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Establish Taiwan's Blue Carbon Sink Measurement and Greenhouse Gas Reduction Methodology

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Start from the Mangroves - Ocean Carbon Sink Creates Blue Economic Miracle

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Translated by Chung Hua Translation Service

The blue carbon economy has increasingly received attention since the rise of the ocean sustainability issue because this discussion can effectively help develop a sustainable blue economy. "Natural Carbon Sink" is one of the key strategies to achieve the country's net-zero transformation. To assist the country in moving towards the net-zero transformation goal, the Ocean Affairs Council has invested in developing the "Mangrove Carbon Sink Methodology." It actively promotes the inclusion of blue carbon in the national greenhouse gas emission inventory, takes stock of blue carbon restoration sites in conjunction with the Ministries of marine affairs, expands public participation and cooperation in blue carbon restoration, demonstrating the contribution of "marine carbon sinks" to the country's net-zero transformation. This issue's "Special Report" article shares Taiwan's blue carbon sink measurement and greenhouse gas reduction methodology, focusing on coastal blue carbon (mangroves, seagrass beds, and salt marshes) with high carbon burial efficiency and review of international blue carbon sink and reduction methodology. Referencing local on-site measurement methods and data, it develops a blue carbon sink measurement and greenhouse gas reduction methodology suitable for Taiwan.

The "International Issues" discusses the most severe maritime oil spill in Peru's history in 2022, focusing on understanding the causes of the oil pollution incident and the damage it caused to the environment and learning from the experience. There are many ship-related industries in the country, including cruise tourism, distant water/coastal fisheries, commercial shipping, etc. Therefore, the analysis of similar international cases can help the country to be more responsible in dealing with similar problems in the future. The "Industry Dynamics" section mainly introduces "Marine Spatial Planning of the Gulf of Guayaquil" to understand how Ecuador and Peru implement cross-border marine spatial planning through cooperation, including confirming the two countries needs for the use of marine space and a consensus on the vision for the future of the bay.

"Latest News" gives an overview of the "G20 Report on Actions against Marine Plastic Litter 2022", a summary of G20 member states and other countries that share the "Osaka Blue Ocean Vision" and the policies and measures taken by the region to prevent, reduce, and manage marine plastic litter, including the contributions of international organizations and non-governmental organizations in solving the problem of marine plastic litter.

Finally, this issue of "Regulatory Systems" introduces the "marine genetic resources" in the "Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction" (BBNJ Agreement) and "capacity-building and the transfer of marine technology" to better understand any possibilities for future marine development through a complete introduction to the BBNJ Agreement.

Establish Taiwan's Blue Carbon Sink Measurement and Greenhouse Gas Reduction Methodology

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Keywords: Blue Carbon, Carbon Sink Measurement, Natural Carbon Sink, Net Zero Emissions by 2050

Natural carbon sinks are the ninth of the twelve key strategies of Taiwan to achieve the goal of "net zero emissions by 2050", of which one of the action strategies is to establish the methodology of blue carbon measurement and the local emission factors. Taiwan is surrounded by the sea and the blue carbon ecosystems are rich and diverse, suggesting the potential to develop natural blue carbon sinks and meet the demand for voluntary carbon market. It is necessary to establish a transparent and open calculation method for blue carbon. By focusing on coastal blue carbon (mangroves, seagrass beds and salt marshes) with high carbon sequestration efficiency, this study reviews international blue carbon development trend and greenhouse gas (GHG) reduction methodologies, takes into account the local carbon sink data, and develops blue carbon inventory and reduction methodologies applicable to Taiwan. SWOT was applied to the development of blue carbon in Taiwan. Finally, short-, medium- and long-term specific strategies for incorporating blue carbon into the National Inventory Report are suggested.

Blue Carbon Plays a Key Role in Mitigating Climate Change

In 2015, the 21st Conference of the Parties (COP 21) of the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement, which, with the unanimous consent of 196 parties, requires all countries to promote carbon reduction measures to mitigate climate change actively. To achieve global long-term greenhouse gas reduction goals, countries worldwide have successfully formulated Nationally Determined Contributions (NDCs) and carbon management tools such as carbon taxes, carbon trading systems, performance standards, and reduction targets. In step with the international community, Taiwan amended the "Greenhouse Gas Reduction and Management Act" to the "Climate Change Response Act" on February 15, 2023, and set net-zero emissions of greenhouse gases (GHGs) in 2050 as a national goal.

