

²⁰ For example, in the case of a seagrass forest, the credit is calculated as “Annal CO₂ sink capacity (t CO₂/year) = activity data (ha) × removable coefficient (t CO₂/ha/year).” In 2019, 7.8ha of eelgrass beds in the Sea Park Yokohama, operated by the city of Yokohama, had a CO₂ storage capacity of 12.3t CO₂/year, and a credit equivalent to 12.3t CO₂ was certified.

the Yokohama City area. However, as awareness of blue carbon grows nationwide, it has been spreading to other municipalities working with the City of Yokohama to develop the blue carbon offset system. And the number of credit applicants and the overall amount of certified credits are increasing every year. In 2017, the city of Yokohama created a calculation method for the reduction in CO₂ emissions achieved after replacing oil tugboats with LNG tugboats, and in 2018, it also created a method for calculating the emission reduction when switching to hybrid tugboats. This system is expanded to other fields.

Finally, at the beginning of the project, credits were primarily used to offset CO₂ emissions produced by short-term business activities. However, starting in 2016, the third year of the project, credits began to be used to offset CO₂ emissions generated from ongoing business activities. And finally, in 2019, it was used by an individual for the first time.

3.2. Offset Credit System of Fukuoka City²¹

In 2018, the City of Fukuoka established the “Hakata Bay Next Conference” to promote cooperation among citizens, fisheries, educators, expertise, and local governments. This conference was created to lead the environmental, economic and social improvement of Hakata Bay’s wealth and try to transit it to future generations. Currently, it is focusing on building eelgrass beds and working on environmental conservation, restoration, and utilization of Hakata Bay.

As part of these activities, a blue carbon offset credit system and funding system were created. The blue carbon offset credit system is the second in Japan after Yokohama City, and the funding system is the first in Japan.

Fukuoka’s blue carbon offset credit system sets the amount of CO₂ absorbed

²¹ This information was referenced from Kuwae et al. (2022).

through the creation, maintenance, and management of eelgrass and macroalgal beds as blue carbon credits owned by Fukuoka City. Proceeds from credit sales is converted to the “Hakata Bay NEXT Conference” to fund environmental conservation activities, including activities related to eelgrass beds. Fukuoka City referred to the method of the Yokohama City project, but some coefficients were different. Using this, the CO₂ absorption of 15.6 ha of eelgrass beds in Hakata Bay was calculated to be 42.1 ton/year, and a credit of 42.1 ton CO₂ was recognized.

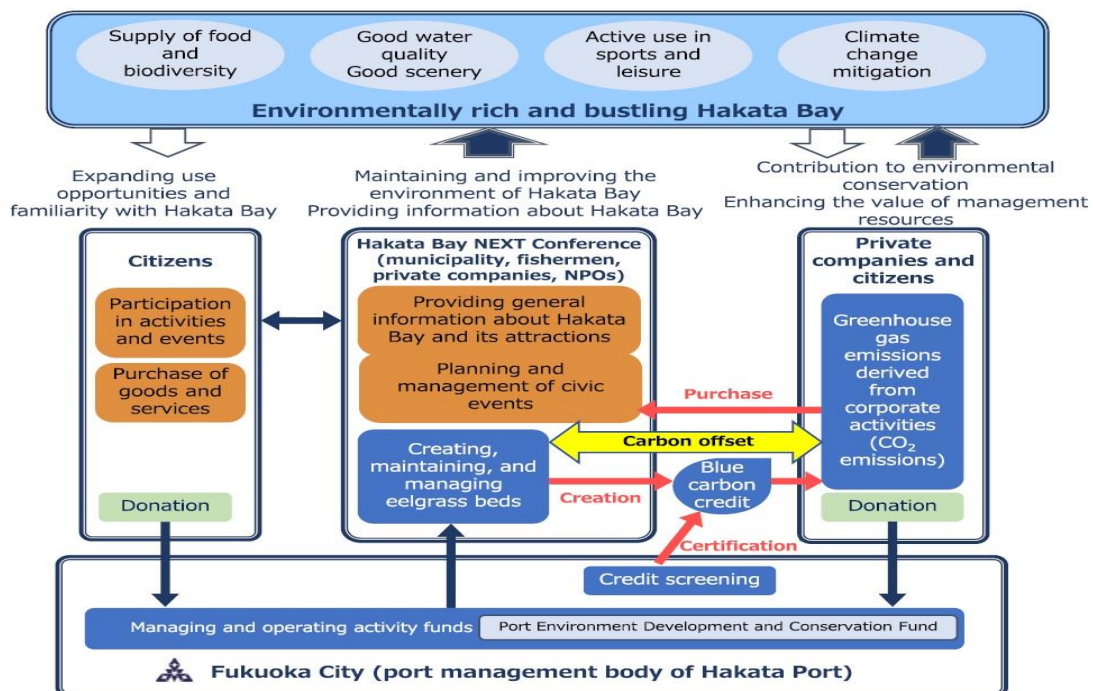


Fig. 2. Framework of the Fukuoka City blue carbon offset credit system. Modified from [56].

The Port Environment Improvement and Conservation Fund is created by collecting donations from companies and individuals, and an additional 2.5% of port usage fees. It is used as a financial resource for environmental conservation and restoration activities.

3.3. Offset Crediting Demonstration by the Japanese Government²²

²² This information was referenced from Kuwae et al. (2022).

In 2020, the Ministry of Land, Infrastructure, Transport and Tourism of Japan approved the Japan Blue Economy Association (JBE) as the Collaborative Innovation Partnership (CIP), a type of government-approved private cooperative. JBE is the first certified CIP in the field of marine environment.

JBE's identity can be realized by researchers, engineers, and practitioners in various fields and positions. All participants serve in equal positions to further strengthen cooperation among various partners, such as private enterprises, local governments, non-governmental organizations, non-profit organizations, and so on. JBE is developing a detailed methodology for the blue economy project based upon scientific and technical evidence, quantitative assessment of ecosystem services, and economic value, etc. Specifically, the roles expected of partners participating in JBE are as follows.

- i. NGO/NPO: 1) Raising public awareness of coastal environmental plans implemented at local sites, 2) Securing funds for these plans
- ii. Private enterprises: 1) Quantification of environmental, social, and governance efforts (ESG) as key performance indicators, 2) Social contribution through SDG-related activities of companies such as SDG 14 (Life Below water), SDG 13 (Climate Action), and SDG 6 (Clean water and sanitation)
- iii. Researchers: Development and identification of a method to measure the CO₂ absorbed by plants growing on the coasts

The Japanese government has decided to carry out an Offset Credit pilot project jointly with JBE, and that is the “J-Blue Credit Project.” This carbon reduction system is designed based on a voluntary carbon market and is expected to be included in the regular trading market if it is included in Japan's national standards and credit system in the future. As the operator of this project, JBE receives subsidies but runs as an independent entity. Therefore, the following differences arise from the system operated by local governments.

First, JBE has a variety of methodological options for setting carbon reduction amounts and credits. Choosing to make technically difficult but more accurate and reliable estimates can increase credit certification rates and reduce transaction costs. Conversely, making the technically easy choice may result in negative effects such as higher fees and lower credit verification rates.

On top of that, JBE can continuously review and improve the methodology that already have been set. These flexible methods that can be reviewed and revised frequently in line with rapid advances in science and technology will reduce costs and increase the efficiency of project operations. This could further develop the carbon market.

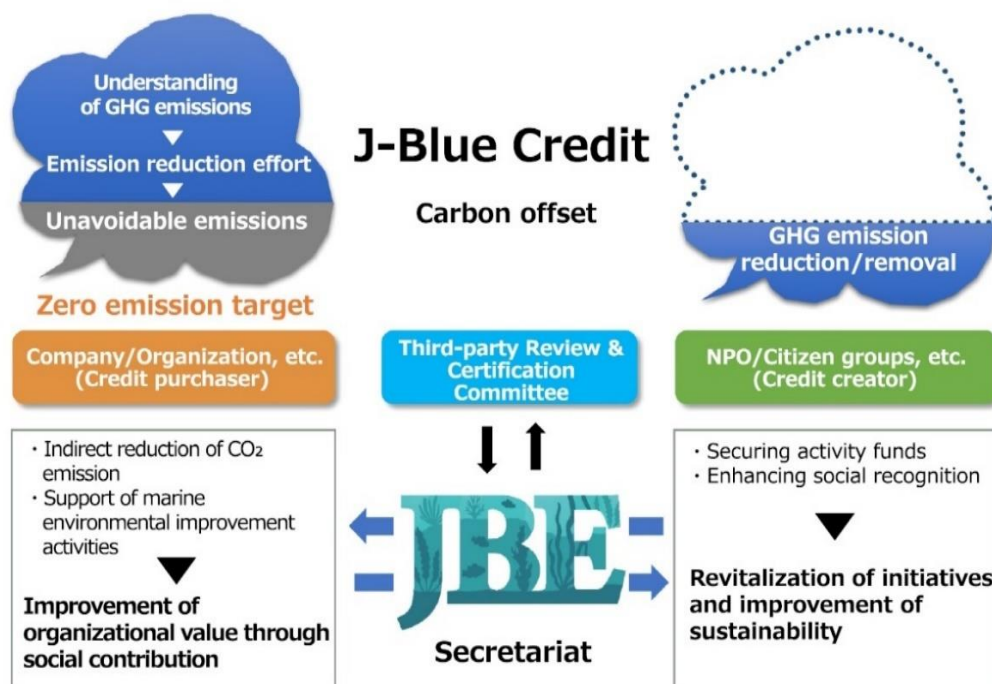


Fig. 3. Framework of the offset crediting demonstration by the Japanese National Government.

Finally, JBE can autonomously set various fee price systems. JBE introduced a pricing mechanism according to various methods such as direct transactions and auctions. If local governments are in charge of transaction brokerage, the unit price of credit transactions will often be fixed mainly by reflecting the existing forest credit system, which already has fixed prices and extensive transaction records. Although fixed prices may reduce disputes between credit producers and buyers, they will not

reflect the supply-demand balance of the carbon market. In interviews about why they purchased blue carbon credits, it was showed that buyers highly appreciated and sympathized with the fact that purchasing credit was not only a response to climate change, but also had other additional benefits, such as the buyer’s goals and branding image. If prices can be set in various ways, these additional benefits can be reflected in the price.

