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Legal fundamentals and key issues for establishing International Ocean Carbon Sink Organization

Qilong Liao

WORLD MARITIME UNIVERSITY

Dalian, China

Legal Fundamentals and Key Issues for Establishing International Ocean Carbon Sink Organization

By

W1011509

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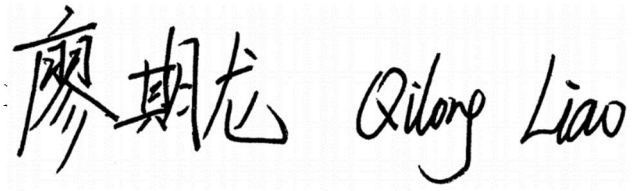
DECLARATION

I certify that all the materials in this dissertation that are not my own work have been identified, and that no material is included for which a degree has previously been conferred on me.

(Signature): 

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Wei FAN

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ABSTRACT

Title of Dissertation: **Legal Fundamentals and Key Issues for Establishing International Ocean Carbon Sink Organization**

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Ocean is a huge Carbon sink and international machinery is proposed for Carbon neutral to combat the climate change. The paper researches UN Charter, UNCLOS and UNFCCC, finding that the principles of common heritage of mankind and common but differentiated responsibilities may constitute the common and balanced mechanism and C4CC Regime as a result. Based on it, International Ocean Carbon Sink Organization is proposed with the three conventions as legal fundamentals. Besides, for the key functions of the organization, including the allocation of Carbon credits from ocean Carbon sink and exploitation regulation, the paper explores the necessities and legal fundamentals. With the organization established, it is expected to set up positive cycle of Carbon credit from ocean Carbon sink – wealth from credit trade – exploitation of ocean Carbon sink to contribute to Carbon neutral and combating climate change.

Key words: UNCLOS, UNFCCC, Common Heritage of Mankind, Common and Balanced Mechanism, Allocation of Carbon Credits, Exploitation of Ocean Carbon Sink

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LIST OF ABBREVIATIONS

CaBM	Common and Balanced Mechanism
CbDR	Common but Differentiated Responsibilities
CHoM	Common Heritage of Mankind
COP	Conference of the Parties to UNFCCC
CO_2	Carbon Dioxide
C4CC	Sea for Climate Change
DIC	Dissolved Inorganic Carbon
DOC	Dissolved Organic Carbon
EEZ	Exclusive Economic Zone
GDP	Gross Domestic Production
GHG	Greenhouse Gas
IMCO	Intergovernmental Maritime Consultative Organization
IMO	International Maritime Organization
IOCSO	International Ocean Carbon Sink Organization
IPCC	Intergovernmental Panel on Climate Change
ISA	International Seabed Authority
ITU	International Telecommunication Union
NDCs	Nationally Determined Contributions
POC	Particulate Organic Carbon
RDOC	Recalcitrant Dissolved Organic Carbon
RoI	Return on Investment
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization

Legal Fundamentals and Key Issues for Establishing International Ocean Carbon Sink Organization

This paper is aimed at figuring out a proper and feasible mechanism, with the ocean involved, that the human beings may adopt, principally based on the global-widely accepted international laws, in the progress of addressing the challenge of climate change due to unprecedented anthropogenic Greenhouse Gas (GHG) emissions.

In the context, the non-intervened ocean Carbon sink means these parts of Carbon removal that:

- The process takes places naturally without significant anthropogenic GHG emissions;

- The process takes places naturally with anthropogenic GHG emissions, but the process is not purposely boosted through human beings' intervention;

The exploitation of ocean Carbon sink means the part of Carbon removal that is processed purposely by human beings' intervention with certain techniques, without resulting in pollution.

CHAPTER 1 Introduction

1.1 Background

1.1.1 Scientific Findings

According to the reports[1] issued by Intergovernmental Panel on Climate Change (IPCC), the global surface temperature in the last decade, 2011~2020, is 1.09°C higher than it in the period of 1850~1900, during which era the temperature is observed and recorded.

For the 1.09°C temperature rise, a warming of 1~2°C is contributed by the well-mixed GHG[1], while, on the other hand, a cooling of 0~0.8°C is contributed by other factors, such as the aerosols. Thus, it is significant the GHG is the main driver of the temperature rise, namely the climate change.

How much has GHG been emitted? According to IPCC reports[1], the total CO_2, as the main component of GHG, emission is 2,424 Gt (1Gt = 1 billion ton) from 1850 to 2019, with an average of 14 Gt per year, while the CO_2 emission is (39.6 ± 2.9) Gt per year between 2008~2017. In this paper, Carbon refers to CO_2 as the main part of GHG.

In the meantime, uptake of 59% of the emission, which is equal to 1,430 $GtCO_2$ from 1850 to 2019, is performed jointly by land and ocean Carbon sinks[1]. Carbon sink, as the reverse process of CO_2 emission, means any process, activity or mechanism which removes GHG from the atmosphere, according to United Nations Framework Convention on Climate Change (UNFCCC[2]).

Further, ocean Carbon sink contributes to uptake of 20~30% of the total emission[1].

Take the emission in 2017 as an example. Total CO_2 emission is 42.5 Gt, and the ocean uptake is 25% of total emission, about 10.7 $GtCO_2$. It is clear that the annual ocean uptake of CO_2 is huge.

What is the total scale of the ocean Carbon sink? According to the joint research[3],

conducted by the scientists from UK, USA, Denmark, Greece, Finland and Italy, there are 38,000 Gt C as Dissolved Inorganic Carbon (DIC), 662 Gt C as Dissolved Organic Carbon (DOC), 2.3 Gt C as Particulate Organic Carbon (POC) in the ocean, as shown in Fig 1. Since 1 Gt C is equal to 3.67 $GtCO_2$, the total scale of ocean Carbon sink is about 142,000 $GtCO_2$.

Thus, it is figured out that the annual ocean uptake, with 2017 case as an example, is less than 1‰ of the total scale of ocean sink.

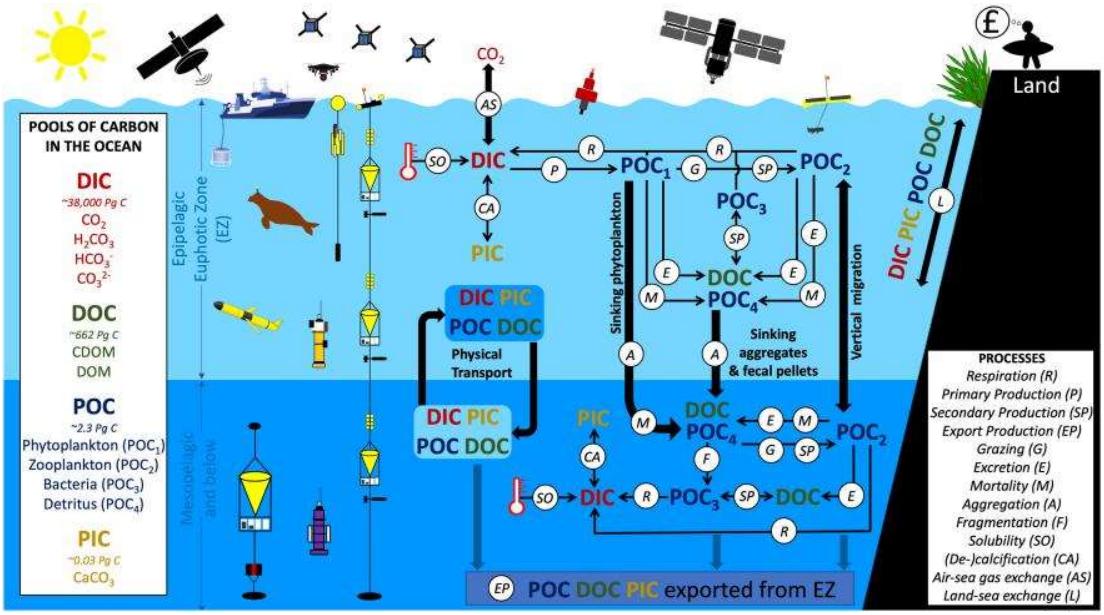

Fig 1 - Scales and processes of ocean Carbon sink[3]

Source: Sensing the ocean biological carbon pump from space: A review of capabilities, concepts, research gaps and future developments, 2021

1.1.2 Findings from International Treaties

There are three critical international treaties[4] on GHG-induced climate change: UNFCCC 1992, Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol 1997) and Paris Agreement 2015.

UNFCCC[2] has 197 parties as of Apr. 19, 2022. As the cornerstone, it provides the objective of stabilizing the atmospheric GHG concentration at such level that the

ecosystems may adapt naturally and sustainable development is possible. The principle of "common but differentiated responsibilities" (CbDR) is agreed, which is a historic contribution of the convention[5].

Kyoto Protocol[6] has 192 parties as of Apr. 19, 2022, even though the US does not ratify it and Canada withdraws[4]. Within the Protocol, the market mechanisms are introduced as cost-effective approaches for emission reductions and has been proved as a successful practice by the European Union (EU) since 2005.

Paris Agreement[7] has 193 parties as of Apr. 19, 2022. The control target of temperature rise is clearly set at well below 2°C in comparison with the pre-industrial level, with the goal of ambitious 1.5°C by pursuing efforts. Besides, the balance between GHG emissions by sources and removals by sinks, which is usually called Carbon neutrality, or Carbon neutral for short, is a subsidiary target for the 1.5°C goal in the second half, 21st century.

1.2 Purpose of the Research

There are three basic facts related to climate change, namely:

- The rate of global GHG emission is very high, more than 40 Gt per annum[1];

- The ocean is a huge Carbon sink, contributing about a quarter of the natural uptake of anthropogenic CO_2 emission[1];

- Currently, there are no sufficient efforts to get the ocean involved in the progress of Carbon neutral.

Thus, this research suggests the international community to establish an organization, namely International Ocean Carbon Sink Organization (IOCSO), under the United Nations (UN) framework. And this paper reveals the legal fundamentals of IOCSO that, in principle, will work based on an innovative legal mechanism, which is named "Sea for Climate Change Regime" (C4CC Regime), as shown by Fig 2.