About 30% of the carbon dioxide emitted by human activities is absorbed by the ocean, which proves that the ocean can play a key role in mitigating climate change. Relative to the green carbon stored in terrestrial forests, the organic carbon stored in the marine environment is called blue carbon. Blue carbon ecosystems generally refer to mangroves, seagrass beds, and tidal salt marshes. The global mangrove area is 140,000 square kilometers, seagrass beds are 790,000 square kilometers, and salt marshes are 60,000 square kilometers. Although these coastal ecosystems only account for 2% of the global ocean surface area, they store at least 50% of the carbon in ocean soils. Restoring blue carbon ecosystems can reduce global emissions by approximately 0.5% and produce co-benefits to local ecosystems and people's livelihoods, including improving water quality, enhancing marine and terrestrial biodiversity, and maintaining local and traditional communities' livelihoods, cultural practices, and values, as well as protecting the coastline and its resilience. Blue carbon ecosystems have higher carbon sequestration potential than forest green carbon because, in addition to the low risk of forest wildfires, terrestrial soil organic matter has more opportunities to come into contact with oxygen and is easily released GHGs due to the decomposition of aerobic microorganisms. However, marine sediments in an anaerobic environment for a long time can have a longer-term carbon fixation effect. Therefore, restoring and managing coastal blue carbon ecosystems is regarded as a natural solution to mitigate climate change. Especially under the current situation of rapid growth in demand for voluntary carbon offset credits, many coastal countries have actively developed blue carbon projects, such as Kenya's Mikoko Pamoja mangrove conservation and restoration plan, Colombia's mangrove conservation carbon emission reduction plan, Pakistan's Sindh mangrove restoration plan, and the Virginia Coast Reserve seagrass restoration plan in the United States.

Taiwan is surrounded by seas rich in blue carbon resources and has the potential to develop blue carbon sinks. Natural carbon sinks are the ninth of the twelve key strategies to achieve the "2050 net-zero emissions" goal. Therefore, Taiwan should announce local blue carbon sink measurement and GHG reduction methodologies as soon as possible and integrate blue carbon in the National Inventory Report. The blue carbon sink measurement methodology can be used as a National Inventory Report method to quantify, track, and report GHG emissions to fulfill the requirements of international climate agreements. GHG reduction methodology confirms and verifies carbon offset credits (or carbon credits, carbon rights) in voluntary GHG reduction projects. The country-specific carbon emission factors established according to the blue carbon sink inventory methodology will also be an important basis for the voluntary GHG reduction methodology. When measuring carbon sinks or conducting GHG inventories, documents are required to describe the "boundaries and base years for emission calculations," "emissions inventory method," and "evaluation methods for quality assurance and control."

When proposing a GHG reduction project, an applicable local blue carbon sink measurement method should be selected to calculate its baseline, scenario, additivity, leakage, and GHG emissions, combined with Taiwan's blue carbon local emission factor, and make an actual estimate of blue carbon ecosystem carbon sinks. After two stages of registration and quota application, it is verified and validated by a third-party inspection agency respectively, and then submitted to the competent authority for review and confirmation following the procedures.

The "boundary and base year for emission calculation" should clarify the management units and responsibilities of the blue carbon ecosystem. It must first describe the inventory and geographical locations and then detail the blue carbon vegetation composition, environmental information, and land use activities within the boundary. The base year is the comparative baseline for blue carbon sinks or greenhouse gas management. In addition to inventorying the location of blue carbon ecosystems (mangroves, seagrass beds, and salt marshes) and summarizing area changes in different years, it is also necessary to consider different land use categories and the conversion of carbon sinks between them.

The "emissions inventory method" must draw up a carbon sink or emission estimation flow chart based on the blue carbon ecosystem of Taiwan's different environments, explaining how to select the applicable estimation level, and carbon stock measurement method. It is necessary to establish local conversion coefficients using representative species of Taiwan's blue carbon ecosystem and conduct uncertainty analysis of carbon sink or emission estimates.

When "evaluation methods of quality assurance and control" compile the inventory, the compiler should evaluate and maintain the data quality. Regular and consistent inspections must ensure the data's consistency, correctness, and completeness, identify and resolve errors and omissions, and record every quality control activity. Quality assurance refers to planned review rules conducted by people not directly involved in the inventory preparation process, preferably by an independent third party, to ensure that carbon or emissions are the best estimates under existing methods and to review the quality control effectiveness of activities. For quality assurance/control of emission data from blue carbon ecosystems, in addition to referring to the Intergovernmental Panel on Climate Change (IPCC)

2006 Guidelines for National Greenhouse Gas Inventories, reported country-specific emission factors and estimated values from other countries can be used for cross-comparison to assess the rationality of the valuation and ensure the accuracy of the blue carbon ecosystem's carbon sink or emission data.

Blue Carbon Included in National Inventory Report

The Paris Agreement under the UNFCCC includes all parties responding to climate change. National Inventory Report (NIR) play an important role in meeting the transparency framework of Article 13 and the global stocktake of Article 14 of the Paris Agreement. This article focuses on the marine coastal blue carbon ecosystem that belongs to coastal wetlands and is classified under the "wetland" category under "Agriculture, Forestry and Other Land Use." The country's 2022 National Inventory Report should be included under Chapter 6 "Land Use, Land-Use Change & Forestry Sector" (LULUCF). In 2021, the United States and Australia have included coastal wetlands in their National Inventory Report, subdivided into mangroves, seagrass beds, and salt marshes, and detailed calculation methods.

Blue carbon sink measurement should abide by the following principles to ensure that relevant information and quantitative results have an accurate and fair basis.

I. Relevance: Select GHG sources, GHG sinks, carbon storage, data, and methods suitable for measuring carbon sinks or GHG emissions in blue carbon ecosystems.

II. Completeness: Covers all relevant GHG emissions or removals within the boundaries of the blue carbon ecosystem.

III. Consistency: The assessment criteria for different inventory years, gases, and categories are consistent so that GHG-related information can be meaningfully compared.

IV. Accuracy: Based on practice, reduce deviations and uncertainties as much as possible.

V. Transparency: Full disclosure of GHG-related information so that intended users can understand how the inventory is compiled and make reasonable and credible decisions.