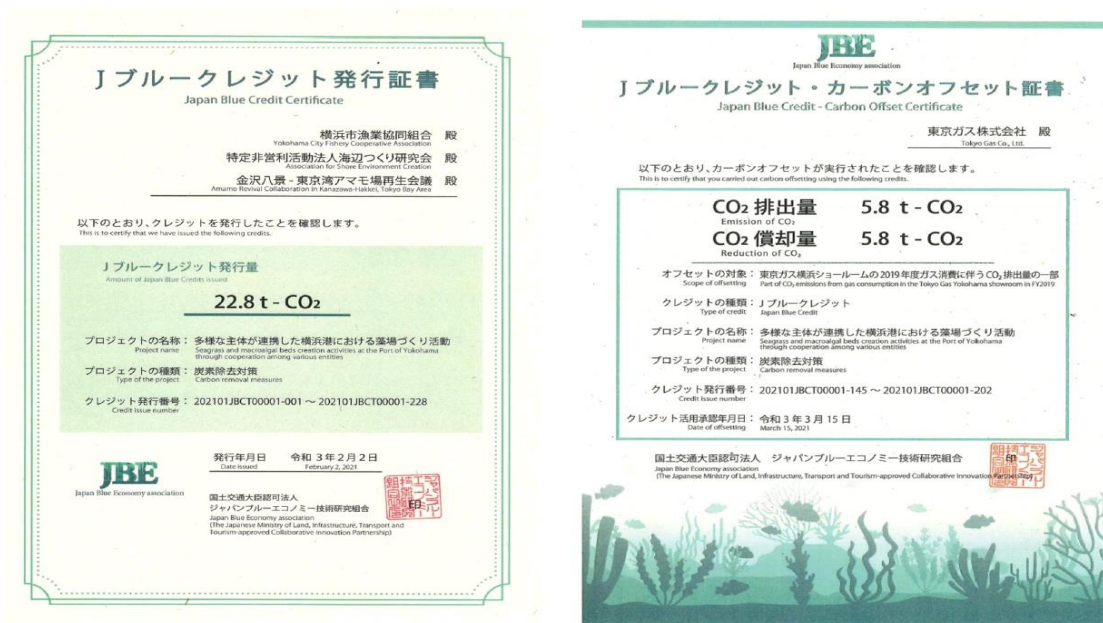


Fig. 4. Example of certificates of (a) the J-Blue Credit and (b) the carbon offset using the credit.

A case study was conducted on newly created eelgrass and sargassum colonies in Yokohama Bay. Planting colony seedlings was carried out by the Yokohama City Fishery Cooperative Association, the Association for Shore Environment Creation, and Amamo Revival Collaboration in Kanazawa-Hakkei. When the CO₂ absorption capacity was calculated, eelgrass was 50.2 ton/year and sargassum was 0.6 ton/year, and carbon credits of 22.6 and 0.27 ton were recognized, respectively. These credits were purchased by three private companies listed on NIKKEI 225 and used to offset CO₂ generated from the companies’ business activities.

Overall, the Japanese people support the blue carbon project, and this support is possible because there are various entities such as local governments, companies, fishermen, and NPOs, and they are directly or indirectly involved in conservation and restoration projects to make blue carbon credits. Credit buyers are also more

sympathetic to the project as a whole, not just limited to the blue carbon credit itself

However, as there are various stakeholders in a certain marine area, such as managers, users, and conservation activity implementers, conflicts may arise among them. Therefore, a system to mediate conflicts can be a success factor for the project, and human, material, and financial resources should be managed and invested under appropriate systems or mechanisms.

4. Policy Cases of France²³

In 2018, the French government established its own standard called ‘Label Bas-Carbone (LBC - low carbon label)’ to certify voluntary carbon projects in the private sector. The LBC is operated by the Ministère de la Transition écologique (the Ministry of Ecological Transition) of France and the LBC has approved 13 methods and certified 628 projects since its introduction. Through this, it is expected to potentially reduce about 2.2 million tons of CO₂.

So far, approval and certification through LBC have been concentrated on agricultural lands and forests, but recently, LBC has focused more on the blue carbon ecosystem. France also recognizes the importance of blue carbon, as one of the ecosystem in response to climate change. France is in the process of introducing it in policies, and seeks to promote market-based blue carbon expansion policies. In April 2023, it officially approved the protection of Posidonia marine meadow located on the French Mediterranean coast, and developed methods for the restoration of mangrove forests and rainforests.

A distinctive feature of the approved approach is that it is looking for a carbon-neutral solution based on nature. In other words, the French government is using a standard called LBC to spread nature-based carbon neutrality and is also encouraging

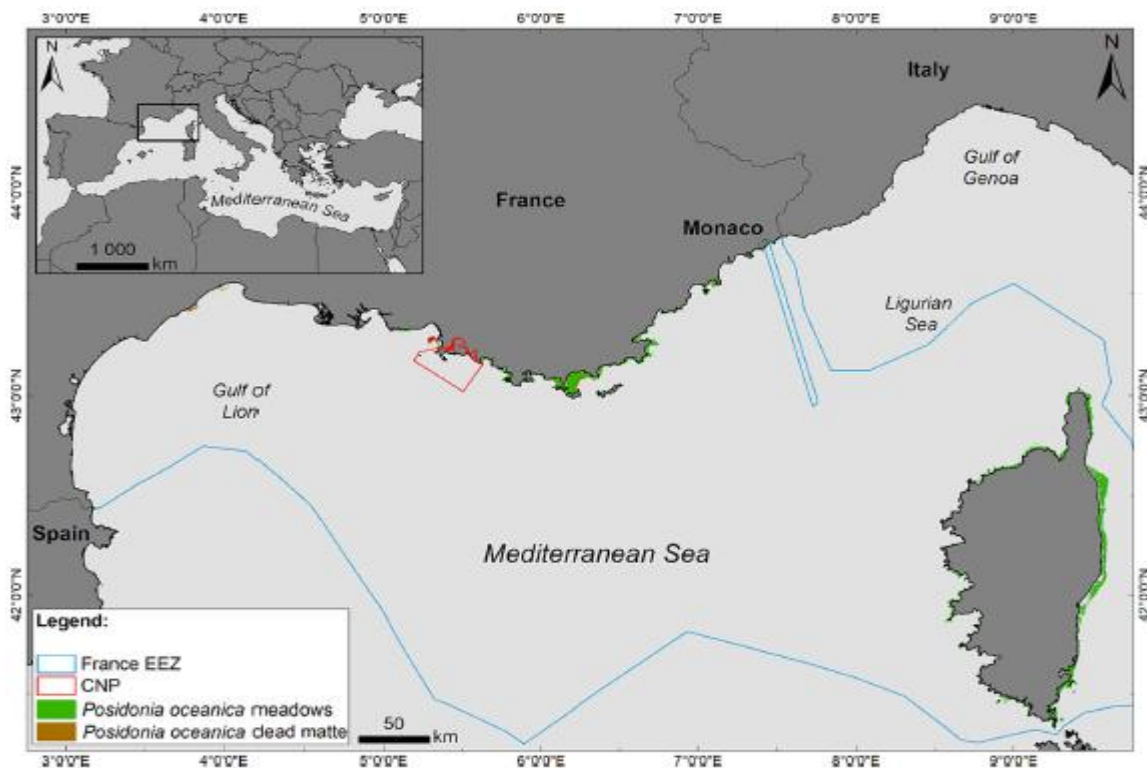
²³ This information is referenced from Comte et al. (2024).

the private sector to voluntarily pursue carbon projects through LBC. Based upon the verified method, a variety of projects about blue carbon are actually being discussed and developed.

4.1. *Posidonia Oceanica Meadows Project*²⁴

Taking the *Posidonia Oceanica* Meadow as an example, meadow seagrasses have had the ability to capture, sequester and store carbon for thousands of years, and this has played a significant role in mitigating climate change. Seagrasses in this region are the type most likely to sequester carbon over the long term. These deep-sea meadows, several meters thick, are composed of rhizomes, roots and organic debris filled with sediment.

<Distribution of *Posidonia Oceanica* Seagrass Meadows>



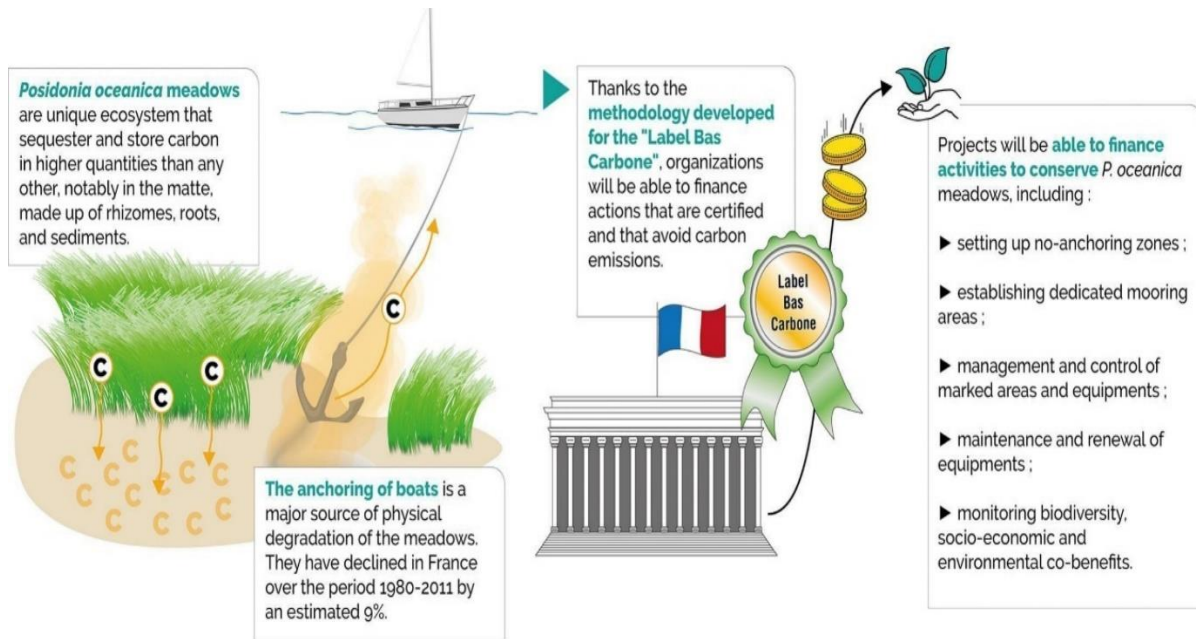
²⁴ This information is referenced from Comte et al. (2024).

The *Posidonia Oceanica* Meadow is protected by being enrolled on the list of protected marine plant species under the French Nature Protection Act of 1976. In addition, it has attracted attention from neighboring countries beyond France, as it was mentioned in the Berne Convention, Annex II of the Protocol to the Barcelona Convention, and the ‘Habitats-Fauna-Flora’ directive of the European Council. Meanwhile, in 2012, Parc National des Calanque (the Calanque National Park) was designated nearby. This national park has a wide protected area with 8,500 ha of land and 43,500 ha of sea, playing an important role in protecting *Posidonia* Seagrass Meadow.