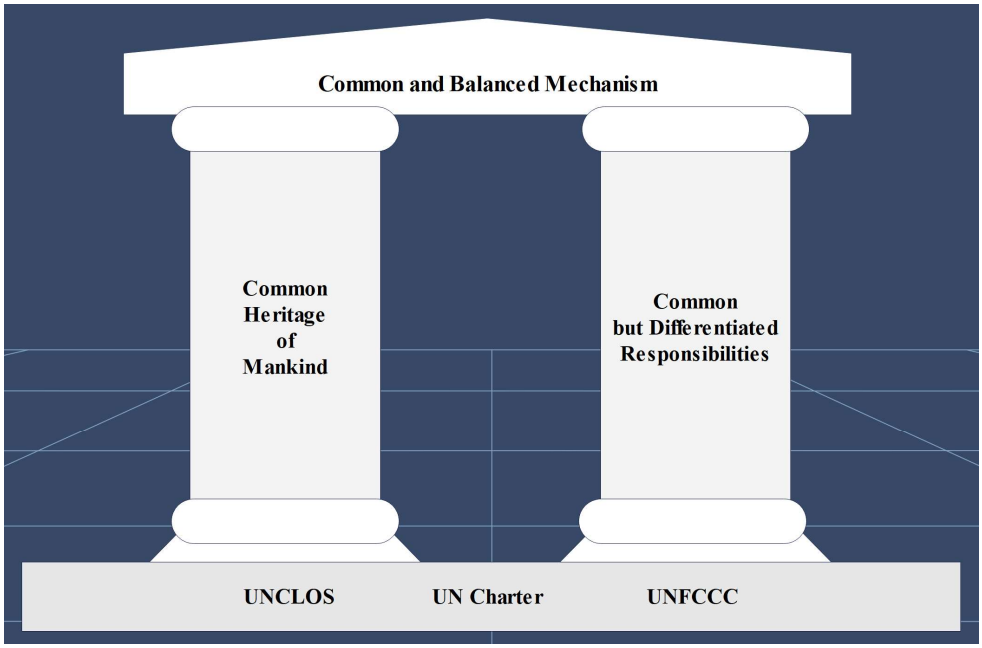

Fig 2 - C4CC Regime

One of the principal functions of IOCSO is on the allocation of the ocean Carbon credits to its member states, of which the legal fundamental and the principle are the key contents of this research.

The other principal function of IOCSO is on the exploitation of the capacity of CO_2 removal by the ocean, which will effectively address the contradiction between the socio-economic development and CO_2 emission. This research reveals the legal fundamental for the function as well.

By figuring out the legal fundamentals for establishment of IOCSO and its two principal functions, based on the global-widely accepted international laws, a proper and feasible mechanism, with ocean effectively involved, is found and may contribute greatly to address the challenge of climate change, foster the world's balanced socio-economic development and promote the realization of the purposes and spirits of the UN Charter[8].

1.3 Paper Structure

Generally, this paper includes introduction, main body and conclusion. The main

body consists of legal fundamentals of the establishment of IOCSO and its two principal functions.

Chapter 1 is the introduction about this research, including the findings about the GHG emissions and removals, purpose of the research and paper structure.

Chapter 2 proposes IOCSO as a UN specialized agency to manage human activities at sea in combating climate change; investigates the legal fundamentals from international conventions; and suggests the innovative C4CC Regime and Common and Balanced Mechanism (CaBM) to be adopted by IOCSO, based on the principles of Common Heritage of Mankind (CHoM) and CbDR.

Chapter 3 discusses the function of allocation of Carbon credits from ocean Carbon removal, including the Carbon credits from non-intervened and exploitation. Besides, legal fundamentals of such function are investigated.

Chapter 4 discusses the function of exploitation of ocean Carbon sink and its legal fundamentals.

Chapter 5 summarizes the whole paper and proposes again to establish IOCSO in combating climate change.

CHAPTER 2 Establishment of IOCSO and Its Legal Fundamentals

2.1 Scientific, Economic and Technical Facts

Scientifically, as GHG is identified as the main factor contributing to global warming[1], there are two steps to control the temperature rise, as discussed below.

The first step is to balance the GHG emission from sources and GHG removal by sinks, namely Carbon neutral, as targeted in the Paris Agreement. The balance may be indicated as the equation below:

$$\text{Neutral} = \text{Emission} - \text{Removal}$$

Within the equation,

- Neutral means Carbon neutral;
- Emission means the quantity of global GHG emission of equivalent CO_2;
- Removal means the quantity of global GHG removal of equivalent CO_2.

After observing the equation, it is found that the Neutral can be achieved either by reducing the Emission, or by increasing the Removal, or by both, as indicated below.

$$\text{Neutral (0)} = \text{Emission (}\searrow\text{)} - \text{Removal (}\nearrow\text{)}$$

Since the global annual emission is more than 40 $GtCO_2$, it is critical to have the ocean further involved into the Removal under human beings' participation to achieve Neutral, with consideration of the ocean as a huge Carbon sink as described above.

The second step is to remove the anthropogenic GHG emission, which is accumulated historically in the atmosphere. Scientifically, the high CO_2 concentration causes the temperature rise, which means the global surface may keep warming to a certain level even though the Carbon neutral is achieved. If human beings would like to cool the surface down to a certain level, it is necessary to

remove some of the accumulated anthropogenic emission from the atmosphere. According to IPCC reports, the quantity of emission accumulated in the atmosphere is about 994Gt and is continuously increasing. For such a huge volume, it is only practicable with the ocean Carbon sink involved.

Technically, it needs a good research foundation to develop a series of techniques on ocean Carbon sink, and needs sufficient capability to further exploit the huge ocean Carbon sink as well.

Firstly, the scientists need to explore the adjustment mechanism of ocean Carbon sink and develop the techniques to observe, measure and enhance its capacity of Carbon removal. Considering the complexity in different oceans, high-tech instruments, tools and equipment are needed to fulfill the task, as well as well-trained talents. However, the availability is usually poor in the developing countries.

Secondly, after the techniques are developed, it is necessary to have such sufficient capabilities that the huge ocean Carbon sink capacity can be exploited, in order to remove tens of billion tons of CO_2 from the atmosphere, considering the vast area[9] of the ocean, about 360 million km^2, and its huge volume[9], about 1.35 billion km^3. It seems impossible to be completed by any one country and thus, the global unity and cooperation makes great sense.

Economically, there are two aspects to be discussed.

Firstly, the right of emission means the right of development, at somewhat extent. Historically, most of the developed counties experienced the emission of high volume or high volume per capita, because emission means energy consumption and further brings power to drive the development. Thus, the developing countries are very likely to experience the high-volume emission stage as well, since they are willing to develop the economy. In other words, most of the countries, especially the developing ones, keep the right of emission to keep the right of development.

For certain developing countries, which are now at the stage of low emission level,

how to assure their rights of development? The answer is to keep the right of emission, which may negatively affect the global reduction of Emission. In this case, the only method to obtain global Neutral is to increase the Removal further, as indicated below:

$$\text{Neutral (0)} = \text{Emission (}\nearrow\text{)} - \text{Removal (}\nearrow\nearrow\text{)}$$

Thus, considering the demand from the developing countries, high Removal is critical for global development, sticking to the purpose and spirits of the UN Charter, under the general background of the global neutral.

Secondly, value of the ocean Carbon sink. The annual ocean uptake is more than 10 $GtCO_2$, and in 2021, the annual mean price[10] of the auction Carbon credit in the European Energy Exchange (EEX) market is €53/tCO_2. Thus, if the ocean Carbon uptake is transferred into the Carbon credit, its market value is €530 billion, which is a huge wealth.

2.2 Current Practice on Carbon Neutral

Globally, there are 85 countries[11] that have adopted the goal of Carbon neutral in principle. Some countries build their Neutral strategy by focusing on Emission reduction and by introducing the remaining Carbon Budget, as indicated below:

$$\text{Neutral (0)} = \text{Emission (}\searrow\text{)} - \text{Budget} - \text{Removal}$$

This practice pays great efforts to reduce the emission, which is highly appreciated since it may output a lot of know-how and technologies for any country on the path of low-Carbon development.

Obviously, this strategy is good for those countries that have experienced the emission Peak. For the developing countries, it is not that applicable, since they need the emission to set up their primitive accumulation, rather than jumping from the primary developing stage to the senior low-Carbon developed stage.

2.3 Establishing IOCSO

According to the discussion above, a closed loop is illustrated as Fig 3 and clarified as below.

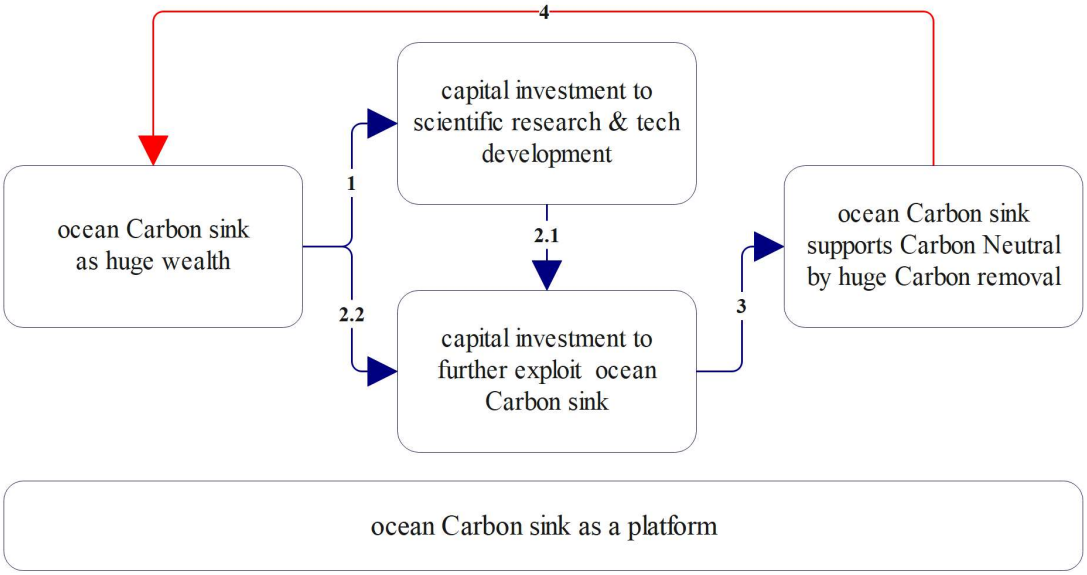

Fig 3 - diagram of ocean Carbon sink to benefit Carbon Neutral

The ocean Carbon sink plays a big role as the platform in order to support the Carbon Neutral, which is the same meaning as to address the challenge of climate change.

Based on the platform, the current ocean Carbon sink is a huge wealth, if put into the Carbon credit market. The wealth may be invested into the scientific research and technical development on enhancing the ocean Carbon sink, as indicated by Line 1.

Then, the tech and the wealth may be put into further exploitation of ocean Carbon sink, as indicated by Line 2.1 and Line 2.2.

With these efforts, the ocean Carbon sink may support the Carbon Neutral through its huge Carbon removal quantity, as initially expected, as indicated by Line 3.

Besides, the increased Carbon removal may be transferred into the Carbon credits for trading in the market again, which adds the wealth in return, as indicated by Line 4.

When the loop in operation with blue line, indicating input / investment flow, and red line, indicating output / return flow, it will be a positive cycle, which generates wealth and supports the Carbon Neutral simultaneously.

However, the scenario above will not take place automatically and a proper mechanism is in need to organize it.

This paper is to discuss the mechanism in respect of:

- What features of the organization shall be equipped for the specific scenario and what the legal fundamentals are for the organization;

- What functions are of the organization and what the legal fundamentals are for the functions.

2.3.1 Current Relative Organizations / Mechanisms

According to the discussion above, the organization shall be featured with international affairs, climate change affairs and ocean affairs. Thus, certain current organizations / mechanisms are figured out as listed in Tab 1.