VI. Comparability: The reporting format of the NIR must be comparable with the GHG inventories of other countries.

Referring to the 2006 IPCC NIR Guidelines and the 2013 IPCC NIR Wetland Supplementary Guidelines, there are three tiers according to the measurement accuracy (Tier 1-3 from low to high accuracy): Tier 1 is estimated using emission factors preset by the IPCC; Tier 2 is estimated using data from key specific locations in each country; Tier 3 is estimated using detailed verification, timed repeated measurements or model calculations. In terms of measurement methods, they include the Flux method, Stock-difference method, and Gain-loss method. The flux method estimates the amount of GHG emissions or removal between soil and vegetation, atmosphere, and water bodies through direct measurements in the field or establishing models. The carbon stock difference method measures the change in carbon stock at two different time points due to ecosystem carbon sequestration and GHG emission. The Gain-loss method collects emission factors from scientific literature or country-specific data, and directly uses the carbon budget model to estimate the increase or decrease in carbon sinks. Various methods can be mixed according to the field situation, and the purpose is to comply with the methodological MRV principles: Monitoring (or Measurement), Reporting, and Verification.

Regarding the inclusion of blue carbon in Taiwan's National Inventory Report, in the short term (one year), refer to the 2006 IPCC NIR Guidelines and the 2013 IPCC NIR Wetland Supplementary Guidelines to announce the blue carbon sink measurement method applicable to Taiwan. In the mid-term (3 years), using the National Inventory Report of the United States and Australia as examples, blue carbon GHG

Figure 1/ Taiwan Hsinchu Xinfeng Mangrove Nature Reserve: It is a mangrove forest of 8.5 hectares in the northern Taiwan region that is a mix of *Kandelia obovata* and *Avicennia marina*
Image by Hsing-Juh Lin

emissions will be included in Taiwan's National Inventory Report, continue to reduce the uncertainty of domestic blue carbon data and develop the blue carbon sink database to facilitate comparison and assessment management of emissions between different years. It is recommended in the long term (5 years) that the competent authorities of various land use types should regularly monitor and publish information on blue carbon land area in Taiwan and establish a blue carbon land use conversion matrix to calculate changes in carbon sinks or GHG emissions caused by different land use activities.

Development of Blue Carbon Voluntary Reduction Project

Currently, the development of voluntary blue carbon reduction projects in various countries is mainly based on the Clean Development Mechanism (CDM) and Verified Carbon Standard (VCS) certification. Because mangrove carbon sink methodology is relatively mature and the carbon sink per unit area is higher than seagrass beds and salt marshes, many coastal countries continue to develop voluntary reduction projects for mangrove carbon sinks. Implemented since 2013, the world's first community-based blue carbon project is located in the Mikoko Pamoja project in Gazi Bay, Kenya, East Africa. It mainly targets mangrove protection in neighboring communities. By obtaining carbon offset credits in the global market through the Plan Vivo certification agency, it is estimated that 2,482 tons of CO_2 offsets can be obtained each year for 20 years. The average carbon trading amount is about US$24,000 per year, 35% of which is used to cover the implementation costs of the blue carbon project, while the remaining 65% is used for the development of the community where the project site is located. China's "Zhanjiang Mangrove Afforestation Project" has successively carried out mangrove afforestation in the Zhanjiang Mangrove National Nature Reserve in Guangdong, China from 2015 to 2020. At the same time, it is developed under dual certifications of VCS and CCB standards (The Climate, Community, and Biodiversity Standards), and 380 hectares of forest have been planted in 5 years. Including soil and biological carbon sequestration, it is expected to contribute 5,880 tons of CO_2 emission reductions each year, and the trading proceeds from the emission reductions will be invested in mangrove management and community livelihood. Japan is also actively developing blue carbon offset projects. The Port Bureau of the Ministry of Land, Infrastructure, Transport, and Tourism calculates the amount of carbon dioxide absorbed in natural ecosystems such as domestic kelp forests and coastal wetlands, and then qualifies them for carbon emission rights and establishes a "Blue Carbon Offset Credit" trading system. This system will begin publicly soliciting buyers in January 2022 and conduct trial transactions at four locations, including Yokohama Port, Kobe Port, Tokuyama Shimotatsu Port, and Kitakyushu Port. The system also establishes cooperative relationships with relevant parties, such as fishery practitioners, to obtain blue carbon offset credits.

This article further uses SWOT to analyze the strengths and weaknesses of Taiwan's development of coastal blue carbon voluntary GHG reduction projects and opportunities and threats in the market to point out the future development and possible solutions to blue carbon in Taiwan.

I. Strengths

- Taiwan's geographical locations and blue carbon ecosystems are diverse and rich, with development potential.
- Blue carbon has market appeal because of its large carbon sequestration capacity, high efficiency, and long storage time.
- In addition to the carbon offset value of the project itself, blue carbon also has other ecosystem services, such as biodiversity, coast consolidation, and water purification functions.
- Taiwan already has complete distribution areas, carbon sink methods, and measurement data of seagrass beds, mangroves, and tidal salt marsh ecosystems.