Despite these conservation efforts, human activities within marine protected areas in the Mediterranean over the past 100 years have resulted in the loss of approximately 10% of their surface area, leading to a variety of crises. In general, seagrass meadows are affected by various physical impacts such as coastal development, trawling fishing, ship anchorage, erosion, and beach nourishment. In particular, the anchoring of cruise ships through moorings is a major cause of the physical deterioration of seagrass meadows.

Researchers such as Dr. Andrien Comte of IRD (Institut de Recherche pour le développement), a French national institution, studied the LBC certified methodology to show the operation and institutionalization process of the blue carbon policy and suggested additional research needed in the future. Anchoring boats near seagrass meadows causes a lot of physical pressure like tearing seagrass communities, and worsening mat which prevents reproduction in the long term. The methodology accredited by LBC assessed that reducing sailing and anchoring could induce to reduce the physical impacts and potentially lower carbon emissions. The LBC’s methodology suggests ways to improve the carbon reserve capacity of *Posidonia* Seagrass Meadow and preserve them. Furthermore, it enables project promoters to implement and monitor conservation measures within the project and secure funding.

< LBC & Posidonia Oceanica Meadow Projects >

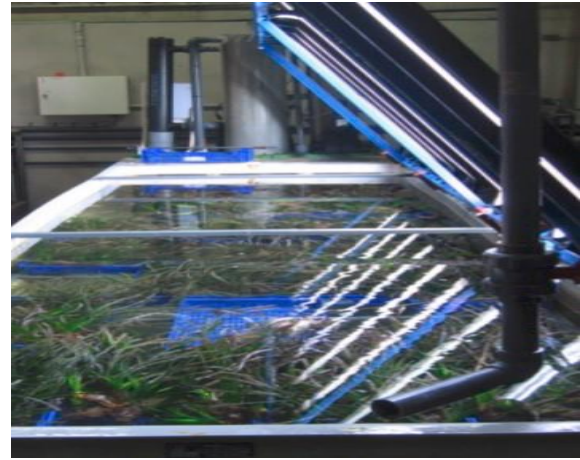


The main contents of the Posidonia Oceanica Meadow Conservation project are as follows.

- i. Term: The project lasts for a basic 10 years and can be extended twice, so it can run for up to 30 years. Calculating the amount of carbon emission reduction through the project is also carried out over 10 years.
- ii. Scope: All projects to protect Posidonia Oceanica Meadow located in the French mainland, and matters related to the removal or reduction of the impact associated with anchoring in Posidonia Oceanica Meadow
- iii. Activities: 1) Setting up no-anchoring zones, 2) Establishing a dedicated mooring area, including necessary preparatory technical research, 3) Relative management and control of marked areas and equipment, 4) Maintenance and renewal of installed equipment, 5) Management of payment systems for the use of mooring areas

Not only was a protection program progressed through France's LBC, but direct restoration activities were also carried out in Spain, which shares the water area. The Red Eléctrica de España (REE), the research institute, did restoration activities around the Balearic Islands in the Posidonia Oceanica Meadow. It was done by planting

seagrasses underwater. The survival rate after one year was over 60%. As a result of the 2020 inspection, the germination rate was confirmed to be over 90%.



In a separate study conducted in 2020-21, *Posidonia Oceanica* Meadow was also found to play a positive role in removing ocean plastic. This is because seagrass filters plastic and mixes it with natural fiber buds called ‘Neptune Balls.’ Starting in 2021, REE has been operating and monitoring a long-term program for four years together with the local government of the Balearic Islands and a research institute called the Mediterranean Institute for Advanced Studies.

5. Policy Cases of Australia

Australia is considered a global ‘blue carbon hot spot.’ Australia holds approximately 12% of the world’s blue carbon ecosystems, which account for about 5~11% of global blue carbon storage. For example, it is known that about 11% of the world’s seagrass blue carbon resides in the seagrass meadows surrounding the coral reefs of the Great Barrier Reef. (DCCEEW, 2024)

These topographical characteristics led to the development of blue carbon policies. The Australian government profoundly understands the importance of the blue carbon ecosystem for climate change mitigation and adaptation, protection of biodiversity and endangered species, disaster risk management, and the economy of

coastal communities. For the purpose of preserving and restoring the blue carbon ecosystem, the Department of Climate Change, Energy, the Environment and Water has been supporting research, marine ecosystem restoration projects, global partnerships, and so on. (DCCEEW, 2024)

5.1. Current Policies Supported by the Australian Government²⁵

According to the DCCEEW official website, the Australian government is focusing on the following policies.

- i. The Australian government is funding \$30.6 million from 2020 to 2025 to take practical action to support the restoration, conservation and accounting of blue carbon ecosystems in Australia and abroad.
- ii. Australia is forming the international partnership with 50 partners including government agencies, NGOs, inter-governmental organizations, and research institutions that share common visions to protect, restore and sustainably manage global blue carbon ecosystems.
- iii. Australia is one of the countries to include coastal wetlands in international carbon accounting by utilizing the IPCC's 2013 Wetlands Supplement, and supports developing countries in measuring, reporting, and verifying.
- iv. The National Environmental Science Program of the Australian government funds scientific research on Australia's marine and coastal environment, including the blue carbon ecosystems, coasts, reef, continental shelves and deep ocean.
- v. Australia is preparing for the first national ocean ecosystem account focusing

²⁵ This information is referenced from the Department of Climate Change, Energy, the Environment and Water of Australia website.

on blue carbon ecosystems.

- vi. As part of the Emission Reduction Fund, Australia is developing a method to secure carbon credits for restoring blue carbon ecosystems.
- vii. Australia has launched the Blue Carbon Accelerator Fund to support the development of blue carbon restoration and conservation projects in other countries and a base for private sector finance.
- viii. Australia has been supporting several countries to encourage global action to protect and restore blue carbon wetland ecosystems. For example, \$6.3 million from 2018 to 2024 for the Pacific Blue Carbon Program, which helps Papua New Guinea, Fiji and others, \$2 million from 2019 to 2023 for the Indonesian Blue Carbon Program, and \$430,000 from 2019 to 2022 for climate change mitigation and sustainable livelihoods in Sri Lanka, etc.
- ix. Australia is supporting countries to encourage global action to protect and restore blue carbon wetland ecosystems. For example, \$6.3 million from 2018 to 2024 for the Pacific Blue Carbon Program helping Papua New Guinea and Fiji, \$2 million from 2019 to 2023 for the Indonesian Blue Carbon Program, and \$2 million from 2019 to 2023 for climate change mitigation and sustainable livelihoods in Sri Lanka. The Blue Carbon Program includes \$430,000 from 2019 to 2022.

5.2. Blue Carbon Conservation, Restoration and Accounting Program²⁶

As a representative blue carbon policy of the Australian government, it is intended to induce active participation of the private sector. The Australian government believes that the program will expand investment in coastal blue carbon ecosystems,

²⁶ This information is referenced from the Department of Climate Change, Energy, the Environment and Water of Australia website.

support making good decisions for private sector, and contribute to global goals for climate and the environment. The Australian government has a plan to invest a total of \$30.6 million from 2021 to 2025 to restore and preserve blue carbon in Australia and abroad.

This program is comprised of 1) Blue Carbon Restoration and Accounting in Australia, 2) Blue Carbon Accelerator Fund, and 3) Community of Practice and International Partnerships.

First, the Blue Carbon Restoration and Accounting in Australia program funds restoration activities in five demonstration projects conducted in Australia and conducts environmental-economic accounting. The demonstration project targets seagrass, mangroves, and mudflats, and aims to prove the economic value of ecosystem services and the benefits of biodiversity from the restoration of the blue carbon ecosystem. The locations of detailed projects were selected through the Blue Carbon Ecosystem Restoration Grants, and five service providers were designated for each site to measure the benefits of restoration and develop accounting.

Next, the Blue Carbon Accelerator Fund has been created to support the promotion of blue carbon restoration and conservation projects conducted in countries other than Australia. Australia, in cooperation with the International Union for the Conservation of Nature, delivers the Blue Carbon Accelerator Fund to countries pursuing the blue carbon project, and these projects are progressed by measuring and analyzing climate, biodiversity, and benefits of blue carbon in order to induce the private sector to invest in the coastal blue carbon ecosystem in the future. In 2022, it provided the readiness support for 4 countries (1 project per 1 country), Benin, Madagascar, Philippines, and Peru, selected at the 2022 United Nations Ocean Conference. In 2023, 4 projects (Indonesia 3, Papua New Guinea 1) were selected for the implementation support.

Lastly, the Community of Practice and International Partnerships is a program that creates a community of acting together and builds international partnerships. It helps knowledge exchange and cooperation between researchers, policy makers and

project managers, and also supports the creation of a community for blue carbon restoration and accounting implementation. Supports are provided through an NGO called the International Partnership for Blue Carbon. Additionally, Australia has joined the Global Ocean Accounts Partnership, and are providing Blue Carbon Accelerator Fund to it.