Tab 1 - Current International Organizations / Mechanisms

Item	Org / Mech	Main Function
1	IPCC	UN body for assessing the science related to climate change[12]
2	UNFCCC COP	UNFCCC supreme decision-making body, which reviews the implementation of UNFCCC and any other legal instruments[13]
3	IMO	UN specialized agency for safety and security of shipping and prevention of marine and atmospheric pollution by ships[14]
4	ISA	UN organization to organize, regulate and control all mineral-related activities in the international seabed area[15]

IPCC[12], jointly created by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988, provides scientific

assessments on climate change, implications and potential future risks to the policymakers, and puts forward adaptation and mitigation options. Its reports are neutral, policy-relevant but not policy-prescriptive and it does not conduct the research on its own. It is obvious that IPCC is a scientific assessment organization, rather than an administrative agency.

UNFCCC COP[13] (Conference of the Parties) is a mechanism to have all UNFCCC Parties represented to review the implementation of UNFCCC, adopt any other legal instruments and take decisions necessary to promote the effective implementation of UNFCCC, including institutional and administrative arrangements. It has several subsidies, which will be discussed behind this list.

IMO[14], (International Maritime Organization), undertakes the responsibilities for the safety and security of shipping and the pollution prevention by ships. It is a professional administrative agency within UN system, which focuses on the international shipping industry.

ISA[15], (International Seabed Authority), is mandated under the United Nations Convention on the Law of the Sea (UNCLOS) to organize, regulate and control all mineral-related activities in the seabed area beyond national jurisdictions. It is a professional administrative agency, which owns the entity to develop the seabed minerals, within UN system focusing on the seabed mining affairs.

Besides, there are several subsidies under UNFCCC COP as listed in Tab 2.

It is identified that the subsidies are standing bodies within UNFCCC COP system, which have respective missions and tasks with regard to secretariat, technology, implementation, fund and compensation.

Thus, it is concluded that the organizations / mechanisms listed in Tab 1, as well as in Tab 2, are not directly suitable to undertake the mission of organizing activities as identified in Fig 3, which are in combination of the international climate change affairs and ocean affairs.

Tab 2 - Subsidies[13] under UNFCCC COP

Item	Body	Main Function
1	UNFCCC Secretariat (UN Climate Change)	UN entity tasked with supporting the global response to the threat of climate change
2	Technology Mechanism	support to developing countries on climate technology development and transfer, both policy and implementation aspects
3	Subsidiary Body for Implementation	all implementation issues under UNFCCC: transparency, mitigation, adaptation, finance, technology and capacity-building
4	Global Environment Facility	an operating entity of the Financial Mechanism under UNFCCC, focused on enabling developing countries to invest in nature and supports the implementation of major international environmental conventions including on climate change
5	Warsaw International Mechanism for Loss and Damage	to address loss and damage associated with impacts of climate change in developing countries that are particularly vulnerable to the adverse effects of climate change

2.3.2 Proposed IOCSO

Even though the current organizations / mechanisms are not directly suitable for certain mission, they are inspiring for figuring out a proper one.

IOCSO, which is short for International Ocean Carbon Sink Organization, is proposed to be established to undertake certain mission, considering several key factors: intergovernmental agency under UN framework, specific functions, and intersectional professions.

Intergovernmental agency under UN framework. Even though the climate change is a macroscopic challenge, its root cause is the microscopic factor from the viewpoint of economics, which is the externality.

As indicated in Fig 4, the black lines indicate the ordinary production process flow, which generates products as wanted, and emission.

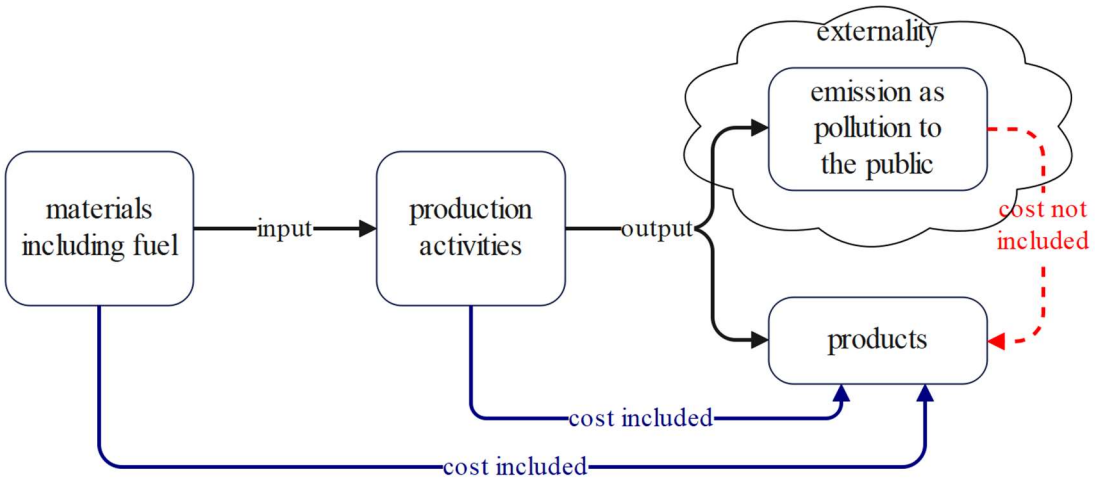

Fig 4 - Externality as the root cause of challenge of climate change

The costs of the materials and production activities are included into the cost of the products, as the blue lines indicate.

However, the cost to address the pollution, resulted from the emission, is not included in the cost of the products as indicated by the red dash line, which is the externality. Since the emission is free of charge, any cost to address the pollution will not be paid by the producer, under the market mechanism.

In this case, the solution has to rely upon the government's administrative regulation to internalize the externality, which is to have the producer incorporate the emission into the cost of the products by paying for the emission. And the motive power is activated to neutralize the emission from each microscopic case. Then the macroscopic emission may be addressed.

Thus, from the microscopic root cause to macroscopic response, the potential solution has to be enforced under government's official measures. Further, to unite the nations globally to address the climate change problem, the intergovernmental agency under UN framework is the best option, since similar practice is widely recognized and there are many mature mechanisms to be used and referred to within the framework.

Specific functions. The mission of the organization, as generally indicated by Fig 3,

includes the exploitation of the ocean Carbon sink / ocean Carbon removal capacity and inherently includes the allocation of the Carbon credits / rights of Carbon emissions to the countries, which are resulted from the ocean Carbon sink.

Firstly, the exploitation of the ocean Carbon sink. The original intention of seeking for or establishing such an organization is to develop sufficient Carbon removal capacity in the ocean, in order to neutralize the anthropogenic CO_2 emission. Thus, the organization shall be capable to fulfill such a function to regulate the exploitation of ocean Carbon removal capacity.

Secondly, the allocation of the Carbon credits. Scientifically, the Carbon neutral is counted according to global emission and global removal. However, from the regulatory point of view, the international counting of Carbon neutral is based on each country. Thus, according the equations below, the Carbon credits from ocean Carbon sink shall be allocated to the countries, which is inherently one of the functions of IOCSO.

$$\text{Neutral} = \text{Emission} - \text{Removal}$$

$$\text{Removal} = \text{Domestic Carbon Credits} + \text{International Carbon Credits}$$

Intersectional professions. Within the academic circle, there are many experts doing researches on the climate affairs covering the atmosphere and ocean factors. However, these two factors belong to different industries:

- Commercial activities at sea, including shipping and fishing industries, focus on the ocean and the ships;

- Climate change response activities, such as emission reduction industry and afforestation, usually take place on land.

However, in order to meet the demand of building huge ocean Carbon removal capacity, the different professions shall be integrated and intersectional professions shall be set up accordingly. Thus, in order to regulate the ocean Carbon sink affairs

effectively, IOCSO shall be configured with the capability of such intersectional professions.

With consideration of the demand of an intergovernmental agency under UN framework, which is entrusted with such specific functions under the background of intersectional professions, there is no existing proper organization and IOCSO is proposed to be established.

2.4 Legal Fundamentals for IOCSO

Before establishing IOCSO, legal fundamentals shall be figured out as the corner stone. Legally, the necessary conditions come from such public international laws, including UN Charter, UNFCCC, as well as UNCLOS, as shown in the C4CC Regime by Fig 2. Besides, one of the sufficient conditions include adopting a new treaty / convention.

2.4.1 UN Charter

UN Charter[8], with its constitutional nature, provides the basic principles and doctrines on governing the international affairs and is widely ratified with 193 Members as of May 1st 2022.

As pointed out, for all the countries, especially the developing countries, the right of emission is equal to the right of development at somewhat extent. Thus, the Carbon neutral problem inherently includes economic affairs.

According to the Preamble of UN Charter, one of the purposes of setting up UN is for the promotion of economic advancement, and it is emphasized again to enhance international cooperation in the economic fields in Art. 1, Art. 13 and Art. 55 successively. Thus, UN is a good international machinery to be employed to support the Carbon neutral problem.

Besides, international organization is welcome to address certain economic concerns,

according to Art. 57. Thus, in principle, the establishment of IOCSO, as the proper organization to address Carbon Neutral problems, complies with the provisions and spirits of the UN Charter.

In order to set up IOCSO with international recognition gained, generally, there are three paths, as below:

- It may be initiated by states. In this case, it should be established by intergovernmental agreement to undertake wide international economic responsibility and then adopted by UN General Assembly later. The typical example is International Telecommunication Union (ITU), which was initially established in 1865, much earlier than the establishment of UN, by adopting the International Telegraph Convention among 20 states and was adopted as one of the UN specialized agencies in 1947. The specialized agency is an autonomous organization, under UN system. In comparison with ITU, it is clear that IOCSO should be an official organization participated by state governments. Then considering the global feature of the Carbon neutral affairs, IOCSO may be recognized globally and adopted as a specialized agency by UN General Assembly.

- UN initiates certain negotiations among states for creation of such a new organization. The typical example is IMO, which was established in 1959, initially named as Intergovernmental Maritime Consultative Organization (IMCO) under the Convention on the Intergovernmental Maritime Consultative Organization, adopted by UN Geneva conference in 1948, and re-named as IMO in 1982. As inspired by IMO case, if negotiation of IOCSO is initiated by UN, it may also be a globally recognized specialized agency. According to UN Charter, the responsibility for initiating the negotiation is vested in the General Assembly of UN, or in the Economic and Social Council, if authorized by the General Assembly.

- UN adopts certain agreement for establishing a professional organization and the organization may be established within UN system, but not recognized as a specialized agency. The typical example is ISA, which was established in 1994 under

UNCLOS 1982 and 1994 Agreement (Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982[16]).

Thus, historic practices provide several paths to establish a globally recognized organization to address international affairs within certain profession. And UN Charter may be one of the legal corner stones for IOCSO.

2.4.2 UNFCCC

Considering that the three milestone agreements, UNFCCC, Kyoto Protocol and Paris Agreement, are systematic climate change agreements, which are significantly different from the topics of UN Charter and UNCLOS, the title *2.4.2 UNFCCC* represents the three climate agreements, rather than the definite UNFCCC.

Aiming at addressing the climate change problem, UNFCCC 1992, Kyoto Protocol 1997 and Paris Agreement 2015 emphasize achieving the climate goal through balancing emissions by sources and removals by sinks of GHG, which, as a globally recognized method for such a long time, is the starting point of action.