II. Opportunities

- The demand for high-quality natural carbon sinks will increase significantly in the future.
- In line with the national "2050 net-zero emissions" goal, various government agencies will actively conduct in-depth research through relevant plans to reduce uncertainty and are expected to propose auxiliary measures for obstructive policies.

III. Threats

- Factors such as natural climate change and artificial environmental interference may directly increase coastal blue carbon GHG emissions.
- Potential risks in the carbon trading market have increased, such as greenwashing and carbon rights fraud.

IV. Weaknesses

- As of November 2023, blue carbon has not yet been included in the National Inventory Report, which means that the scale of blue carbon cannot be determined, which affects the supply information that can be provided to the market.
- The technical level and monitoring technology are relatively difficult for blue carbon. There is a lack of professionals to implement the project and blue carbon-related verifiable institutions.
- The implementation cost of blue carbon projects may be higher than that of green carbon projects.
- In addition to coastal blue carbon, other ocean blue carbon is challenging to prove and plan due to additionality or project boundaries.
- Most blue carbon ecosystems in Taiwan are located on public rather than private land, and project developers must first obtain land use rights. However, the draft of Taiwan's maritime space planning law, the "Sea Area Management Act," has not yet been completed, and the use of sea area space may cause controversy.
- Coastal blue carbon still lacks economic value reuse plans.
- The powers and responsibilities related to coastal blue carbon are scattered among various ministries, and there is still a lack of planning mechanisms for project application.

2022 Peru's Most Severe Maritime Oil Spill Event in History - Who Should be Responsible for This Environmental Disaster? Experiences and Lessons Learned

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Keywords: Oil Pollution, Submarine Pipeline, Tsunami

On the early morning of January 15, 2022, the underwater oil pipeline ruptured, causing crude oil from an Italian-owned oil tanker to pour into the ocean. The tanker was at the offshore buoy area of the largest refinery in the northern part of Lima, the capital of Peru, for cable mooring and unloading at that time. This incident, known as the most serious oil spill in the history of Peru, led to Peru declaring a state of environmental emergency. One of the world's most abundant marine ecosystems and at least 2,000 coastal fishermen who rely on it for their livelihoods faced a problem when meeting this oil pollution accident: Who should be responsible for climate crisis and catastrophic wildlife casualties? The responsibility for the leak is still being debated between the oil company, the tanker captain, and the Peruvian government. Is it a natural disaster or human-caused? Meanwhile, the damage to the environmental ecosystem and society continues to spread. Peruvian authorities and the international community should continue to take action to mitigate its impact.

2022 Peru's largest scale oil spill event in history

The oil spill incident in the vicinity of Lima, Peru occurred on January 15, 2022. On that day, an Italian tanker named Mar Dorecum (Crude Oil Tanker, IMO: 9446374, MMSI 247275900), carrying Brazilian-produced Buzios crude oil, had an oil spill accident near the La Pampilla refinery, located in Ventanilla district on the northern coast of Lima, Peru's capital (Figure 1). The refinery is operated by Repsol, a Spanish energy company, and hereinafter referred to as Repsol. The leakage was caused by the rupture of a manifold on the underwater oil pipeline (Figure 2), and the cause is still under investigation and dispute clarification [1]. It is possible that the leakage is related to the tsunami caused by the volcanic eruption in Tonga, which affected Peru, causing a leak during the oil transportation operation of the Peru refinery located 10,000 kilometers away [2]. The refinery operated by Repsol claims that the abnormal waves caused by the volcanic eruption led to the rupture of the underwater oil pipeline and leakage, resulting in Peru's worst ecological disaster. Peru has demanded compensation from Repsol, amounting to 4.5 billion US dollars [3].

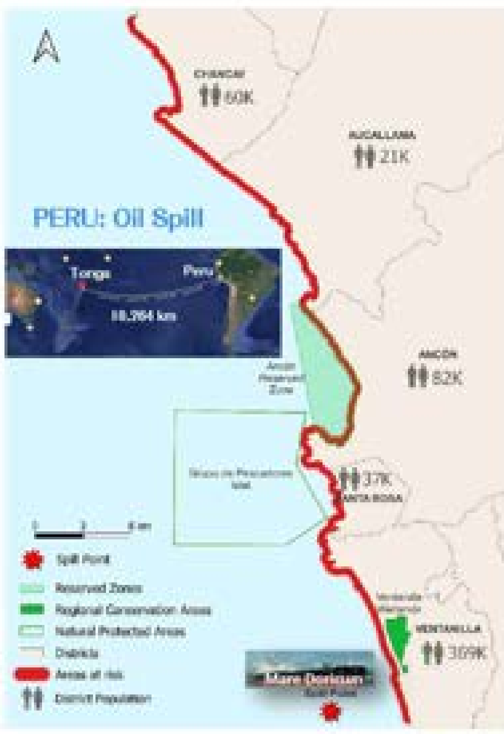

Figure 1/ 2022 Peru's largest-scale oil spill event map
Source/ OCHA [4], Modified by the author

The initial estimate of the leakage amount from Brazilian crude oil was 6,000 barrels (equivalent to approximately 1,100 metric tons), but subsequent investigations updated it to 11,900 barrels. The details of the incident are listed in Table 1 [5].