<Blue Carbon Restoration and Accounting in Australia>

Funding recipient	Project	Location	Funding (excl. GST)
Sunshine Coast Regional Council and Partners	The Blue Heart – Blue Carbon Wetland Restoration Project. This project includes the: restoration of former farming land to coastal wetlands. The includes benefits for: <ul style="list-style-type: none"> • carbon sequestration • biodiversity • flood mitigation • recreation • First Nations engagement. 	Sunshine Coast, Queensland	\$2,036,000
Southern Regional Natural Resource Management	Demonstrating Outcomes of Blue Carbon Ecosystem Restoration of Temperate Saltmarsh Cool climate tidal marsh restoration with benefits for: <ul style="list-style-type: none"> • coastal resilience • biodiversity • recreational fisheries • tourism. 	Pitt Water-Orielton Lagoon, Tasmania	\$793,947
The Nature Conservancy Australia and Partners	South Australian Blue Carbon Ecosystem Restoration Project Tidal marsh restoration with benefits for: <ul style="list-style-type: none"> • biodiversity • social • cultural values. 	Upper Gulf St Vincent, South Australia	\$2,896,526
Greening Australia	The Mungalla Blue Carbon Project. This project includes the tidal restoration of former cattle grazing property. It includes benefits for: <ul style="list-style-type: none"> • Indigenous heritage • ecotourism • Great Barrier Reef water quality • bird and marine biodiversity. 	Ingham, Queensland	\$1,779,988
The University of Adelaide	The Gulf St Vincent Seagrass Restoration Project. This project is a seagrass restoration project. It includes benefits for: <ul style="list-style-type: none"> • marine diversity • sediment stabilisation • shoreline protection • nutrient processing. 	Port Gawler, South Australia	\$1,972,500

5.3. NSW Blue Carbon Strategy 2022-2027

New South Wales State (NSW) of Australia is estimated to have 7,100 ha of salt marsh, 15,300 ha of seagrass, 13,700 ha of mangroves, and 14,800 ha of kelp forest. The amount of carbon expected to be stored by these blue carbon absorption sources is about 10 million tons, which is equivalent to the amount of carbon emitted by 500,000 Australian homes per year. In addition, NSW's kelp forests form part of the Great Southern Reef, which stretches 8,000 km along the southern coastline of the Australian continent from the border between NSW and Queensland to Western Australia, which is estimated to sequester and store more than 30% of the entire Australian continent's blue carbon. That means NSW has a good environment to promote blue carbon policies. (NSW's DPE, 2022)



However, the blue carbon ecosystem in NSW has also been threatened by

human activities and climate change. Since European immigrants settled in the Australian continent, the blue carbon absorption sources recognized by IPCC, mangroves, salt marshes, and seagrass have decreased by 52-78%, 50%, and 20-26%, respectively. (NSW's DPE, 2022) Accordingly, NSW government established the 'NSW Blue Carbon Strategy' in 2022.

This strategy believes that blue carbon is an efficient natural carbon sink and it contributes to job creation and the revitalization of the local economy through improved water quality, sound fishing, nature-based tourism, and entertainment. This strategy clearly states that a lot of benefits can be generated by the blue carbon market mechanism and project. For example, improving water quality by trapping sediment, preventing abnormal weather events by reducing coastal erosion, protecting endangered species and increasing species diversity by protecting and restoring important habitats, revitalization of the tourism industry by fishing and coastal will be beneficial for the local economy. Furthermore, it pursues environmental protection based upon scientific evidence. (NSW's DPE, 2022)

This strategy has five priority areas and 18 detailed tasks. The first priority area is to conserve blue carbon ecosystems and support adaptation and migration. What attracts particular attention in this priority area is that it examines the effects of existing laws and policies in the point of view of blue carbon. To be specific, the Coastal Management Act 2016 and the Resilience and Hazards State Environmental Planning Policy, etc., are reviewed to ensure that they effectively contain matters related to the protection of blue carbon and the adaptation of the ecosystem to climate change. (NSW's DPE, 2022)

The second priority area is to deliver blue carbon projects in areas owned or managed by private, public and indigenous peoples based on nature-based solutions. This is a project to understand the mutual impact between blue carbon conservation and human activities and to help coastal ecosystems, indigenous peoples, and local communities adapt to climate change. This includes the movement of blue carbon due to sea level rise, the transformation of blue carbon land use practices, and changes in

blue carbon management methods due to the introduction of the carbon market. In other words, the coastal ecosystem can adapt to climate change through habitat movement, and blue carbon habitat users and managers can switch to appropriate management techniques to increase productivity and protect it at the same time. Another detailed task states that First Nations people who own and manage blue carbon habitats must be supported so that they can receive social, cultural, environmental, and economic benefits through blue carbon. Through this, First Nations people and local communities can continue to maintain their livelihoods and communities, and secure a steady income to respond to climate change. (NSW's DPE, 2022; Yoon, 2023)

The third priority area is to highlight to internalize blue carbon in existing maritime policies. In other words, it is intended to reflect the matters on blue carbon in connection with the existing marine plans. These priority areas include simplifying the permitting process for blue carbon projects, integrating blue carbon projects into coastal management programs, converting low-lying soil vulnerable to extreme weather into blue carbon habitats, and so on. (NSW's DPE, 2022; Yoon, 2023)

The fourth priority area deals with R&D on blue carbon. While setting research priorities, research like the impact of human behavior on the carbon storage of blue carbon, valuing blue carbon ecosystem services, and the effectiveness of restoration and conservation, will be conducted in cooperation with key partners on and the effects of valuation, restoration, and preservation of blue carbon ecosystem services. (NSW's DPE, 2022)

The last priority area is about promoting investment in blue carbon. The NSW government quantifies the ecosystem services and benefits caused by the blue carbon project and investigates and tests new financial models to expand investment in the blue carbon market and natural capital. To this end, the NSW government collaborates with stakeholders to study the blue carbon financing model and path. It also has plans to test the first NSW government-approved Blue Carbon Instrument by 2025. Through this, the final goal is to grow the blue carbon market in New South Wales. (NSW's DPE, 2022)

Chapter 5. Policy Implication

Korea is the third country in the world, following the United States and Australia, to reflect coastal wetland carbon absorption in its national Greenhouse Gas Inventory (GHG Inventory)²⁷, and has considered blue carbon as a major tool in its domestic marine climate change policy. The current government has included the expansion of carbon absorption sources such as mudflats and marine forests as one of national goals, and blue carbon has been directly dealt with in various plans. And at last, in May 2023, the Ministry of Oceans and Fisheries of Korea, the core ministry in charge of policies related to blue carbon, established the ‘Blue Carbon Promotion Plan’ in order to make blue carbon policy more actively and systematically under the vision of a great transition to carbon neutrality in the marine and fisheries field, and a thorough response to the climate crisis. (MOF, 2023)

In a situation where the importance of blue carbon has been growing as a decisive solution to carbon neutrality and climate crisis internationally, the Blue Carbon Promotion Plan is very significant in that it is the first blue carbon promotion strategy established to realize carbon neutrality in the maritime and fisheries sectors and achieve the goals of the 2030 Nationally Determined Contribution and 2050 Carbon Neutral Roadmap. Basically, this plan was made to increase carbon absorption and climate disaster response capabilities through the protection and restoration of blue carbon, at the same time strengthening cooperation with the private, regional, and international communities. (MOF, 2023)

This plan consists of three driving strategies, nine key tasks, and a number of detailed tasks. Looking specifically, the first strategy is to strengthen the ocean’s carbon absorption and climate disaster response capacity. The goal is to strengthen carbon absorption through creating marine forests, restoring mudflats, and designating and

²⁷ The Ministry of Oceans and Fisheries conducted related research from 2017 to 2021 to lay the foundation for building a blue carbon national greenhouse gas inventory for salt marshes and seagrasses. As a result, salt marshes were included as a sink in the national greenhouse gas inventory in 2022.

protecting additional protected areas, while to improve response to coastal disasters by converting artificial structures in areas vulnerable to coastal disasters or erosion areas into green infrastructure such as blue carbon. The detailed action plan to achieve this is as follows. (MOF, 2023)

- i. Absorbing 230,000 tons of carbon by expanding the area of salt marshes, which are recognized as blue carbon sinks by the IPCC, from the current 32 km² to 660 km² by 2050
- ii. Absorbing 180,000 tons of carbon by expanding the area of marine forests, which restores seaweed and algae under water, from the current 291 km² to 540 km² by 2030
- iii. Designating 1,318 km², more than half of the entire mudflats as a protected area
- iv. Promoting the ‘Living Shoreline’ project to build eco-friendly coasts in areas vulnerable to coastal disasters and coastal erosion in order to not only get blue carbon but also respond climate disasters

The second strategy is to increase private and regional participation in the blue carbon policy and do international reduction projects based upon international cooperation. The MOF will make a ‘Blue Carbon ESG Portfolio’ for each field, such as international cooperation, coastal development, and public relation, to help companies easily participate, and form a ‘Blue Carbon Partnership network’ to enhance cooperation more systematically and organically. (MOF, 2023)

A notable task in this strategy is the introduction of a ‘Marine Ecosystem Service Incentive System.’ This is a system in which the government and the private sector sign prior contracts for the maintenance and promotion of ecosystems and pay incentives based on the performance of the private sector. For example, after contracts with fishermen or fishermen’s organization with aquaculture technology to build seagrass meadows, the government pay incentives according to their performance. It is expected to induce participation of private sector. (MOF, 2023)

Additionally, international cooperation will be strengthened, too. The government plans to secure carbon absorption quarter from abroad through bilateral or multilateral cooperation, and ODA projects with Southeast Asian and Pacific island countries, etc. (MOF, 2023)

비전	해양수산 탄소중립 대전환과 기후위기 대비 태세 완비
방향	<ul style="list-style-type: none"> ■ 해양의 탄소흡수 및 기후재해 대응능력 강화 ■ 민간·지자체 등으로 참여 저변 확대
목표	2030 NCD 및 2050 탄소중립 로드맵 목표를 차질없이 달성 ※ 해양 탄소흡수량: ('22)약 1.1만 톤 → ('30) 106.6만 톤 → ('50) 136.2만 톤

추진 전략	추진 과제
① 해양의 탄소흡수력 및 기후재해 대응능력 강화	<ul style="list-style-type: none"> ① 해양 식생 조성 통해 탄소흡수 강화 ② 신규 블루카본의 선제적 보호·복원 ③ 「숨쉬는 해안 뉴딜」 통해 기후재해 대응 강화
② 민간·지역·국제협력 등 블루카본 조성 참여 확대	<ul style="list-style-type: none"> ① 기업의 ESG 경영 연계 ② 어업인·지자체 참여 기반 마련 ③ 국제감축 통한 국외 탄소흡수량 확보
③ 신규 블루카본 인증 및 장기 추진 기반 마련	<ul style="list-style-type: none"> ① 신규 블루카본 인증 가속화 ② 해역별 연구거점 인프라 조성 ③ 인벤토리 등 데이터 고도화

The last strategy is to lay the foundation for the long-term implementation of the blue carbon expansion policy. Research on potential candidates, coral reefs, oyster shells, and phytoplankton, as well as non-vegetation tidal flats, benthic sediment, and seaweed, which are leading candidates, will be deeply conducted, and continuous

international cooperation will be continued for IPCC's recognition. Additionally, the MOF plans to establish a Blue Carbon Empirical Research Center and a Base Center for each sea area to conduct more systematic research and to advance the calculation of blue carbon inventory. (MOF, 2023)

The Blue Carbon Promotion Plan explained above seems to be consistent with the trend of international discussions and the direction of countries leading blue carbon policies such as the United States and Australia. However, in order to implement this plan more efficiently and produce practical effects, I would like to make some policy suggestions below.