In UNFCCC, there are several articles that constitute a thread of Carbon sink exploitation - economy & trading - organization & subsidy.

In Art.4, all parties are encouraged to commit to cooperate to enhance the sinks, including oceans, coastal and marine ecosystems. It is obvious that international cooperation on exploitation of ocean Carbon sink is highly appreciated as one of the commitments. To make it clear, ocean Carbon sink may be developed to neutralize the Carbon emission, as a part of the response of climate action.

In Art. 3, one of the principles is provided that open international system shall be promoted under the cooperation of all parties with sustainable economic growth and development for better addressing the problems of climate change, especially for supporting the developing countries. This principle emphasizes the function of

economic growth in addressing the climate problems. In other words, trusting that economic growth results in more tools than problems, the international community is encouraged to adopt the development methods, rather than any methods that may cause the effect of “no development, no emission”, which may lead to continuous poverty.

Besides, the other part of the principle provides that any measure in combating the climate change problems, no matter unilateral, bilateral or multi-lateral, should not count against international trade through disguised restriction or arbitrary / unjustifiable discrimination. This provision safeguards the international trade, as a part of economic development, by preventing potential unilateral or group-based obstacles for their own interests, which may damage the global efforts on combating climate change. Further, for the global coordination of cost-effective Carbon neutral, the exchange of Carbon credit shall be recognized as a part of the international trade.

In Art. 7, in order to promote the effective implementation of UNFCCC, including the articles above, the COP is mandated to establish certain subsidiary bodies. Practically speaking, the provision is pragmatic. There are lots of jobs to do in addressing the global climate change problems and the COP, as an annual conference arrangement, is far more insufficient to deal with. Thus, it is necessary to establish such standing bodies / mechanisms to deal with daily jobs within certain professions. With regard to ocean Carbon sink, there are also tons of jobs, such as organizing scientific research and technical development, global negotiation on the allocation of the Carbon credits and international trading of the Carbon credits, exploitation of the ocean Carbon sink. Thus, it is in compliance with the spirit of Art. 7 provision to establish IOCSO for addressing ocean-relevant Carbon Neutral jobs.

Besides, the Paris Agreement, as the latest development of UNFCCC, also support such provisions as above.

In Art. 7, it is encouraged to cooperate to strengthen institutional arrangements, in order to enhance the actions of combating the climate change.

In Art. 16, besides establishing subsidiary bodies, such other functions, as required for effective implementation of the agreement, shall be exercised, which further broadens the paths and methods in achieving the climate goal.

After reviewing UNFCCC and Paris Agreement, the thread of Carbon sink exploitation - economy & trading - organization & subsidy is clear:

- Exploitation of the ocean Carbon sink is a global consensus and legally supported by the two climate treaties, which are binding on all 193 parties;

- The action, combating climate change, shall benefit the economic growth and international trade, including trading of Carbon credits, shall not be in obstacle;

- Certain organization is encouraged to be established for effectively combating climate change.

With comparison between the items above and the inherent features of IOCSO, as indicated in Article 2.3.2 of this paper, it is found that both of them align in principle. Thus, it is concluded that UNFCCC, as well as other instruments under its framework, may be one of the legal corner stones for IOCSO.

2.4.3 UNCLOS

Aiming at promotion of the economic and social advancement of all peoples of the world, UNCLOS[17], known as the “constitution of the oceans”, provides a legal order for promoting the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment.

Under the spirits, there are several provisions related to organizations.

In Art. 156, in order to facilitate the States Parties to organize and control activities in the Area, particularly with a view to administering the resources of the Area, which includes the seabed and ocean floor and subsoil beyond the limits of national jurisdiction, ISA is established. Through this article and its practice of establishment

of ISA in 1994, UNCLOS demonstrates its supportive attitude on employing international machinery, as initiated in UN Charter, to address such problems within certain profession to promote the economic and social advancement.

In Art. 197, relating to marine environment protection and preservation, competent international organization is employed for the States to cooperate in formulating and elaborating international rules, standards and recommended practices and procedures on a global basis.

Besides, the phrase “competent international organization” is used in many other articles related to navigational safety.

Practically, IMO is recognized as the “competent international organization” in dealing with the affairs of navigational safety at sea and issues of the marine environment pollution prevention. And International Civil Aviation Organization (ICAO) is recognized as the “competent international organization” on the provision of safety and environment issues related to the aircraft.

Even though there is no entity to implement the whole UNCLOS as its duty, through observing these provisions and practices, it is found that the mechanism, which employs different international organizations, including ISA, IMO and ICAO, to address different issues within respective professions, is effective in implementing UNCLOS as a whole.

As inspired above, in order to effectively address the issues within the profession of ocean Carbon sink, IOCSO may be employed under UNCLOS context.

And the establishment of IOCSO will be supported by UNCLOS, as interpreted below.

As inherently required, scientific research and technical development on ocean Carbon sink are crucial for the successful discharge of the duties of IOCSO. Fortunately, both of the duties are supported by UNCLOS.

In Art. 239, States and competent international organizations are requested to promote the development of marine scientific research.

In Art. 266, States are encouraged to cooperate, through competent international organizations, to promote the development and transfer of marine science and technology.

That is to say that by undertaking the responsibilities of scientific research and technical development on ocean Carbon sink, which are inherent duties, IOCSO, as the competent international organization within the profession of ocean Carbon sink, is encouraged by UNCLOS.

Thus, it is concluded that UNCLOS may be one of the legal corner stones for IOCSO.

With regard to the inherent duties of IOCSO, considering its functions of the allocation of Carbon credits from ocean Carbon sink and exploitation of the ocean Carbon sink, IOCSO shall conduct such jobs, including but not limited to:

- Scientific research on the mechanism of ocean Carbon sink;

- Evaluation of the potential Carbon removal capacity in different oceans;

- Development of ocean Carbon sink technologies according to the situations of different oceans;

- Development of technologies to monitor the Carbon quantities removed by ocean Carbon sink, for precise allocation of the Carbon credits.

Without these researches and developments, ocean Carbon sink would not be exploited safely, fairly and cost-effectively, and IOCSO will be meaningless. Thus, scientific research and technical development on ocean Carbon sink are inherent duties of IOCSO.

2.4.4 New Convention

As demonstrated above, UN Charter, UNFCCC and UNCLOS are crucial legal

corner stones for IOCSO. However, none of them directly request to establish such an organization. Thus, according to international practices, a new convention, namely IOCSO Convention for easy expression, shall be adopted, providing the establishment, principles, functions, organs and other terms of the organization.

This article discusses mainly on the principles and several other key issues.

With consideration of the nature of inter-nation of IOCSO and its main jurisdiction at the high seas, the principles of Common Heritage of Mankind (CHoM) from UNCLOS, and Common but Differentiated Responsibilities (CbDR) from UNFCCC, shall play big roles in the context of IOCSO Convention.

Principle of CHoM.

It is a long evolution of rights at sea with hundreds of years. Briefly, Hugo Grotius, a famous Dutch Jurist, demonstrates the navigational freedom at the high seas in 1609[18]; José León Suárez, the Rapporteur on behalf of the League of Nations from Argentina, finds that "the riches of the sea are the patrimony of the whole human race" in 1926[19]; Arvid Pardo, Maltese then Ambassador to UN, claims that "the seabed and the ocean floor are a common heritage of mankind" [19] and it is adopted into the UNCLOS 1982 as a main principle for the governance of the seabed and ocean floor and subsoil beyond the limits of national jurisdiction, which is known as the Area in the UNCLOS context.

Except in UNCLOS 1982, the principle of CHoM has been adopted by the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, known as the Moon Treaty 1979[20]. The application of CHoM is becoming wider, and then it will be meaningful to explore what features are inherently incorporated in the principle of CHoM, what are the boundaries of the application of the principle of CHoM, and in which case the resource may be recognized as the CHoM, since the governance principle is not defined for many resources at the high seas yet.

There is no definition of CHoM in UNCLOS. While as a principle, there are several elements scattered in *Section 2 Principles Governing the Area, Part XI the Area*, behind the principle of CHoM. And Daniel Goedhuis, a famous Dutch scholar in international law, concludes four key features[21] for the principle of CHoM:

- Non-sovereignty: A prohibition of sovereign claim on the resource.

- Governance: common governance by certain regime recognized internationally.

- Benefit: Sharing the benefits / harvests from the exploitation of such resources.

- Purpose: For peaceful purposes exclusively.

Based on Goedhuis' four key features, a Governance-Harvest Framework, indicated in Fig 5, is set up to identify the boundaries of CHoM, for which there are no questions / arguments in the non-sovereignty and peaceful purpose terms.

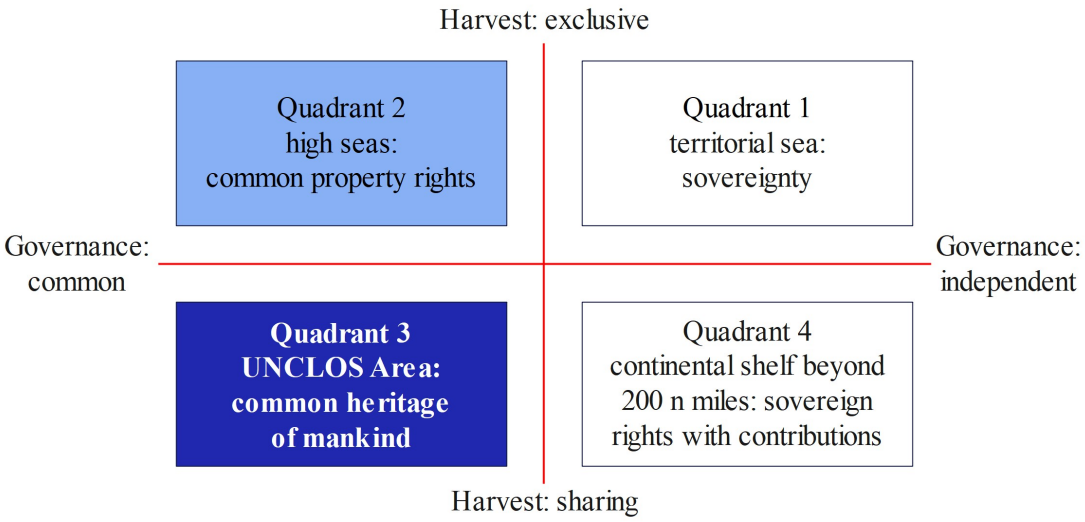

Fig 5 - Governance-Harvest Framework

The framework is divided into four quadrants:

- Quadrant 1 features independent governance and exclusive harvest. The typical case is the resources in the territorial sea, in which the sovereign state manages the resources independently and enjoys the sovereignty of the resources.

- Quadrant 2 features common governance and exclusive harvest. The typical case is

the fishery resources at the high seas. In principle, the high seas are under the common governance of UN and its related organization / specialized agency according to UNCLOS and other international laws. For the fishery resources at the high seas, people enjoy the common proper rights, which means no exclusive rights to the resource is authorized to any body, and no one is entitled to exclude others from the exploitation, but the harvest results in exclusive property rights. To make it brief, resources in this quadrant are of common governance and of exclusive harvest.