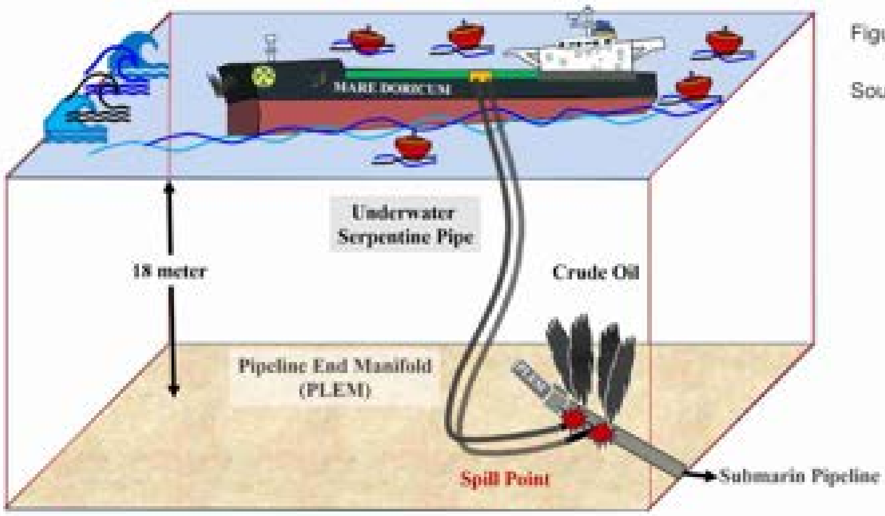

Figure 2/ Peruvian coast oil tanker leakage situation diagram
Source/ Made by the author

Table 1/ Incident details of the oil spill near Lima, Peru

Oil Spill	Date of Occurrence	January 15, 2022
	Location	Near Lima, Peru
	Primary Threat	Crude Oil
	Ship Name	Mare Doricum, Crude Oil Tanker
	Tags	Pipeline, Tsunami
Leakage Materials	Products of Concern	Buzios Crude (From Brazil)
Leakage Amount	Total Amount at Risk of Spill	11,900 Barrels (Equivalent to approximately 2,182 metric tons) Original estimate: approximately 6,000 barrels (equivalent to approximately 1,100 metric tons)
location coordinates	Latitude (Approximate)	11° 55.23′ South
	Longitude (Approximate)	77° 8.56′ West
Response Actions	On-Water Recovery	Applied
Cleanup Technology	Shoreline Cleanup	Applied
	Dispersants	Unknown/Not Applicable
	In-Situ Burn	Unknown/Not Applicable
	Bioremediation	Evaluated But Not Used

Source/ Oil Spill near Lima, Peru (2022), NOAA Incident News [5], Modified by the author

Preliminary situation of oil spill accident, reported by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) on January 23, 2022, regarding the Peruvian oil spill incident [6], and the update on January 27, 2022 [4], releasing the following key messages:

- On January 15, 2022, an oil spill incidence occurred in the refinery owned by Repsol, a Spanish company, near the Ventanilla district in the northern metropolitan area of Lima. The Peruvian government officially declared a state of environmental emergency.
- The estimated amount of leakage is 6,000 barrels, roughly equivalent to about 1,100 metric tons, approximately 400 tons more than international standards for a large spill, a serious test for national response capacities in most countries.
- Due to ocean currents pushing the oil pollution northward, this leakage incident has impacted the wildlife and coastline of five areas located north of the leakage site. Nearby communities have been responding to the impact of the oil pollution leakage on local wildlife and natural resources.

- The Peruvian government's response to this disaster involves multiple different public departments, and a report from Repsol indicates that the company has deployed manpower about 1,800 personnel for emergency response and deployed professional equipment to hold the further spread of oil pollution.
- Following the Government's request for UN support, a team of personnel from OCHA, the OCHA and UN Environment Programme (UNEP)-led Joint Environment Unit (JEU), UN Disaster Assessment and Coordination (UNDAC) and technical experts identified by the JEU is deploying to provide analysis and recommendations on disaster response and coordination.

Event overview

On January 15, 2022, a subsidiary refinery owned by Repsol, experienced an oil spill incident. On January 21, the Peruvian government declared a 90-day state of environmental emergency along the coastline approximately 90 kilometers north of the capital Lima. Initially, approximately 6,000 barrels of oil leaked into open waters. According to the report from Peru's Agency for Environmental Assessment and Enforcement (OEFA) as of January 23, the affected area consists of 7.1 million square meters of water (approximately 713 hectares) and 1.8 million square meters of coastline.

Oil pollution continues to spread and is being pushed northward by ocean currents, reaching the neighboring Ancón district, two national marine protected areas, and the nearby Chancay port in the northern region. Peruvian authorities describe this situation as the most severe ecological disaster in recent Peruvian history.

This leakage incident has caused serious environmental damage and posed risks to the health and livelihoods of residents in the coastal areas in emergency situations, especially for fishing families and the local tourism economy. According to a report from the Ministry of the Environment in Peru, the impact of the oil spill incident could result in direct and indirect losses of $52 million to the tourism industry. Many untrained and unprotected individuals are risking their health to rescue affected wildlife on nearby beaches. Peruvian authorities estimate that the affected area, both at sea and on land, will exceed 1,400 hectares, with over 500 hectares within marine wildlife protection areas and approximately 512 hectares of natural protected areas being affected. Over 50 kilometers of coastline face the risk of oil pollution.