1. Strengthening Comprehensive and Cooperative Governance

The commonality of the overseas cases introduced above, such as the United States, Australia, and Japan, is comprehensive and cooperative governance.²⁸ In these countries, not only the central or federal government but also local governments and the private sector are actively and widely participating in making and executing policies about the expansion of blue carbon. In addition, even among government ministries, even if policy customers and goals of each ministry are different, inter-ministerial cooperation is relatively well carried out in various ways, and even within one ministry, multiple departments work together for making and executing policies. Local governments, research institutes, private companies, civic groups, and international organizations are engaged in a variety of activities in diverse fields, including pilot projects for the protection and restoration of blue carbon, various blue carbon-related research, securing financial resources, public relation, and education. It is a system in

²⁸ The IPCC evaluated that climate resilient development as an integrated climate action is very urgently required. Climate resilient development promotes sustainable development for all by integrating adaptation and reduction through comprehensive governance and collaborative policies. The IPCC emphasized that civil society, the private sector, and government should all participate to accelerate the transition to climate resilient development. (Yoon, 2023) This can also be referred to in promoting the blue carbon policy.

which each entity cooperates based on autonomy and responsibility after the government sets project standards, supports the budget, and provides opportunities for communication.

The blue carbon restoration and preservation project is primarily a project to secure a blue carbon sink, but ultimately it must be a project that can have a positive effect on the coastal ecosystem and the lives of people who live there. For example, seagrasses and mudflats are not only effective blue carbon absorption sources, but are also home for numerous creatures and a living place for the people living there. It is directly related to the livelihood activities of fishermen, and can be linked to the economic activities of local residents through tourism, a new source of income. For this reason, the participation of various government agencies and stakeholders is necessary from the decision-making stage to implementation and evaluation of the blue carbon policy.

In the case of the United States, research and projects on the subject of blue carbon are well operated based upon the Sea Grant program, which has already been progressed for more than 50 years and institutionally established. Like other Sea Grant programs, local governments, regional research institutes, and universities are at the center of program, and the results are commonly shared. Within NOAA, several divisions work together to carry out blue carbon protection and restoration projects and technological research.

Working groups among U.S. government agencies are being formed to make efforts to restore blue carbon. Specifically, NOAA and the U.S. Department of State cooperate to conduct the 'Blue Carbon Inventory Project'. Additionally, for the Establishing a Blue Carbon Network for the Gulf Coast project, several organizations such as NOAA, the U.S. Fish and Wildlife Service and civic groups, are participating in a pilot project to restore the Gulf coast and are building a platform to share blue carbon information among entities that manage the Gulf coast.

In Australia, the government also provides financial support by creating a fund, and various individual projects are being promoted. These projects target domestic and

foreign oceans, and in particular, domestic blue carbon restoration is promoted by selecting project promoters for blue carbon measurement and research. In addition, in the ‘NSW Blue Carbon Strategy 2022-2027’ established by the NSW government, it is planned to ensure that local stakeholders participate when carrying out the blue carbon projects and that the social and economic factors to have an impact on local stakeholders must be taken into consideration.

Japan is similar. The central or local government led a pilot project to restore seagrass meadows, and conducted research and quantification to make a blue carbon credit from restored seagrass meadows. However, other organizations like NGOs were always involved in the restoration projects and credit operations. The City of Fukuoka formed a consultative body called the Hakata Bay Next Conference to make and operate an offset credit system, and the Japanese central government’s offset crediting demonstration also had several private entities participate through the Collaborative Innovation Partnership called the Japan Blue Economy Association (JBE). In the early stages of establishing the blue carbon policy, there was an aspect that the government took the lead, but as time passes and the system reaches a mature stage, it seems that it wants to eventually move toward a carbon trading market led by private companies and civic groups.

In Korea as well, there appears to be a consensus that, in making and developing the blue carbon policy, cooperation between relevant organizations, participation of local governments and residents, and utilization of expertise from research institutes and experts are necessary. However, the critical thing is that, unless it is operated as a formal procedure, institutionalization is necessary to ensure actual participation and cooperation.

The most powerful way is to institutionalize it as a law or norm, but even before that, it can be realized by including cooperation with relevant ministries or divisions and participation of the private sector in the project guidelines. If governance system, like the United States, is spread throughout a whole administrative environment, that can be naturally implemented even when promoting blue carbon-related policies,

explicit norms or laws may not be necessary for flexible operation of the projects. However, in Korea, where cooperative and comprehensive governance system is relatively less common than in the United States, there is a need to establish legal or institutional mechanisms to ensure forming governance well during the project implementation process.

2. Establishing Comprehensive National Plan on Blue Carbon

It is necessary and important to approach blue carbon expansion as a comprehensive policy package rather than a cross-sectional approach in terms of creation of carbon absorption sources, coastal maintenance, and marine research. This is because activities to restore, conserve, and protect blue carbon sinks lead to the protection of coastal ecosystems and have a great impact on residents and creatures living in the area.

In other words, the restoration and protection of blue carbon sinks can make a healthy coast by protecting the habitat of organisms, improve the lives of fishermen by increasing fishing production, and lead to tourism income by becoming an eco-friendly and easily accessible coast. Strategies and plans that lead to this virtuous cycle are needed. It is stated that the priority goal of the blue carbon policies is to enhance the carbon absorption capacity and thereby strengthen the ability to adapt and respond to climate change. But these projects should be progressed to be linked with ways to promote and utilize ecosystem services and to increase the benefits of local communities.

Let's take a look at a specific example. Currently, one of the representative blue carbon projects in Korea is the Marine Forest Creation Project.

The Blue Carbon Promotion Plan announced by the Ministry of Oceans and Fisheries in May 2023 only presents the area of marine forest (291 km² in 2023 → 540 km² in 2030) and the target for carbon absorption through this (98,000 tons in 2023 →

180,000 tons in 2030). (MOF, 2023) However, in order to develop into a more comprehensive project, socio-economic goals such as the effect of creating fishery resources and increasing the income of local fishermen and residents, and satisfaction with the quality of life need to be presented together. If so, wouldn't this project be more convincing and receive more support? This adversely shows that blue carbon can become a broader strategy and project by being linked to fisheries, coastal management, and fishing village policies. This comprehensive promotion approach will naturally lead to cooperation and connection between relevant ministries and agencies or related departments within the MOF.

In this context, the international community and countries such as the United States, Australia, and so on are implementing blue carbon policies based on nature-based solutions. This can be seen by looking at a comprehensive range of bills such as the 'Ocean Based Climate Solutions Act', the 'Blue Carbon for Our Planet Act', and the 'Blue Carbon Protection Act' that have been continuously proposed in the U.S. Congress. These bills generally authorize NOAA to put in place programs to strengthen research on blue carbon, enhance the protection and restoration of blue carbon ecosystems, and promote ecosystem services. In addition, creating a new funding program in order to support state governments, individuals and organizations that own or manage land, Indian tribes, U.S. Pacific Island owner groups, non-governmental organizations, educational and research institutions, etc., to participate in the blue carbon project, is included. (Yoon, 2023) The United States is emphasizing the cooperative work of related agencies and departments while promoting the blue carbon policy.

In Korea, there is a need to strengthen the linkage between projects through the enactment or revision of the underlying laws and to ensure that even projects that do not directly deal with blue carbon can be promoted by taking blue carbon into consideration. Before that, it is necessary to design a project so that it can be linked with other programs. For instance, when selecting a target site for the blue carbon projects, priority may be given to areas that need to buffer coastal disasters. Or areas vulnerable to coastal disasters can be selected in order for being protected with nature-based

solutions such as tidal flat restoration projects. In addition, selection or evaluation criteria can be set for projects proposed in connection and harmony with the development of fishing villages and the preservation of the blue carbon ecosystem to be given priority.

One more thing to emphasize is the need to further expand policy linkage. Currently, there are 19 ministries in Korea. The ministry in charge of overall blue carbon policy is the Ministry of Oceans and Fisheries (MOF), and the directly related ministry is the Ministry of Environment. Then, how about the Ministry of Science and ICT (MSIT), the Ministry of Employment and Labor (MoEL), the Ministry of Culture, Sports and Tourism (MCST), and the Ministry of Strategy and Finance (MoSF)? At first glance, these ministries and Blue Carbon seem unrelated. However, as mentioned earlier, the blue carbon policy is very comprehensive, so the linkage with various projects of each ministry can create a greater synergy effect.

Let's take some examples. The MoSF, which oversees the tax system, can provide tax benefits to companies that support the creation of blue carbon. The Ministry of Public Administration and Security in charge of the local self-government system is able to provide various support to local governments that are pursuing blue carbon expansion policies. The MSIT responsible for national R&D policies will be able to find ways to expand R&D budget for blue carbon as well as connect with existing R&D projects. The Moel is the ministry that oversees vocational training and encouraging employment of private companies. It may consider expanding training program for raising blue carbon experts and providing employment subsidies to companies hiring blue carbon-related personnel. The Ministry of SMEs and Startups can support venture companies that run in the blue carbon area, which is a relatively blue ocean. The MCST in charge of overseeing public relation is able to support public relations or communication work to raise public awareness and attention of blue carbon. If this happens, blue carbon will go beyond the work of some ministries, including the Ministry of Oceans and Fisheries, and become a field where various policies of all ministries are harmonized.

3. Promoting Blue Carbon Policies Tailored to Regional Characteristics

What was interesting in the process of researching overseas cases such as the United States and Australia was that a number of blue carbon policies were mainly operated by regions focus. Projects conducted in the Gulf Coast and Chesapeake Bay regions and Sea Grant programs of the United States are involved in local stakeholders and experts gathering to analyze problems, find solutions, and share information. In Japan, a national blue carbon credit project was promoted based on the projects of Yokohama City and Fukuoka City. And recently, when private companies participate in blue carbon creation projects as part of ESG management, more cases are being promoted in cooperation with local governments in the region where the companies are mainly active. In particular, the NSW State Government of Australia received attention for establishing a mid- to long-term comprehensive plan for five years, even though it is a state government.

What is the secret that local governments, not central governments, have been able to push for blue carbon policies that are expected to require high levels of science and technology, and large budgets?

First of all, there were partnerships and networks on the basis of it. Even if it was started as a local project, the alliance consisted of the central government, local environmental groups, NGOs, and regional universities was formed. It was able to effectively respond to various issues that arose in the process of promoting the blue carbon project.

Second, knowing the local situation well is also a big strength. Local governments inevitably better know more details than the central government, such as the characteristics of local seas or mudflats and the quantity and quality of human and material resources that can be utilized in the region.

Next, it can also induce active participation of local residents and fishermen. As

local residents are directly affected by the blue carbon ecosystem, drawing their participation and support is an important factor in the success or failure of the project. In addition, it has the effect of being able to utilize the know-how and tacit knowledge of local fishermen.