- Quadrant 3 features common governance and sharing harvest. The typical case is the resources in the Area within the UNCLOS context. The resources are under the governance of ISA, which is a UN organization as the common management regime, and it is provided that appropriate mechanism shall be arranged for equitable sharing of benefits derived from the exploitation in the Area. The resources with such features are recognized as the CHoM. Both of the resources within Quadrant 2 and Quadrant 3 are of common governance, but only the harvest from resource within Quadrant 3 should be shared and it is such a significant mandatory obligation that usually not requested in other situations. In other words, when identifying whether a resource is CHoM or not, special attention shall be paid to investigate whether the harvest should be shared.

- Quadrant 4 features independent governance and sharing harvest. According to the features, such a kind of resource, under an independent governance, shall do mandatory harvest sharing. According to UNCLOS, the coastal state of the continental shelf enjoys the sovereign rights for exploiting the natural resources over the continental shelf and if such kind of natural resource is exploited over the continental shelf beyond 200 n miles from the baseline, certain amounts of payments and contributions shall be made to ISA, which will distribute them to states parties to UNCLOS. It is obvious that the resource from the continental shelf beyond 200 n miles matches the features within Quadrant 4.

Then, is the principle of CHoM applicable for IOCSO? Can it be adopted by IOCSO

Convention? In the IOCSO context, the organization's functions include the allocation of Carbon credits from ocean Carbon sink and exploitation of ocean Carbon sink. And the principle of CHoM is verified for IOCSO according to Goedhuis' four key features and the Governance-Harvest Framework, as below:

- Non-sovereignty: At the high seas, there is no sovereignty permitted to be claimed within IOCSO context, which keeps the same with UNCLOS.

- Governance: At the high seas, the activities of ocean Carbon sink are provided to be under the governance of IOCSO, an intended UN specialized agency as the common management regime.

- Benefit: Carbon credits from both the non-intervened and the exploited ocean Carbon sink shall be shared, through proper mechanism under certain allocation scheme.

- Purpose: Exclusive for peaceful purposes, in alignment with UNCLOS.

Is it possible to do non-sharing of the Carbon credits from ocean Carbon sink? As estimated in *2.1 Economic Facts* in this paper, the market value of Carbon credits from ocean Carbon removal in 2021 is about €530 billion and is growing with the increasing price of Carbon credit. Possession of such a huge wealth by any country or any countries does not comply with the spirits of the UN Charter, one of which is described as "faith in the equal rights of nations large and small", and may result in epic warfare, which is absolutely not acceptable. So, the benefit from the ocean Carbon sink must be shared.

Thus, it is concluded that:

- The ocean Carbon sink and its Carbon removal capacity are in compliance with the features of CHoM;

- The ocean Carbon sink shall be recognized as CHoM;

- The principle of CHoM shall be adopted by IOCSO Convention.

Principle of CbDR.

As the most commonly accepted principle to combat the threat of climate change induced by anthropogenic GHG emission, CbDR is repeatedly emphasized by UNFCCC 1992, Kyoto Protocol 1997 and Paris Agreement 2015, all of which have no less than 192 parties globally.

The principle of CbDR evolves with the practices on international treaties adopted in different eras.

Principle of CbDR in UNFCCC.

The common obligations for all of the parties to the convention includes to report the anthropogenic GHG emissions and to cooperate internationally to adapt to climate change.

The differentiated responsibilities mainly focus on stronger obligations to the developed countries, which are listed in Annex I in the convention. There are 35 highest-income countries listed in Annex I and they are known as the Annex I Parties. The Annex I Parties shall do more rigorous reporting and reviews. Besides, there are 25 countries, which are already listed in Annex I, listed in Annex II in the convention and they are known as the Annex II countries. The Annex II countries shall provide financial resources to meet the full costs of developing countries in complying with their obligations and provide financial resources for the transfer of technology to the developing countries.

Since the UNFCCC is a framework convention, which does not deal with very detailed problems, the principle of CbDR is set up as a consensus, which is a historic contribution. However, there are some negative effects. The additional responsibilities, as differentiated, are vested on the developed countries listed in Annex I and Annex II, which lists are fixed. The non-Annex I countries do not “graduate” from the group of developing countries into such lists, which makes the anticipation of the developed countries fail, and such kinds of gaps directly result in

the U.S. non-participation of the Kyoto Protocol and the failure of Copenhagen negotiations in 2009.

Principle of CbDR in Kyoto Protocol.

In Kyoto Protocol, the common obligations for all the parties do not change and there is no new commitments for developing countries.

On the other side, the differentiated responsibility to the Annex I countries changes. Kyoto Protocol establishes the target of overall GHG emission reduction on average by 5% below 1990 levels[22] during the first commitment, 2008-2012, which is legally binding to Annex I countries. However, the U.S. signs but does not ratify the Kyoto Protocol and Canada withdraws it.

Principle of CbDR in Paris Agreement.

The common obligations[23] for all parties include:

- Submission of "Nationally Determined Contributions" (NDCs), which contains nonbinding pledges to mitigate GHG emissions;

- Maintain successive NDCs by 2020 and every five years thereafter;

- Pursuant domestic measures to achieve the objective of NDCs.

The differentiated responsibilities include:

- Mobilization of financial resources, which quantified goal is set at no less than $100 billion per annum, from developed countries to support the developing countries' mitigation and adaptation efforts on climate change. And voluntary financial support from all countries is encouraged;

- Absolute economy-wide emission reduction targets undertaken by developed countries, with developing countries encouraged to move towards such targets over time.

Even though the development of the treaties experiences bifurcation between

countries in different developing stages, and the specifics within the principle of CbDR change, the principle itself is always the greatest common divisor, which demonstrates the international consensus on collaboratively undertaking the responsibilities in addressing the challenge of climate change and inherently incorporate the obligation to pay efforts to achieve Carbon neutral, with recognizing differentiated responsibilities.

From macroscopic discussion, as above, it is found the principle of CbDR contributes its vitality as the greatest common divisor among different countries and among different eras. How about in the microscopic context?

According to previous discussion and indication by Fig 4, the emission, as pollution to the public, is externality for the market, and is not paid by the market automatically without CbDR, since the process of addressing-pollution costs money and builds up the total cost of the product, which may weaken the competitiveness of the product.

Under the Carbon neutral context, since it is mandatory to address the pollution from emission, the cost of the product increases structurally, which results in no comparative competitiveness weakened and payments by all the market participants practicable.

Thus, with CbDR, structurally increased cost of the product pays for the efforts of exploiting Carbon sink, including enhancing the removal capacity from ocean Carbon sink. Within a positive cycle, there will be a new balance between emission and Carbon removal, as indicated in Fig 3, and the climate change may be effectively controlled.

It is obvious that, in the microscopic economic context, CbDR also makes great sense by impelling the market to pay for the efforts guided by IOCSO. Besides, the output from IOCSO will certainly support the achievement of the principle of CbDR. Thus, the principle of CbDR shall be adopted as one of the principles in the IOCSO Convention.

Common and Balanced Mechanism (CaBM)

Even though Paris Agreement achieves virtually universal acceptance, it is still a great challenge to neutralize the emission of 42.5 $GtCO_2$ per annum, which is still increasing. How can the huge ocean Carbon sink serve the Carbon neutral further?

The CaBM is proposed.

The CaBM is such a mechanism that:

- It is supported by CHoM and CbDR, which are established on the corner stones of UN Charter, UNCLOS, UNFCCC and continuous agreements under its framework;

- It serves the combat of climate change by activating the huge force of the ocean and activating natural and legal persons' motivations through market mechanism;

- It avoids the potential conflict between economic development and Carbon neutral.

Such a system, consisting of conventions, principles, operational mechanism and the logic relationships among them, is named as Sea for Climate Change Regime, and C4CC Regime for short, as indicated by Fig 2.

The principle of CHoM establishes the rights from the sea for the parties, according to UNCLOS. It is a good principle in general, gains consensus among parties and becomes a bright spot in UNCLOS and even in many other international treaties. However, practically, it has never been exactly achieved as initially anticipated, of which main reasons include the limited application scope within the Area under UNCLOS context, limited stock density and limited commercial Return on Investment (RoI). Nevertheless, in C4CC Regime, the situation of principle of CHoM will change, when the application scope extends from the Area to all the high seas for ocean Carbon sink.

The principle of CbDR firstly generates responsibilities on all of the parties to relevant conventions. Practically speaking, the international obligation is always

weak on enforcement or will be weakened in operation if such obligation is not combined with any positive rights or interests available for certain countries. With regard to CbDR, the U.S. non-participation to Kyoto Protocol is the evidence of such weakness. Besides, the potential damage to the development rights of the developing countries is always a threat to the complete implementation of UNFCCC and continuous agreements under its framework, if emission reduction is always emphasized as the only path to Carbon neutral.

With comprehensive consideration as above, it is proposed to combine the rights from CHoM and the obligations from CbDR, which is CaBM.

Within CaBM,

- The rights from CHoM are activated to fulfil the obligations from CbDR.

- The obligations from CbDR provide market demand for Carbon credits, as one of the outputs of implementing the rights from CHoM.

The basic interpretation for CaBM consists of component words of it.

The word “Common” firstly follows the word in CHoM and CbDR, since the word “common” has been recognized globally as a brand in the international law areas, including in the law of the sea context and in climate change law context.

Secondly, it indicates the combination of common right in the sea context and common obligation in the climate change context. Such combination is indivisible and it does not make sense to emphasize any part of the combination.

Thus, to make it brief, “Common” in CaBM stands for both Common rights from CHoM and Common obligations from CbDR.

The word “Balanced” is more or less from the description of Carbon neutral as “balance between anthropogenic emissions by sources and removals by sinks” from Paris Agreement, which points out the initial purpose of establishing CaBM.

Besides, for the inherent meanings, balance is also an important philosophy in

implementing the rights and the obligations.

Balance in the implementation of rights. Within the IOCSO context, essentially there are two types of rights resulted from CHoM: allocation right of non-intervened Carbon credits and allocation right of exploited Carbon credits.

The allocation right of non-intervened Carbon credits. As discussed previously, the annual ocean uptake is more than 10 $GtCO_2$ and according to the equation below, equivalent Carbon credit is generated.

$$\text{Neutral} = \text{Emission} - \text{Removal}$$

And then the Carbon credit shall be allocated to the countries. But how? With its market value of €530 billion, the allocation is critical not only economically, but for the global peace. Objectively, if a certain allocation solution of virtually global acceptance is not achieved, a new world war might be triggered. Again, how? Firstly, absolute equitable-allocation never exists. The developed countries may claim more allocation due to their large economic scale and absolute heavy-burden on Carbon neutral, while the developing countries may claim more allocation for their large population based on the belief “all men are created equal”. Secondly, as a compromise, balanced allocation is a potentially feasible solution, with comprehensive consideration of the factors, such as population, surface area, emission status etc.