Emergency response

Repsol mobilized more than 1,800 manpower to clean up oil pollution. They deployed over 50 heavy machinery equipment installed in the 2,800-meter oil pollution isolation barrier zone between Cavero and Faro Chancay to provide support needs.

The United Nations on-site team also held exchanges and meetings with relevant departments of the Peruvian government, including the Ministry of Environment responsible for leading the country's response work, the Prime Minister-led Ministerial Conference, and the National Institute of Civil Defense Institute (INDECI). They sought to understand the current response and coordination mechanisms through the National Emergency Operations Center (COEN). Measures corresponding to their respective thematic tasks were taken by various government institutions, from ministries to regulatory bodies, including clean-up, containment, response and monitoring, supervision, analysis, and potential assistance measures for affected families.

Repsol's report showed that cleaning staff increased from 1,800 to 2,200, with a total of more than 70 heavy machinery, 27 large vessels, and 90 boats deployed to handle the remaining cleaning work. The oil company also stated that a safety barrier of 4,400 meters has been set up and over 10,000 cubic meters of affected sand have been cleared and treated, equivalent to approximately 2,000 containers.

Environmental and ecological impact

The main environmental issues after the event include:

I. Large-scale water and coastline pollution;

II. Impact on local wildlife, ecosystems, and natural resources;

III. Impact on local community livelihood, food security, and health.

The first report from the Peruvian Oceanographic Institute (Instituto del Mar del Perú, IMARPE), based on samples collected three days after the ecological disaster caused by Repsol, concluded that "the total concentration of petroleum hydrocarbons is very high", not only polluting the seawater but also affecting plants, animals, and other marine species. One month after the incident, interviewed experts unanimously acknowledged that, in addition to surface cleaning of oil on the beaches (Figure 3), it would take several years to restore the affected ecosystems and areas [7]. The oil pollution has caused damage to one of the world's richest marine ecosystems; according to the National Service of Natural Areas Protected by the State (SERNANP) of Peru, fish and invertebrates have died, resulting in over a thousand oil-covered seabirds (Figure 4), with hundreds of seabirds dead. Marine mammals, such as otters, are also severely affected and are on the brink of extinction [8].

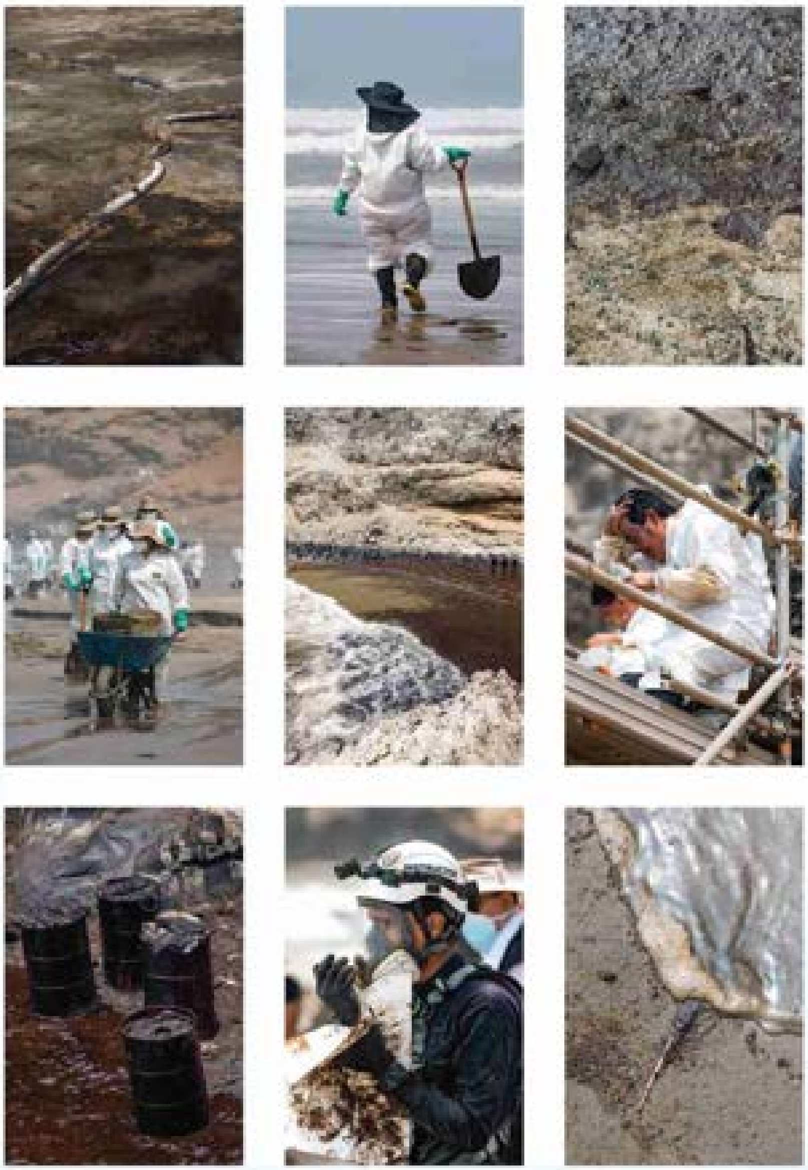

Figure 3/ Oil spill crisis devastates 21 beaches, Peru imposes emergency environmental order
Source/ OCHA [9]