Lastly, there is the advantage of small-scale projects. Compared to green carbon, which has reached a certain level of maturity through long-term discussions and various policy developments, blue carbon is in a relatively early stage where consensus on its necessity is being formed and scientific research is beginning. Therefore, it is important to create success stories or good cases, and it may be more advantageous to promote projects at the local level. This is because projects at the local level can be progressed more flexibly than national projects, and visible results can be relatively clearly identified.

As such, Korea also needs to promote blue carbon projects tailored to the characteristics of the region with local governments at the center. Fortunately, Incheon and Chungcheongnam-do has studied the current status of blue carbon and policies in the region, and as the heads of some local governments have expressed their willingness to implement blue carbon policies, it is expected that local-led blue carbon projects will be activated in the near future.

4. Securing Finances through Expanded Private Sector Participation

Blue carbon restoration and protection is a mid- to long-term project that requires a considerable budget. For instance, the Marine Forest Project, which started in 2009, costs approximately 33 billion won to build about 30 km² every year. This does not include the local government's follow-up management budget. The Ministry of Oceans and Fisheries also invests around 25 billion won every year in the Tidal Flat Restoration Project, which has been promoted since 2010. In addition, tidal flat vegetation projects, R&D, etc. are also required a large amount of budget.

The problem is that in order to respond to climate change that are progressing more rapidly and international negotiations, it is expected that related budgets will inevitably increase in the future. Therefore, to continue various blue carbon projects beyond 2030, there are limits to the national finances alone. Here, let us propose methods for managing initial finances and securing mid- to long-term finances in preparation for the inevitable increase in costs.

Currently, most of our blue carbon projects and research are carried out with national finances. Other countries, such as the United States, are also currently progressing projects centered on government budget. In the U.S., various research and pilot projects are being promoted using the funds of the Sea Grant Program, and measures to secure finances stably are included in the blue carbon-related legislation proposed to Congress. The Australian federal government also invests \$30.6 to implement five demonstration projects over five years. The creation of seaweed forests and the ‘J-Blue Credit Project’ in Japan have been also funded and subsidized by the government. The French government has developed a certification program called LBC and supported the private sector in making protection methodologies to meet the standards.

However, the difference between these countries and Korea is that these countries are pursuing blue carbon projects and research with mid- to long-term finances in mind, but Korea does not seem to consider it. And while we focus our budget on direct blue carbon creation, these countries focus their budgets on scientific research such as creation methods and carbon measurements, social and economic benefit analysis, and operation and management plans. Based on the scientific blue carbon measurements and portfolios derived through this, these countries seem to be encouraging private participation in the creation of blue carbon. When the state presents standards, methods, and portfolios, it aims to create voluntary blue carbon and secure financial resources centered on non-governmental organizations or the private sector accordingly.

A representative example is Verra’s carbon trading system, which make private

sector volunteer creation of carbon sinks and carbon trading in the market. Verra has produced and operated the most widely used carbon credits in the world, and also established a method to certify blue carbon credits and quantify them. In Australia, the government also has supported pilot projects and ensured that the project must include blue carbon restoration as well as benefit analysis and accounting system development. In the future, the results of this project will be presented to the private sector as guidelines, and based on these, it is expected that many private companies will be able to participate in blue carbon restoration and protection. Japan is entering the stage of forming a voluntary market that measures the carbon generated from seaweed forests after their restoration, develops them, and trades them as credits. The organization that runs this credit is currently receiving subsidies from the government, but it is expected that it will be able to operate with its own profits as the carbon trading market gradually expands.

Recently, many companies in Korea are voluntarily participating in the blue carbon creation project. Hyundai Motor Group, POSCO, Hyosung, Shinsegae, LG Chem, KB Financial Group, and Jungbu Power have signed agreements with the government and are directly creating blue carbon sinks or promoting them to the public. This is done in connection with the ESG management of companies rather than through the carbon market. The Ministry of Oceans and Fisheries also plans to expand these blue carbon restoration activities linked to corporate ESG management in accordance with the Blue Carbon Promotion Plan.

However, blue carbon projects based on the social responsibility of several large corporations alone have limitations in contributing to 2050 carbon neutrality or NDC, and continued fiscal input of the government is still required. Therefore, we should also consider the market-based blue carbon business through the aforementioned carbon credits.

As the production of carbon credits expands from forests to oceans, the concept of a carbon market on land can be similarly applied to the ocean. If blue carbon trading is currently carried out based on a voluntary market, it is expected that when an

agreement is reached between countries in the international community in the future, it will be recognized as an actual asset and become publicly traded. Then, blue carbon credits will play a significant role in securing the financial resources for blue carbon projects.

Furthermore, in that producers of blue carbon credits can be fishermen who farm seaweed, village fishing grounds, fishing communities that own mud flats, or local residents who carry out coastal cleanup activities, blue carbon credits provide economic benefits to coastal communities. As the blue carbon projects based on carbon credits will encourage various economic entities and local residents to participate in the blue carbon project, and it is expected that the project will naturally expand into the private sector.

The public's interest and participation are also required to secure mid- to long-term financial resources. Everyone knows that planting trees in the mountains can prevent global warming, and that Arbor Day is a day to plant trees. However, it is not well known that seagrasses and mudflats can absorb carbon 50 times faster than forests and store carbon 10 times more. May 10th is the Marine Arbor Day. Although the Marine Arbor Day has already celebrated its 12th anniversary, it is a reality that many people are still unaware of it. According to Kim (2023), the awareness rate of blue carbon among Koreans is around 21%. (Kim, 2023) If interest from the public increases further, it is expected that the participation of companies and individuals in blue carbon projects will also increase faster.

For example, if individuals, families, schools, businesses, and civic groups adopt and manage tidal flats and marine forests like the Adopt-a-Highway Project in the United States, it will be able to increase public awareness and attract more participation. Allowing credit generated through blue carbon conservation activities to be donated or sold to the government could serve as another source of funding for the blue carbon programs. Outreach can also be realized through the moral value that 'I can plant seaweed in the deep sea for the planet.' Public participation and interest may lead more visits to coasts, which can have the effect of increasing the income of the local

community.

In conclusion, the expansion of blue carbon can lead to the promotion of blue carbon projects based on natural-based solutions that go beyond responding to climate change and increase the health of coastal ecosystems and improve the quality of life of local residents. And all of these economic and social effects will be of great help in securing financial resources in the mid- to long-term implementation of the blue carbon policies.

5. Expanding the Scope of Blue Carbon Research

Response policies to climate change be based on science, and objective, accurate evidence. This is because policies actively respond to climate change may rather result in maladjustment or offsetting the effects between related policies. Accordingly, in the United States, in relation to the project to create blue carbon habitats for coastal organisms, NOAA Fisheries, the implementing agency, presents scientific research as a major policy area. In the ‘Blue Carbon Strategy 2022-2027’ announced by NSW, it is clear that the government supports evidence-based blue carbon projects. Therefore, scientific evidence is an essential prerequisite when establishing blue carbon-related strategies and policies.

Contributing to the Nationally Determined Contribution (NDC) by expanding carbon absorption and responding to climate change are the most basic goal of the blue carbon project. In order to be included in the NDC, it is necessary to calculate the exact amount of carbon absorption of blue carbon, accumulate related statistical data, and conduct scientific research on methods to improve carbon absorption capacity. The U.S. is also working on an inventory project to quantitatively measure its own and foreign countries. Korea is also trying to build inventory data on mudflats, and needs to prepare in advance by expanding this to new blue carbon candidates which have not yet received approval from IPCC.

As mentioned continuously, measuring accurate carbon absorption and analyzing its effectiveness are the most basic and prerequisites for international certification. Periodically conducting comprehensive research on the distribution of blue carbon sinks by sea area and expected carbon absorption will be an effective way to establish a comprehensive plan for responding to climate change and get and international certification.

In addition, in order to realize the aforementioned governance and promote comprehensive policies, research on the social and economic impacts of blue carbon must be conducted. In other words, protection and restoration projects of blue carbon and their benefits on climate adaptation, fisheries, tourism, etc. should be evaluated. In Australia, research about examining the socio-economic impacts of blue carbon and enhancing mutual benefits among related fields is conducted within the large framework of the Blue Carbon Strategy. Ways to help local communities naturally adapt to climate change and maintain their living base and lifestyles are also studied. Furthermore, when pursuing the expansion of nature-based blue carbon, continuous monitoring is essential to identify short-term and long-term impact. To ensure the sustainability of the blue carbon project, the improvement of ecosystem services and socio-economic benefits should be evaluated from a perspective of the whole life-cycle (Yoon, 2023)

On the other hand, although it is important to get and accumulate blue carbon data through R&D, how to share this information with those involved in the research process or policy decisions is also an important issue. This means high transparency and accessibility to information. To this end, it is required to establish an information sharing platform, build a cooperation system between organizations, and improve laws and institutions. In the United States, there is some of the Sea Grant pragmas that studied legal and institutional solutions to information sharing problems that may arise among participating organizations in the process of promoting blue carbon restoration and recovery.

As seen above, research on blue carbon is very extensive. It must proceed throughout the entire policy process, including project design, implementation, and

evaluation. Not only procedural and institutional research, but also substantive and content-related research is needed. In addition to the carbon reduction effect, studies are needed on various social and economic benefits, too. Lastly, with the legal issues such as jurisdiction, it is prepared to consider the system for trading the generated blue carbon in the carbon market when the blue carbon project is activated, although it has not yet been discussed in earnest in Korea.