The allocation right of exploited Carbon credits. The exploited Carbon credit is such a kind of credit from the exploitation of the ocean Carbon sink. For example, a company exploits the Carbon sink in the territorial sea, EEZ, continental shelf beyond EEZ and high seas respectively and harvests certain Carbon removal from those areas, then the allocation of those Carbon credits shall be balanced with consideration of the UNCLOS regime, the public nature of the high seas and the company’s efforts.

Balance in the implementation of obligations. Within the UNFCCC and continuous agreements under its framework, the quantitative responsibility is still outstanding for

each country. Thankfully, the Paris Agreement establishes the “ambition mechanism” with the non-binding enforcement power from the “name-and-shame” method. Besides, balanced implementation of obligations is another enforcing method in parallel. Firstly, the Carbon credit shall be introduced into the market as a kind of industrial product with the feature of indispensable, which is almost the same with the feature of fuel. Secondly, each country has the right to exploit the ocean Carbon sink, under certain IOCSO mechanism and to trade the Carbon credits internationally. Thirdly, through the market mechanism of competition, it will result in the most cost-effective international specialization for each country to achieve its Carbon neutral. Within such a mechanism, it features that:

- Global emission and removal are balanced;

- Each country balances its emission and removal in its account;

- Each country achieves optimal proportion of the Carbon credit sources, which is balanced between domestic produced credit and international traded credit.

The word “Mechanism” refers to the rules and regulations, that are generally in accordance with the propositions above and are to be prescribed in the IOCSO Convention and relevant instruments promulgated by IOCSO in the future.

With the CaBM implemented under C4CC Regime, there are such advantages as below:

- Macroscopically, the exploitation of ocean Carbon sink will:

- benefit economic development, which will be indicated by intuitional Gross Domestic Production (GDP) through domestic and international Carbon credit trade, and climate change combat;

- cancel the conflict between economic development and emission reduction, if the emission reduction is the only measure to achieve Carbon neutral;

- support the long-term development of the countries;

- gain advanced science and technology within the aspects of oceanographic, marine chemistry, marine biology, monitoring instrument, satellite observation, big data and offshore engineering etc., which will systematically feedback the whole industry positively.

- Microscopically, by involving in the exploitation of removal capacity, the entities, for example the companies, may earn from

- building the removal capacity for other companies as a service;

- selling Carbon credit as a product, if the company owns the capacity;

- transferring relevant technology.

As above, the core principles of the IOCSO Convention are demonstrated on their applicability and the innovative mechanism, namely C4CC Regime, is introduced comprehensively.

Besides UN Charter, UNFCCC and UNCLOS, another international treaty, Vienna Convention on the Law of Treaties[24] (Vienna Convention), is helpful to adopt the IOSCO Convention on the general terms, within which the typical supportive articles are listed as below:

- According to Art. 5, the Vienna Convention applies to IOCSO Convention, as the constituent instrument of an organization, namely IOCSO.

- According to Art. 27, any party shall not invoke its domestic law provisions as justification for its failure to perform a treaty; and as per Art. 29, a treaty is binding upon each party in respect of its entire territory. In the IOCSO context, IOCSO Convention may contain certain provisions on pollution prevention induced from the exploitation of ocean Carbon sink and such provisions shall be implemented even in the territorial sea and shall prevail regardless of the involvement or not of international factors.

- According to Art. 28, the principle of non-retroactivity of treaties applies, which

means, in the IOCSO context, the Carbon removal by the ocean Carbon sink before the convention entry into force shall not result in any Carbon credits to be allocated. And in other words, the earlier the IOCSO Convention is adopted, the more wealth can be allocated to the world.

CHAPTER 3 Function of Carbon Credit Allocation and Its Legal Fundamentals

As indicated by Fig 3, the ocean Carbon sink results in huge wealth from two paths: Carbon credits from non-intervened ocean Carbon sink and Carbon credits from exploitation of ocean Carbon sink. They shall be allocated in line with the principle adopted in UNCLOS, as the constitution of the oceans, and under the CaBM. Thus, the allocation principle will be determined with respect to the maritime regions, which are generally indicated by Fig 6 according to the definitions in UNCLOS. Besides, as a basis of allocation, the principles, methods of the measurement of the quantity of the ocean Carbon sink shall be agreed internationally or issued by certain mechanism of IOCSO.

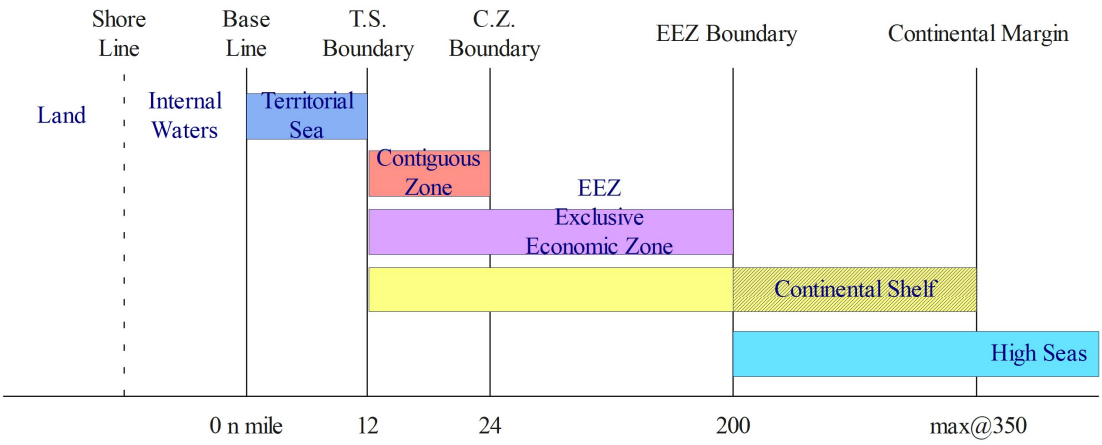

Fig 6 - Maritime Regions

3.1 Carbon Credits from Internal Waters and Territorial Sea

Internal waters are the waters at the land side of the baseline of the territorial sea, as indicated by Fig 6.

Territorial sea is an adjacent belt of sea, with a maximum breadth up to 12 n miles from the baseline, and is beyond the land territory and internal waters of a coastal state, which extends its sovereignty to the belt of sea, to the air space over the belt of sea, to its seabed and subsoil as well.

According to the definitions, which are generated from UNCLOS, it is found that

both internal waters and territorial sea are within the territorial scope of a coastal state, which has the right to utilize them, such as scientific research and economic exploitation, in accordance with its own intention and to gain harvests from such utilizing activities, as long as the utilization is not intended for pollution to the sea.

Obviously, the allocation shall be conducted in line with the descriptions above, namely:

- Carbon credits from non-intervened ocean Carbon sink within internal waters and territorial sea shall be allocated to the coastal state. The reasons are summarized as below:

- The areas of internal waters and territorial sea are empowered as parts of the sovereignty of the coastal state by UNCLOS, and as a matter of course, all the economic interests within those areas shall be allocated to the coastal state.

- Since IOCSO is an inter-governmental organization on behalf of the mankind as a whole within certain work scope, such Carbon credits shall be allocated to the government of the coastal state, which is a measure to implement the principle of CHoM.

- The coastal state enjoys the right to allocate the Carbon credits from exploitation of ocean Carbon sink in the internal waters and territorial sea. The reasons are summarized as below:

- Since the effort of exploitation of ocean Carbon sink is paid by natural or legal persons intentionally rather than by the nature unintentionally, the allocation right does not belong to IOCSO.

- Considering the exploitation of ocean Carbon sink is under the jurisdiction of the coastal state, the allocation right itself belongs to the coastal state.

3.2 Carbon Credits from EEZ

The EEZ is an area beyond and adjacent to the territorial sea, which does not extend

beyond 200 n miles from the baselines from which the breadth of the territorial sea is measured, as indicated by Fig 6.

In the EEZ, the coastal State has sovereign rights to exploit the natural resources, including both living and non-living ones, of the waters superjacent to the seabed and of the seabed and its subsoil, and to conduct other economic exploitation activities, such as the production of wave energy, current energy, as well as wind energy.

Since the economic right is exclusive for the coastal state in the EEZ, the Carbon credit, which is also regarded as a kind of economic interest, shall be allocated exclusively, namely:

- Carbon credits from non-intervened ocean Carbon sink within EEZ shall be allocated to the coastal state. The reasons are summarized as below:

  - According to UNCLOS, the coastal state enjoys the right of economic interests exclusively, hence the Carbon credits from non-intervened ocean Carbon sink shall be allocated to the coastal state.

  - Due to the nature of IOCSO as an inter-governmental organization, such Carbon credits shall be allocated to the government of the coastal state, rather than any other kinds of organizations, unless otherwise agreed between IOCSO and the state.

- The coastal state enjoys the right to allocate the Carbon credits from exploitation of ocean Carbon sink in the EEZ. And the reason refers to that, described in the situation of territorial sea.

3.3 Carbon Credits from the Continental Shelf

According to scientific researches, there are certain amount of CO_2 removed to the seabed with inorganic and organic types, as indicated by Fig 7 and Carbon credits are generated accordingly.

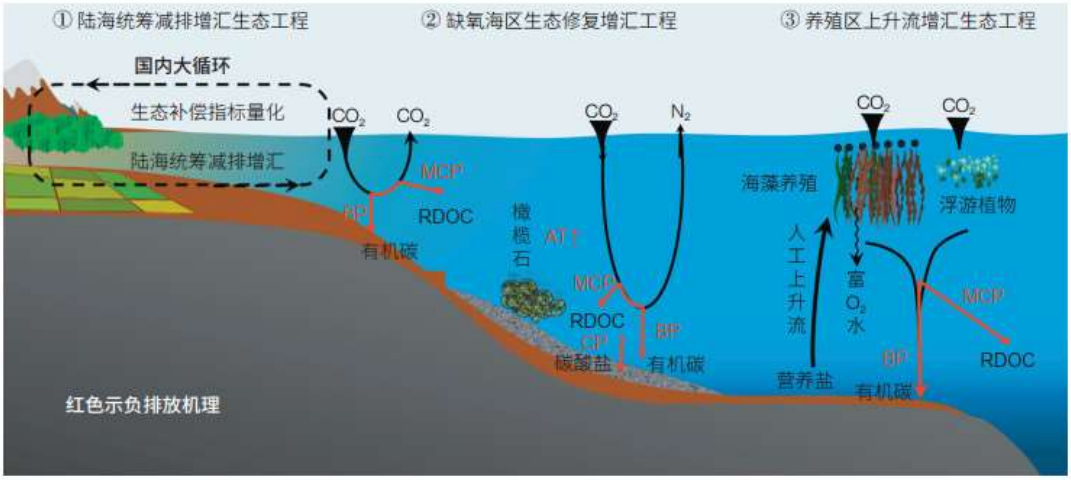

Fig 7 - Schematic illustration of eco-engineering approaches for ocean negative emission[11]

AT, alkalinity; BP, biological pump; MCP, microbial carbon pump; CP, carbonate pump; RDOC, refractory dissolved organic carbon

The continental shelf comprises the extended seabed and subsoil of the submarine areas from the territorial sea throughout the natural prolongation of land territory to the continental margin's outer edge, or to a distance of 200 n miles from the baselines, if the extension of the continental margin's outer edge is less than that distance. As indicated by Fig 6, the continental shelf extends from the outer edge of the territorial sea to the outer edge of the continental margin and is no less than the EEZ boundary.