Figure 4/ Birds covered in oil after the leakage incident
Source/ OCHA [9]

Conclusion

This oil spill caused a large amount of oil to enter the Peruvian coast, causing serious damage to the local environment and ecosystem, and affecting the livelihoods of the local fishing industry and impacting tourism activities. Oil pollution affects marine organisms and has a negative impact on the local fishing industry. Although Peruvian authorities have quickly initiated emergency response plans in an attempt to stop the spread of oil pollution and subsequent cleanup efforts have begun and continue for a period of time, but oil pollution still causes long-term harm to local coastal communities and marine ecosystems. Additionally, further investigations are ongoing to determine the causes and responsibilities of the incident. In summary, the January 2022 oil pollution incident in Peru has had a significant environmental, ecological, and economic impact on the local coastal area. Authorities and the international community should strengthen the emergency response mechanisms, regulations, and enforcement against marine pollution incidents in order to provide appropriate remedies for the affected nature, organisms, and stakeholders. Ongoing monitoring programs of the long-term effects of oil pollution on the environment, ecosystems, fisheries, and human health will help understand the extent of the pollution damage, assess the socio-economic impacts, and determine the recovery time, thereby aiding in the effectiveness of cleanup actions. Furthermore, it is important for cruid oil transport operators to fulfill their responsibilities in good management, operations, and pollution prevention and control. Public-private cooperation should strengthen pollution response technologies and capabilities in order to make preventive measures and emergency response to marine pollution more comprehensive.

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Future Spatial Demands of Uses and Scenarios in the Gulf of Guayaquil: The First Step Towards Cross-border Marine Spatial Planning

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Keywords: cross-border marine spatial planning, Gulf of Guayaquil, blue economy, Ecuador, Peru

Among 17 Sustainable Development Goals of the UN 2030 Agenda for Sustainable Development, Ecuador and Peru have many common goals, paving the way for cross-border cooperation in marine spatial planning (MSP) for the region of the Gulf of Guayaquil. To put cross-border cooperation in practice, the first thing is to identify Ecuadorian and Peruvian demands for space as well as whether both sides agree on the future scenarios of the Gulf of Guayaquil. Potential future demands for space for the Ecuadorian and Peruvian sides of the Gulf of Guayaquil are identified, including conservation, fisheries, aquaculture, oil & gas, maritime transport & ports, deep-sea exploration, etc. Future conditions of sectors are thus predicted based on three potential future scenarios, which are: the trend scenario, the conservationist scenario, and the integrated scenario. The information derived from the potential demands for space as well as the scenarios serves as a foundation for both countries to engage in future cross-border MSP as well as realizing sustainable blue economy.

Introduction

The Gulf of Guayaquil is situated on the northwestern part of South America. It is an inlet of the Pacific Ocean, covering an area of over 12,000 km². With a large number of Ecuadorian and Peruvian rivers draining into this gulf, the gulf is a large estuarine ecosystem, characterized by extensive mangrove forests that provide critical habitats for a range of birds and marine species. It is also a productive fishing ground. The important fish that are found include tunas, sardines, anchovies, etc. [1]

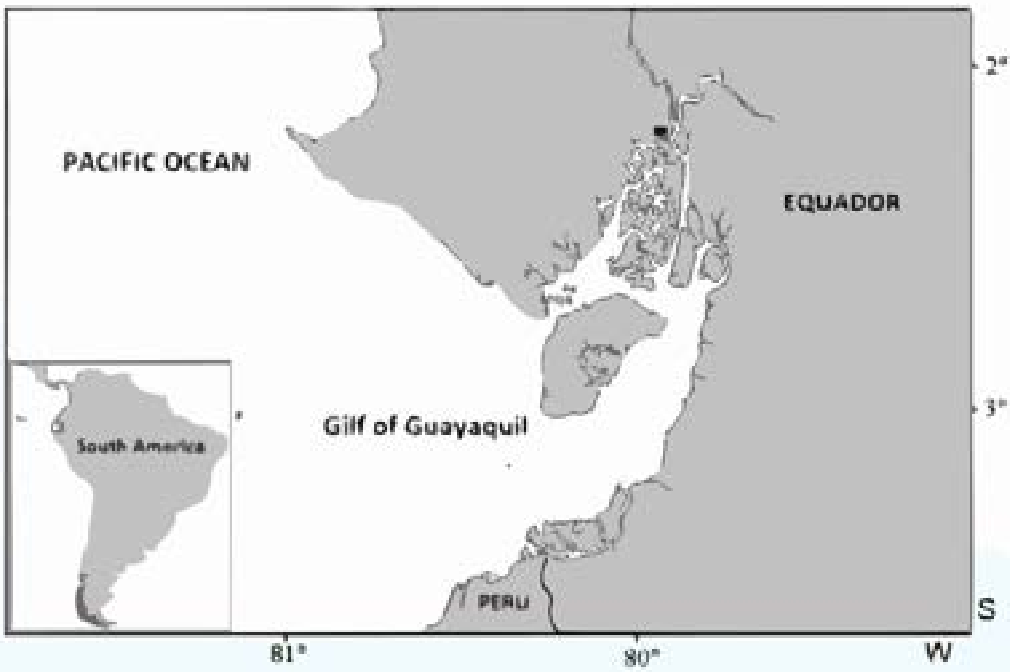

Figure 1/ The Gulf of Guayaquil is an inlet situated on the east Pacific Ocean, under jurisdiction of Ecuador and Peru
Source/ adapted from [2]