6. Reinforcing International Cooperation

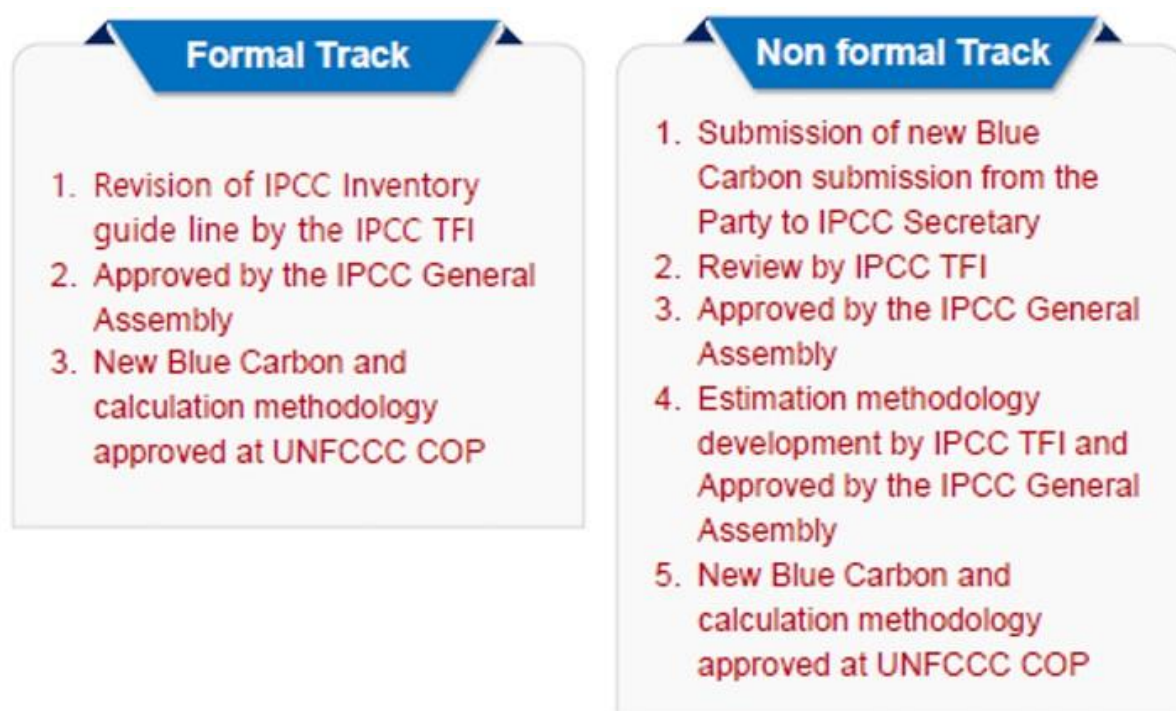
The expansion of blue carbon began with global efforts to actively respond to climate change and reduce greenhouse gases. In the process, the direction of the project in which the coastal ecosystem and local residents should be considered together was presented, and governance methods and blue carbon credits have been discussed how to develop a comprehensive and sustainable project. The reality is that through the expansion of blue carbon, we have to contribute to carbon reduction in the Nationally Determined Contribution (NDC) and the international community in practical and quantitative numbers. To this end, cooperation with international organizations and other countries must be made smoothly.

In particular, since only blue carbon sinks certified by IPCC can be included in NDC as an official carbon sink, international cooperation efforts are urgently needed to ensure that new blue carbon candidates can receive additional IPCC verification. Korea's mudflats centered around the West Sea are so wide that they are recognized as one of the world's top five mudflats. Currently, only seagrass and salt marshes have been accepted by IPCC, and non-vegetation tidal flats have not been certified. As the United States also wants non-vegetation tidal flats to be included as a blue carbon sink approved by the IPCC, close cooperation with the U.S., etc. is needed.

In addition, although accurate measurements of the amount of carbon reduction

should be premised, since certification of new blue carbon sinks such as benthic sediment²⁹ and seaweed³⁰ is also necessary, cooperation with interested countries is also required. (MOF, 2023)

For non-vegetation tidal flats, benthic sediment, etc. to be newly certified as blue carbon sinks, they must be included in the IPCC Guideline for National Greenhouse Gas Inventories. There are two ways to revise guidelines: formal track and non-formal track.



In the formal track, when the IPCC’s Task Force on National Greenhouse Gas Inventories (TFI) raises the need to revise the guideline, the IPCC General Assembly approves the need, and then the expert pool in each field is formed to draft a guideline revision. If the IPCC General Assembly approves the guideline revision, the revision is submitted to the UNFCCC COP, and if it is approved here, the guideline is finally

²⁹ The benthic sediments are sediments distributed on the seabed of the continental shelf. The UK and China are showing interest in IPCC certification.

³⁰ Seaweed habitats are places where organisms that photosynthesize and grow in water like kelp. The U.S. and Australia are showing interest in IPCC certification.

revised.

The informal track begins when member countries submit a proposal to the IPCC Secretariat stating that something need to be recognized as a new blue carbon sink. If the IPCC General Assembly accepts the need, the TFI makes a guideline revision. If the revision is passed by IPCC and UNFCCC COP General Assembly, respectively, the guidelines is finally revised. (Kwon et al., 2022)

Looking at the guideline revision process, we can know that the IPCC TFI plays a central role. TFI is managed by a Secretariat consisting of two elected co-chairs and 12 elected members, and is supported by the Technical Support Unit in Japan. In order for non-vegetation tidal flats to be approved as new blue carbon sinks, continuous communication with TFI is important, and cooperation with Japan, which is in charge of technical support, is also likely to be necessary. Scientific research on blue carbon seems to be more effective to cooperate to build common data and suggest the need for recognition rather than to be promoted by any one country. It seems that it would be more effective for scientific research on blue carbon to be conducted collaboratively by several countries to build common data and, rather than for any one country to do it alone.

It is important to take the initiative and lead discussions in the international community. If there is something that is advantageous to one's own country, it is effective to take the initiative and induce discussions to direction what it wants. Just as President Yoon of Korea proposed the Green Climate Fund in a speech at the UN General Assembly in September 2023, it is necessary to raise our voice in the international community and make more active proposals on what we want in response to the climate crisis. The same goes for blue carbon. If seaweed and mudflats widely distributed in Korea are included in the absorption source, the realization of carbon neutrality can be closer. There is a need to cooperate with countries such as Japan and the United States that expect certification of similar blue carbon sinks, and to work more actively to have negotiating power at international conferences.

By the way, leadership in the international community are greatly influenced by

how much one has contributed to the international community. Actually, Australia provides its Blue Carbon Accelerator Fund through IUCN to projects in countries selected at international conferences. Australia supports this fund to the Global Ocean Accounts Partnership and seeks to build international partnerships, too. The Blue Carbon Inventory Project of the United States is also a program that supports countries that do not include blue carbon in the National Green Gas Inventory due to a lack of technology.

If Korea also supports countries that do not meet the level required by international organizations such as the IPCC, it will be easier to get more support from those countries in the international community and achieve favorable results for us. The ‘Blue Carbon Promotion Plan’ announced in May 2023 includes strengthening bilateral and multilateral cooperation with Southeast Asia and Pacific island countries and actively utilizing ODA projects. It is significant to increase the proportion of blue carbon in bilateral and multilateral cooperation in marine technology exchange, and to support blue carbon research and restoration activities beyond simple material support. Efforts should also be continuously made to share blue carbon restoration technology and carbon calculation and evaluation methods required by international organizations. In addition, it is expected that securing overseas blue carbon quarter through cooperation with countries with large quantities of mangroves that have already been certified as sinks will contribute to meet the NDC.

The Ministry of Oceans and Fisheries has been participating in several international conferences to respond to climate change, such as Our Ocean and the COP. Considering that blue carbon has been recognized as an important measure against climate change in recent climate response conferences, that discussions on blue carbon are increasing, and that separate sessions are being run, the role of the Ministry of Oceans and Fisheries is expected to become more important bigger in the future. In preparation for this, the MOF must constantly monitor the trends of discussions in the international community, and carefully review and well prepare for measures that are advantageous to us in advance.

7. Improvement of Laws and Systems

In order to promote blue carbon policies more systematically and effectively, it is compelling to find out the limitations of the current domestic laws and systems and improve them.

As reviewed in policy cases in the United States and Australia, blue carbon protection and restoration management is the starting point of policies related to blue carbon. Contents on the protection and restoration of blue carbon is scattered in various laws under the jurisdiction of the Ministry of Oceans and Fisheries. The Conservation and Management of Marine Ecosystem Act allows an area requiring conservation to maintain or promote the function of a carbon sink of the marine ecosystem to be designated and managed as a marine protected marine area.³¹ This only serves as the basis for designating a protected area and does not mention any analysis of the effect on the increase in blue carbon or benefits after designation. The Act on the Sustainable Management and Restoration of Tidal Flats and Adjacent Areas Thereof stipulates the basis for tidal flat restoration and management, eco-villages, and tourism, and the Fishery Resources Management Act stipulates the creation and management of marine forests, the impact on the marine environment before and after implementation, and the analysis of the effect of creating fishery resources.³² These laws can be the legal basis for individual detailed projects to secure blue carbon absorption sources, but it is

³¹ Article 25 (Designation and Management of Protected Marine Areas) (1) The Minister of Oceans and Fisheries may designate areas falling under any of the following subparagraphs, whose marine ecosystems or marine landscape require special protection, as protected marine areas and manage such areas: 6. Areas needed to be conserved, in order to maintain or improve their function as carbon sinks of marine ecosystems

³² Article 41 (Projects for Formation of Fishery Resources) (1) Administrative agencies may implement projects for the formation of fishery resources including the following projects in accordance with the master plan and implementation plan: 3. Projects to install marine forests

(3) Before and after implementing a project for the formation of fishery resources, an administrative agency shall survey and evaluate the impact of the project on the marine environment, the effect of formation of fishery resources, etc.

difficult to serve as a basis for mid- to long-term business effect analysis and scientific research. (Yoon, 2023)

Therefore, the current legal system makes it hard to design or manage comprehensive strategies and projects that take into account climate change, coastal ecosystems, and the benefits of local residents, and has shortcomings even when comparing to the international trend toward a more comprehensive approach to blue carbon policies.

The United States and Australia are also making efforts to establish blue carbon policies by reviewing and evaluating existing systems and law, and considering new legislation based upon them. The Korean government should also reexamine the necessary parts throughout the entire process of the blue carbon policy, including decision-making, securing financial resources, implementation, network and partnership, international cooperation, and performance assessment, and prepare related laws and systems.

When approaching the blue carbon policy in the perspective of responding to climate change, creating a healthy marine ecosystem, and improving the quality of life of residents in the area, rather than just as a means to achieve the NDC, it is expected that comprehensive and systemic policy will be possible. In this process, governance to contain various values must be institutionally guaranteed, and a system that can evaluate effects and feedback must also be legally regulated. Furthermore, it is necessary to prepare the basis for institutions systems to move toward a blue carbon market in which the private sector takes the lead, such as activating the trading of blue carbon credits that other countries have been preparing.

The legal basis for blue carbon expansion strategies, such as vitalizing governance, establishing comprehensive and effective policies, promoting regional plans, securing finances and inducing participation of private sector, expanding and diversifying research scope, securing finances and inducing private participation, and strengthening international cooperation, as suggested above, can also be supplemented by revising the current laws. But, there may also be ways to enact new laws to approach

the blue carbon policy in a new paradigm.