The legal continental shelf is the geographical continental margin, which consists of the geographical continental shelf, continental slope and continental rise, as indicated by Fig 8. The phrase "continental shelf" means the legal continental shelf in this paper if the prefix "geographical" is not used.

According to UNCLOS, the outer limit of the continental shelf shall not exceed 350 n miles from the baselines.

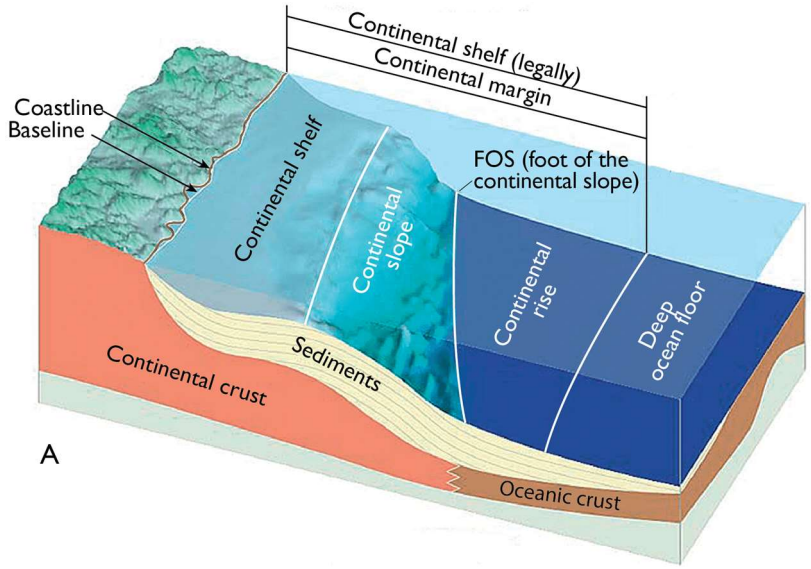

Fig 8 - Continental Shelf and Continental Margin[25]

3.3.1 Carbon Credits from the Continental Shelf within 200 n miles from Baseline

In the EEZ, the coastal State has sovereign rights to exploit the natural resources of and to conduct other economic exploitation activities from the seabed and its subsoil, which are parts of the continental shelf and colored yellow without diagonals as indicated by Fig 6. In other words, the economic interests from the continental shelf, which part is covered by the superjacent waters in EEZ, and superjacent waters are included in the exclusive economic interests of a coastal state. Thus, in accordance with the non-overlap principle, the allocation of Carbon credits from the continental shelf in EEZ shall follow the principles and provisions of the allocation in EEZ.

3.3.2 Carbon credits from non-intervened ocean Carbon sink within the Continental Shelf beyond 200 n miles

According to UNCLOS, the coastal State enjoys the sovereign rights for the purpose of exploring the continental shelf and exploiting the natural resources over it. It does not make it clear whether the economic interests belong to the coastal state or not, if no exploitation is conducted or no exploitation is necessary to be conducted. In this case, the ownership of the Carbon credits from non-intervened ocean Carbon sink

needs discussion, since the Carbon credits come from non-exploitation.

According to UNCLOS, the coastal state enjoys the sovereign right, as independent governance, to the continental shelf beyond 200 n miles, and shall make certain amounts of payments and contributions, which means harvest sharing but not exclusive. With reference to the category system indicated by Fig 5, the resource, which is the Carbon removal capacity in this case, over the continental shelf beyond 200 n miles, features independent governance and sharing harvest and positions in Quadrant 4.

Thus, the Carbon credits from non-intervened ocean Carbon sink within the continental shelf beyond 200 n miles shall be allocated, as below:

- either to the coastal state completely, with payments and contributions from the coastal state to IOCSO, which shall distribute them to states parties;

- or to the coastal state partially, with the non-allocated parts remained to IOCSO, which shall distribute them to states parties.

With regard to the quantity or percentage of the contribution, it needs further discussion among the IOCSO states parties.

The UNCLOS provides the maximum of the contribution up to 7% of the annual production from the continental shelf beyond 200 n miles in the context of exploiting the minerals, which is of high cost, high risk and relatively low revenue due to the sparse distribution of the minerals.

In the case of the Carbon credits from non-intervened ocean Carbon sink, it is assumed to pay relatively rare efforts with gaining lucrative returns, hence it is recommended to promote the contribution rate, with detailed percentage to be discussed further.

3.3.3 Carbon credits from exploitation of ocean Carbon sink within the Continental Shelf beyond 200 n miles

It is authorized to the coastal state with the sovereign rights for exploiting the natural resources over the continental shelf by UNCLOS. Thus, the coastal state has the exclusive right to authorize and regulate the exploitation of the ocean Carbon sink within the continental shelf beyond 200 n miles.

For the allocation of the Carbon credits, there are three parties involved, as discussed below:

- IOCSO. With reference to ISA, certain international organization, which in this case shall be IOCSO and would be provided in IOCSO Convention, is authorized by UNCLOS to gain certain percentage of annual production of the economic development activities from the coastal state, as a kind of contribution. The percentage is like this: 0% for the first five years, 1% for the sixth year, 1% increment for each subsequent year until the twelfth year, and 7% remained thereafter[17]. IOCSO shall distribute the contributions to the state parties.

- Coastal state. The coastal state is the party to authorize the exploitation entity to conduct such activities, as well as the party to levy from the exploitation entity for the state's interests. Besides, it is also the coastal state's obligation to pay the contributions to IOCSO, which shall be provided in IOCSO Convention. Thus, the coastal state will levy that part of contribution from the exploitation entity for its further transfer to IOCSO.

- The exploitation entity. As a kind of economic development activity, the exploitation of the ocean Carbon sink is assumed to be conducted by one or more exploitation entities, which have the rights to gain certain return, as well as the obligations to pay taxes. Thus, certain amount of Carbon credits shall be allocated to the exploitation entity according to the regulations of the coastal state.

Thus, the Carbon credits from exploitation of ocean Carbon sink within the continental shelf beyond 200 n miles will be allocated to IOCSO, coastal state and the exploitation entity.

3.4 Carbon Credits from the High Seas

According to UNCLOS, the high seas is defined as all parts of the sea that are excluded from the EEZ, territorial sea and internal waters, as indicated by Fig 6, as well as the archipelagic waters in certain cases.

The total surface area of global EEZs[26] is about 140 million km^2, and the total surface area of EEZ, territorial sea and internal waters is estimated 154 million km^2. Considering the total surface area of world oceans is about 362 million km^2, it is worked out that the total surface area of the high seas is about 208 million km^2, which is about 57% of the total sea surface area of world, which further means huge potential of Carbon credits from ocean Carbon sink.

3.4.1 Carbon credits from non-intervened ocean Carbon sink within the high seas

According to previous discussions, ocean Carbon sink at the high seas features common governance and sharing harvest, as indicated by Fig 5, and the principle of CHoM applies. Thus, the Carbon credits from non-intervened ocean Carbon sink belong to all human beings and, ideally, all of them shall be allocated to all human beings.

However, considering the initial purpose of establishing IOCSO to transfer the ocean Carbon sink into huge wealth to support Carbon neutral to combat global climate change, huge amount of capital is needed to conduct scientific research, technical development, as well as capacity building, as indicated by Fig 3, thus, certain percentage of Carbon credits from non-intervened ocean Carbon sink shall be allocated to IOCSO, on behalf of mankind as a whole, which arrangement has several advantages resulting from trading the Carbon credits, as below:

- The administrative expenses of IOCSO shall be covered and the member states do not need to undertake their proportion further.

- IOCSO will be able to invest into ocean-wide scientific research and technical development, which arrangement will benefit and facilitate the technology transferring to the developing countries. This is a feasible measure to meet the needs and interests of the developing countries.

- IOCSO may set up certain funds to support the developing countries to exploit the ocean Carbon sink, as a way to participate to combat the climate change. This is a measure under CaBM to balance the capabilities of different countries in combating the climate change.

The specific percentage of Carbon credits for IOCSO is subject to further research and international negotiations.

Besides, the majority of the Carbon credits shall be allocated to member states on behalf of their people respectively. Considering the huge wealth from Carbon credits, the mission with very high priority is to figure out commonly acceptable allocation solution at the early stage of IOCSO. It is foreseeable that most of the countries will claim based on their status and then open negotiation shall be welcome.

However, it is necessary to agree on the principle for allocation, or, the negotiation will be endless discussion and arguments. The principle for allocation is “relatively equitable”, under which, several factors may be considered, including but not limited to population, surface area, historic emission, emission status etc.

After certain factors are agreed, the next step is to agree on each weight of the factors, which will finally result in practicable formulation, as indicated below, to calculate the allocated quantity of Carbon credits for each country.

$$Q_A = (W_1 * R_1 + W_2 * R_2 + W_3 * R_3 + ... + W_n * R_n) * Q$$

$$W_1 + W_2 + W_3 + ... + W_n = 1$$

Q_A: quantity of Carbon credits allocated to country A

Q: total quantity of Carbon credits from non-intervened ocean Carbon sink within the

high seas, excluding the quantity of Carbon credits allocated to IOCSO.

W_n: weight of the n^{th} factor. The weight is based on the negotiation agreement.

R_n: ratio of the n^{th} factor for country A. The ratio is based on country A's objective status. For example, if item Population is the n^{th} factor and the population of country A is P_A and the world's population is P_W, it will be calculated with

$$R_n = P_A / P_W.$$

The allocation of Carbon credits from non-intervened ocean Carbon sink within the high seas is a comprehensive mission and IOCSO shall stand on the fair position on behalf of mankind as a whole.

The Carbon credits shall be allocated both to IOCSO and to all member states. The most difficult job is to gain consensus on the factors of allocation and their weights, which will determine whether the IOCSO regime succeeds or not.

3.4.2 Carbon credits from exploitation of ocean Carbon sink within the high seas

Under the CaBM, the factors, including UNCLOS regime, the public nature of the high seas and the company's efforts, shall be considered during allocation of Carbon credits from exploitation of ocean Carbon sink within the high seas.

Since the principle of CHoM applies to ocean Carbon sink at the high seas, IOCSO, which is on behalf of the mankind as a whole, shall be shared with a certain percentage of the Carbon credits, as a kind of harvest sharing.

Besides, the company pays certain efforts and undertakes the risk of uncertainty, hence, the majority of the Carbon credits shall be allocated to the company.

Thus, there are two parties involved in the allocation of Carbon credits and their respective allocation proportions shall be well defined in the IOCSO Convention.

CHAPTER 4 Function of Exploitation of Ocean Carbon Sink and Its Legal Fundamentals

According to Fig 3, the initial and main purpose of establishing IOCSO is to exploit the ocean Carbon sink to combat climate change. Inherently, IOCSO has the function of regulation of the exploitation activities.

The geographical regulation scope of IOCSO is the waters, seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction, which includes the high seas.

With regard to the Area, which is defined in UNCLOS, it needs proper treatment, because:

- Geographically, the exploitation in the Area is within ISA work scope;
- For the specific business, exploitation of the ocean Carbon sink in the Area is within IOCSO profession;
- Since both ISA and IOCSO are UN bodies, negotiation makes sense and certain agreement shall be achieved for specialization. It is recommended to have IOCSO as the body to control, regulate and organize the exploitation of ocean Carbon sink in the Area, according to the principle of profession.

4.1 Resource

The resource exploitation is an important activity at sea. But what is resource?

According to the Cambridge Dictionary, resource is defined as a useful or valuable possession or quality[27].

According to the definition, there are two dimensions to investigate the meaning of resource, as below:

- Possession / quality of a thing, that may be physically existed or non-existed;
- Value / utilization of a thing, that may be positive or negative.

Thus, the intuitive framework is figured out for easy categorization that whether a thing is resource or not, as indicated by Fig 9.

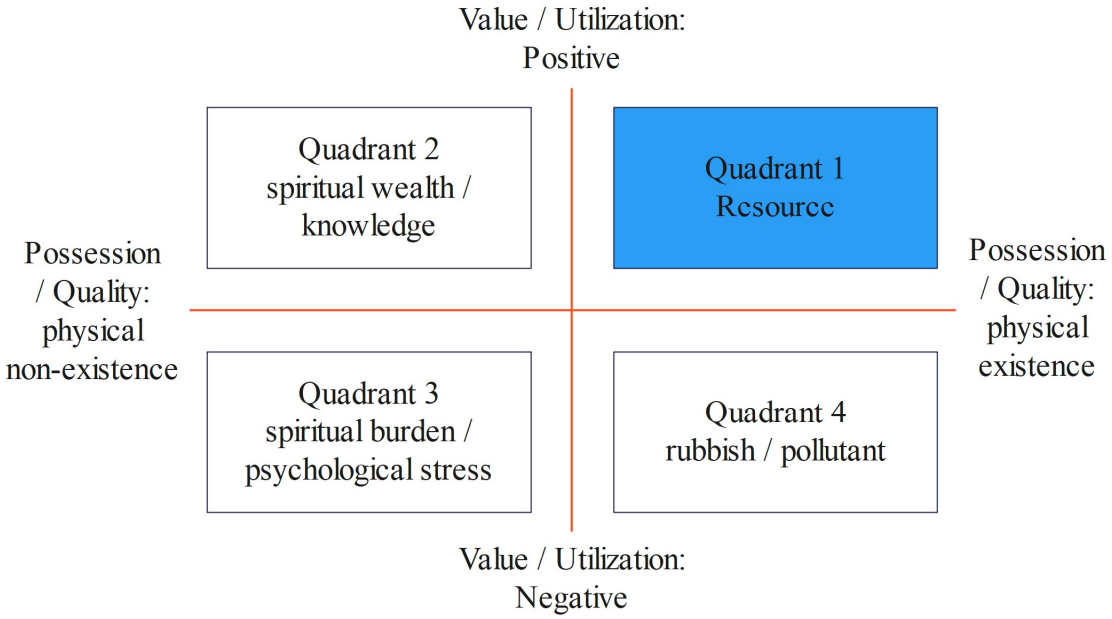

Fig 9 - Categorization Framework of Resource

Based on the two dimensions, a coordinate is established, and four quadrants are interpreted as below:

- Quadrant 1, with physically-existed possession / quality and positive value / utilization, complies with the definition of resource. In other words, anything owning these two features may be recognized as a kind of resource. For example, the ocean Carbon sink has such quality of removing the CO_2 by the ocean, which physically exists, and its utilization is positive for balancing the density of CO_2 in the atmosphere and combating climate change. Hence, it is a kind of resource.

- Quadrant 2 features something with physically-non-existed possession / quality and positive value / utilization. The typical cases are the spiritual wealth, such as inspiring stories, and knowledge. For example, the knowledge, with positive utilization, of how to exploit the ocean Carbon sink is a kind of quality, which does not physically exist, because the knowledge is an awareness. The knowledge is different from the knowledge carrier, such as paper, which

physically exists.

- Quadrant 3 features something with physically-non-existed possession / quality and negative value / utilization. The typical cases are spiritual burden / psychological overstress.
- Quadrant 4 features something with physically-existed possession / quality and negative value / utilization. The typical cases are rubbish / pollutant. For example, the ocean acidification may be caused unexpectively during exploitation of ocean Carbon sink, in this case, the applied materials become pollutants, which causes the exploitation as pollution process.

With the categorization framework, investigate the ocean Carbon sink:

- It is a fact proved by scientific researches that the ocean removes CO_2 from the atmosphere through physical methods, chemical methods, as well as biological and microbiological methods by the materials, physical and chemical properties of the materials and the ecosystem. The typical processes are exampled as below:
  - The sea water dissolves some CO_2 molecule directly;
  - The quality of alkalescence of the sea water absorbs CO_2 by transferring the molecule to HCO_3^-;
  - The phytoplankton absorbs CO_2 through photosynthesis into organism, which will be transferred to be DOC after death;
  - The microorganism can transfer parts of the DOC into RDOC for storage on the seabed / ocean floor for thousands of years.
- It is found that such a quality of the ocean Carbon sink exists physically.
- The utilization of ocean Carbon sink is positive, from the viewpoint of combating the climate change.

Thus, ocean Carbon sink shall be recognized as resource.

4.2 Legal Fundamentals for Function of Exploitation of Ocean Carbon Sink

There are four aspects of legal fundamentals for function of exploitation of ocean Carbon sink.

4.2.1 UN Charter

According to UN Charter, one of the UN purposes is the international cooperation in economy and UN shall promote higher conditions of economic development. From the view point of economic development, the exploitation of ocean Carbon sink complies with the spirits of UN Charter, and UN Charter constitutes a legal fundamental for the function of exploitation of ocean Carbon sink.

4.2.2 UNCLOS

There are six items of freedoms within high seas: navigation, overflight, submarine cables and pipelines laying, fishing, scientific research, construction of artificial islands and other installations. It is obvious that the exploitation of ocean Carbon sink is out of the scope of the freedoms.

On the other side, UNCLOS adopts the principle of CHoM and endows ISA on behalf of mankind as a whole with the right to exploit the resources in the Area, which is defined by UNCLOS. It is reasonably assumed that the exploitation of resources, which comply with the principle of CHoM, may be conducted under the conditions laid down by UNCLOS and by other rules of international law. Thus, if UNFCCC, as a widely accepted law in the profession of climate change, supports the exploitation of ocean Carbon sink, UNCLOS would support it accordingly.

4.2.3 UNFCCC

UNFCCC Article 4 provides the commitments that taking into account the CbDR, all

parties shall promote in enhancement of Carbon sinks, including biomass, oceans, other coastal and marine ecosystems. Thus, it is found that the exploitation of ocean Carbon sink is supported by UNFCCC, as well as UNCLOS.

Considering the crossover area between UNFCCC, as a basic instrument in the profession of climate change, and UNCLOS, as the constitution of the oceans, it is better to constitute an agreement to harmonize the provisions complying with both conventions.

4.2.4 IOCSO Convention

IOCSO Convention shall be that agreement adopting the harmonized provisions between UNCLOS and UNFCCC.

UNCLOS does not prohibit the exploitation of the ocean Carbon sink, as a kind of resource, if other international law applies.

On the other side, UNFCCC provides global commitments on exploitation of ocean Carbon sink.

Thus, UNCLOS will, in principle, permit the exploitation of the ocean Carbon sink.

In order for IOCSO to implement its function of exploitation of ocean Carbon sink, IOCSO Convention shall not only adopt the harmonized provisions, but also have UNCLOS and UNFCCC as the sponsorship instruments, and then, the chain of legal fundamentals for function of exploitation of ocean Carbon sink is integral.

Besides, the exploitation of ocean Carbon sink helps each country achieve Carbon neutral, which makes the CaBM meaningful. Hence, CaBM shall be adopted into IOCSO Convention.

4.3 Pollution

The exploitation of ocean Carbon sink shall be under the provisions of UNCLOS and pollution to the marine environment is prohibited.

Pollution to the marine environment is well defined by UNCLOS. It means introducing substances / energy into the marine environment, by man directly or indirectly, which results in

- harm to living resources and marine life;
- hazards to human health;
- hindrance to marine activities;
- impairment of quality for use of sea water;
- reduction of amenities.

For example, it may make CO_2 absorbed through injecting high-pressure CO_2 to the deep sea, as a kind of Carbon removal, which meanwhile causes ocean acidification, as a kind of pollution. Thus, such kinds of exploitation of ocean Carbon sink shall be prohibited.

Thus, during functioning the capacity exploitation of ocean Carbon sink, the derived pollution shall also be prevented, which is a part of the functions of IOCSO.

CHAPTER 5 Summary and Conclusions

This paper is aimed at exploring a new path to combat the climate change by establishing a new international organization for effective management of the Carbon credits from ocean Carbon sink. The legal fundamentals for establishing the organization and its key functions are well discussed.

According to the research, it is found that Carbon sink is one of the potential options with great contribution in combating climate change, which should have obtained sufficient attention equal to the reduction of Carbon emission, and ocean Carbon sink is one of the most important players naturally.

With further investigation, it is found that three of the important international instruments, including UN Charter, UNCLOS and UNFCCC, support to enhance economic development condition and environment protection, which may be the cornerstones in establishing IOCSO that is designed to control, regulate and organize the exploitation of ocean Carbon sink. And the C4CC Regime is established with CaBM as the core, which is based on the principles of CHoM and CbDR from UNCLOS and UNFCCC respectively. CaBM is designed to recognize the common wealth of the ocean Carbon sink at the high seas, to activate common efforts, to balance the rights and obligations, and to balance each state contribution in combating climate change.

Through CaBM, IOCSO is expected to allocate the Carbon credits, from both the non-intervened ocean Carbon sink and exploitation, to IOCSO and all countries, which may result in activating the massive scientific research, technical development and exploitation activities, so as to build the positive cycle among investment, Carbon removal effect and RoI in combating climate change.

Besides, CaBM also supports IOCSO to manage the exploitation of ocean Carbon sink with the ultimate goal of Carbon neutral, which is to further remove the historically-emitted CO_2 from the atmosphere, resulting in certain surface

temperature.

Since the proposal of establishing IOCSO with certain functions is an innovative idea without any direct guiding instruments and reference documents, three of the important international instruments, including UN Charter, UNCLOS and UNFCCC, are the key applicable conventions and certain compatible provisions are found.

Besides, in order to harmonize the crossover provisions from conventions of different professions, IOCSO Convention is recommended to be adopted with the sponsorship from UNCLOS and UNFCCC.

After certain research, it is concluded that ocean Carbon sink will be a key factor for Carbon neutral, with the development rights of developing countries sufficiently respected. Thus, IOCSO is highly recommended to be established with key functions of Carbon credit allocation and exploitation of ocean Carbon sink, for which certain legal fundamentals are sufficient.

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