It was in 2009 that blue carbon was firstly recognized through academic reports, and it was not until 2013 that blue carbon was added as a carbon absorption sources by the IPCC. Mangroves, salt marshes, and seagrasses were certified as official carbon sinks in 2014. Since then, there has still been little change. This is because it has not been long since it was reflected in each country's policies and begun to be discussed in earnest. This report proposes the enactment of a new general, framework law, believing that blue carbon can be an opportunity to organically connect marine policy and fisheries policy, which have been insufficiently connected so far.

The bill written below is the overview of the '(tentative name) the Framework Act on Blue Carbon for Our Ocean', made through referring to domestic and foreign laws.

Chapter 1. General Provisions

- Article 1. Purpose
- Article 2. Definitions
- Article 3. Basic Principles
- Article 4. Scope of Application
- Article 5. Relationship to Other Statutes

Chapter 2. Formulation of Framework Plan for Blue Carbon

- Article 6. Formulation of Framework Plan for Blue Carbon
- Article 7. Implementation Plans for Blue Carbon
- Article 8. Formulation of City/Do Plans
- Article 9. Inspection of Implementation Progress of Framework Plan

Chapter 3. Blue Carbon Restoration and Expansion Council

- Article 10. Establishment of Blue Carbon Restoration and Expansion Council
- Article 11. Functions of Council
- Article 12. Meetings
- Article 13. Investigation and Hearing of Opinions

Chapter 4. Blue Carbon Expansion Policy Measures

- Article 14. Blue Carbon Impact Assessment
- Article 15. Valuation and Utilization of Blue Carbon
- Article 16. Designation and Management of Blue Carbon Protected Zone
- Article 17. Project for Restoration, Protection and Preservation of Carbon Sinks

- Article 18. Scientific, Environmental and Economic Research for Blue Carbon
- Article 19. Implementation of International Cooperation Projects
- Article 20. Establishment of Blue Carbon Management System
- Article 21. Operation of Blue Carbon empirical research center and base center

Chapter 5. Blue Carbon with the People

- Article 22. Social Safety Network through Blue Carbon
- Article 23. Support for Voluntary Blue Carbon Projects
- Article 24. Support, Education and Public Relations for Blue Carbon
- Article 25. Support for Civil Organizations for Blue Carbon Expansion

Chapter 6. Establishment and Operation of Blue Carbon Fund

- Article 26. Establishment of Blue Carbon Fund
- Article 27. Purposes of Fund
- Article 28. Money Transferred from General Accounts
- Article 29. Operation and Management of Fund
- Article 30. Accounting Agency of Fund
- Article 31. Disposal of Profits and Losses

Chapter 7. Supplementary Provisions

- Article 32. Strengthening of International Cooperation
- Article 33. Preparation of Blue Carbon Reports
- Article 34. Cooperation with Relevant Agencies
- Article 35. Compensation for Loss
- Article 36. State Subsidies
- Article 37. Reporting
- Article 38. Hearings
- Article 39. Entrustment or Delegation of Authority

Chapter 8. Penalty Provisions

- Article 40. Penalty Provisions
- Article 41. Joint Penalty Provisions
- Article 42. Administrative Fines

Meanwhile, in the situation that it is expected that the expansion of blue carbon would become a new paradigm, national, regional, and private projects would be organically connected, various research would be conducted, and international relations would be more complicated and important, it is time to consider the organization that operates it in advance.

In the case of NOAA in the United States, each department in charge of fisheries, oceans, and climate pursues their own works. Comprehensive blue carbon planning and performance management are managed by NOAA's National Ocean Service, blue carbon restoration and protection projects are implemented by NOAA's National Marine Fisheries Service, and international cooperation and research projects are operated by NOAA's Oceanic and Atmospheric Research. When promoting a comprehensive project, it seems that by forming a cooperative department, the project is carried out without any gaps in work through efficient distribution and systematic cooperation.

However, our departments are divided and operated by individual business units such as tidal flat restoration, marine forests, and protected marine areas. Research is conducted and budget is executed, respectively. There is also a way to allocate additional work to existing departments, but this is also inevitable to secure additional manpower and financial resources, and it is worried about limitations in collaboration due to partitions between departments. If so, it can be more efficient and effective to introduce a plan to create a dedicated organization that can design and operate the entire blue carbon policy in line with the new paradigm.

Chapter 6. Conclusion

Rapid climate change and rising sea level have reached a level that threatens our lives. The habitats of fish and animals are changing, many people around the world are suffering from water shortages, and many lives are being lost due to climate disasters. Now, we have to worry that 60% of all life on Earth may become extinct and humans may be included in that list.

Amid this sense of crisis, discussions have been actively taking place in the international community to minimize carbon dioxide emissions and respond globally to climate change. The 2015 Paris Agreement obligated all countries around the world to reduce greenhouse gases. A lot of countries, including Korea, have declared that they will achieve carbon neutrality by 2050 and are taking specific actions to reduce carbon emissions. As a responsible member of the international community, Korea also has been making efforts to establish a national basic plan for carbon neutrality and enacted the Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis.

However, despite these global efforts, it is predicted that the time when global temperatures rise by 1.5 °C earlier than before industrialization. In this situation, the international climate-related conference held in 2023 called for more active and urgent responses from countries.

Now, just reducing carbon emissions is not enough. We need to achieve carbon negativity by absorbing and storing carbon already emitted into the atmosphere. In a situation where forests, a representative carbon sink, are losing their absorption capacity due to aging, the ‘ocean’ is attracting attention as a new sink to replace it. Considering the time and space constraints required to create a sink, it is more advantageous to create new seaweeds, algae, and mudflats than to create a forest.

In the past 10 years, discussions have continued on blue carbon, the carbon absorbed by the ocean, and in some leading countries, scientific research has been

conducted to the extent that blue carbon can be included in the NDC and managed, and practical restoration and protection have been made. Korea has been also pursuing projects such as creating marine forests and restoring mudflats, and conducting research to quantify the amount of blue carbon absorbed.

This study was conducted to examine ways to expand blue carbon, which is attracting attention as a sustainable measure for achieving carbon neutrality, and to maximize its effectiveness. First, I looked at trends in carbon neutrality and blue carbon policies in the international community and domestically, and studied policy cases of countries that had been steadily pursuing blue carbon policies. Then, improvements were drawn compared to the blue carbon policy currently being promoted by the Korean government.

As a result of reviewing the overseas policy cases of the United States, Japan, Australia, and France, it was possible to discover some below commonalities, although they differ slightly depending on each country's policy environment and the progress of the blue carbon policies that have been implemented so far.

First, it is moving beyond consensus on the importance of blue carbon to the stage of policy implementation. Plans are established and restoration and protection projects of blue carbon sinks are being promoted. Each government conducts an assessment of the project and improves the shortcomings of the projects. For the continuous implementation of the blue carbon project, the policy approach, research scope, financial security, ground laws, management system, and socio-economic effects are reviewed comprehensively

Second, each country is promoting blue carbon expansion projects in connection with various values. For example, they are operated as a policy beyond responding to climate change, linking to values such as creating a healthy coastal ecosystem and improving the quality of life of local residents and communities. Considering the coastal ecosystem, a blue carbon restoration project based on natural solutions is developed. In order for reflecting the benefits of residents, a model that can generate income is made. Accordingly, blue carbon research is also being broadly conducted on various topics.

While Korea's research mainly stays at the level of defining blue carbon and reviewing international discussion and research trends, in these countries, lots of various concerns that may arise throughout the entire project process are selected and treated as research topics.

Third, various stakeholders are participating, and the scope of participation is gradually expanding. Many related government agencies, non-governmental organizations, local residents, and experts participate in the process of making and implementing policies and evaluating performance. There are some cases that the government presents guidelines and overall manages the project, while the private sector plans, implements, and evaluates the project.

Fourth, they are promoting the development and trading of blue carbon credits. Even if scientific research on blue carbon absorption began for inclusion in the NDC, it has now developed into a movement to develop blue carbon credits. In the United States, the voluntary blue carbon credit trading market has been already operated through the non-governmental organization Verra. Japan measured the carbon absorption of blue carbon, developed its own blue carbon credit based on this, and began voluntary trading. Australia and France also studying and reviewing projects in which blue carbon producers secure finances through blue carbon, too. It seems that the blue carbon business is already considering the sustainability of the business beyond implementation.

Compared to most countries other than these leading countries that are unable to include blue carbon in their NDC or promote proper restoration projects due to lack of technology, Korea's blue carbon project is progressing relatively well in line with the flow of discussions in the international community. However, it is also true that Korea is in early stages rather than the United States, Japan, and Australia. In this study, implications of Korea's blue carbon policy were derived based on the characteristics of countries that systematically promote blue carbon policies.

To begin with, it is necessary to establish a more comprehensive blue carbon promotion strategy and policy, and secure close connectivity between projects. For

example, the blue carbon expansion project should be able to realize economic and social values along with responding to climate change. In addition, the effectiveness will increase when individual local governments design and promote projects that reflect local features well at the same time as establishing comprehensive policies at the national level.

Second, in order for the blue carbon policy to develop into a comprehensive policy that combines various values, the participation of various stakeholders must be guaranteed. It is necessary to institutionalize it as a norm, but in the short term, guidelines should be prepared so that it can be reflected in individual projects. Going one step further, the government presents guidelines and private sector leads the development of cooperative governance.

Third, it is required to conduct research with diverse content and scope. Various studies should be conducted, including scientific research such as how to create blue carbon sinks and measure carbon absorption, as well as ways to link between projects, review legal problems, and analyze the socio-economic benefits of the projects. In addition, research involving local governments, residents, experts, etc. in each region is also needed so that blue carbon policies can be created suitable considering its characteristics.

On top of that, the participation of the private sector is very important for continuous project promotion and financing. The government's finances play a big role in the initial stage of designing, research, and implementing projects, but market principles must be established in order for the project to continue to be carried out thereafter. To this end, it is necessary to quickly review and introduce a trading system in the carbon market by creating blue carbon credits, on which other countries have already made significant progress.

Next, international cooperation should be further strengthened. Carbon neutrality and blue carbon expansion are policies for global issues that require cooperation with the international community, and above all, this is necessary for new blue carbon, such as non-vegetation tidal flat, benthic sediment, and seaweed

certification from IPCC.

Finally, preparing and institutionalizing ground laws is very critical in order to promote these policies more systematically and effectively. It is also important to secure a dedicated organization for effective policy promotion.

The expansion of blue carbon is related to the moral responsibility in the international community to achieve carbon neutrality. In addition, it is an effective countermeasure against climate change and, it is a policy that can be directly linked to our future life. In conclusion, there is a need to reconsider and promote the blue carbon policy from the perspective of a policy that can take responsibility for the distant future, moving away from a short-term policy that focuses only on achieving immediate creation goals.

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