Cross-border MSP is one of important objectives of the International Guide on Marine/Maritimes Spatial Planning (MSPglobal) [3]. The Gulf of Guayaquil, under jurisdiction of Ecuador and Peru, is a cross-border water, serving a good venue for implementing cross-border MSP. Ecuador and Peru have many common goals on the 17 SDGs. This facilitates both sides to engage in cross-border cooperation in MSP and thus to promote blue economic development. This article identifies Ecuadorian and Peruvian potential future demands for space and analyzes future scenarios of the Gulf, serving as a basis for both sides to cooperatively engage in cross-border MSP in the future. (The content of the article is mainly excerpted and compiled from [4].)

Potential future demands for space

Identifying Ecuadorian and Peruvian potential future demands for space is an important first step for cross-border MSP for the region of the Gulf of Guayaquil. The demands for space include conservation, fisheries, aquaculture, oil & gas, maritime transport & ports, deep-sea exploration. As for the demand of conservation, two proposals for protected areas were identified on the Peruvian side. While two priority conservation areas were identified on the Ecuadorian side in MSPglobal, Ecuador is not planning to establish new protected areas in the Gulf of Guayaquil. With respect to the demand of aquaculture, Ecuador has already identified some offshore aquaculture sites with some of them have already have a specific target use, such as production of macroalgae, or production of fish in cages. Peru also identified potential areas for offshore aquaculture of bivalves.

With regards to the demand of oil & gas, there are large areas of hydrocarbon prospects on the Peruvian side that are mostly in deep waters and have not been drilled yet. However, no data show the existence of hydrocarbons for the Ecuadorian side. On the demand of marine transport & ports, the Peruvian National Port Development Plan 2019 identified thirty-seven port development areas for construction or expansion of port terminals. The Ecuadorian Strategic Mobility Plan 2013-2037 also identified the sites for expansion of existing ports as well as construction of new ports.

As for the demand of deep-sea mining, studies are still incipient. While the modelling results of depth data show the potential sites of ferromanganese crusts, geological and geophysical research are still needed to prove their existence. In addition, with the increasing demand for rare earth elements used by the technology industry to produce smartphone, batteries, photovoltaics, and wind turbines, it is expected that deep-sea mining will become one of important uses in marine space.

Potential future scenarios for the Gulf of Guayaquil

The scenario represents a potential situation in the future. It reflects specific goals, priorities and values. The scenario of the Gulf of Guayaquil depends on the goals, values and priorities of uses set by Ecuador and Peru in relation to MSP. There are three potential scenarios for the Gulf, which are: the trend scenario, the conservationist scenario, and the integrated scenario.

Scenario I: the trend scenario

The trend scenario is a business-as-usual scenario with no common vision agreed by both countries. In this scenario, each country has its own goals, actions and spatial demands without considering an ecosystem-based approach. It is expected that conflicts between uses as well as uses and natural environments would intensify in the multi-use waters. Table 1 describes the future conditions of sectors in the trend scenario.

Table 1/ Future conditions of sectors in the trend scenario of the Gulf of Guayaquil

Sector	Future conditions
Conservation	• The mangrove coverage will decrease due to illegal logging and new shrimp aquaculture continues to develop. • The proposals of two new protected areas will not be approved.
Fisheries	• The industrial shrimp fisheries, besides having original zones, further have extended zones. • Fish stocks will decrease due to overexploitation. • There will be conflicts in the traditional fishing grounds between local fishing vessels and foreign boats due to lack of surveillance.
Aquaculture	Shrimp aquaculture development will increase and offshore aquaculture will not be a reality yet.
Tourism	The tourism sector will still operate below its capacity.
Oil & gas	• The exploration and exploitation of oil and gas will keep increasing. • Decommissioned platforms will not yet be removed.
Maritime transport & ports	• Shipping will continue increasing due to growing demands for commodities and goods. • The dredging deposit site will remain in the same position, inside the 1 NM Reserve Area for Species Reproduction in Ecuador.
Deep-sea mining	There will be a lack of investment in research and business projects.
Renewable energy	There will be a lack of investment in research and business projects.

Source/ [4]

Scenario II: the conservationist scenario

The conservationist scenario means two countries agree to the conservation vision. It represents a situation in which environmental objectives would be the top priority and all other sectors would have limitations, or even prohibitions. In this scenario, new protected areas would be created, activities with high potential impacts limited, and development of new uses based on ecological sustainability. In the case of oil and gas, for example, new projects would not be allowed, and even existing activities that are within the new protected areas would stop. The sector of maritime transport and ports also need transition to become more environmentally friendly. Green port strategies would be in place to tackle environmental challenges such as air pollution, noise, dust, waste and water pollution. Table 2 presents the future conditions of sectors in the conservationist scenario.

Table 2/ Future conditions of sectors in the conservationist scenario of the Gulf of Guayaquil

Sector	Future conditions
Conservation	• The mangrove coverage will increase due to reforestation, prohibition of new shrimp aquaculture developments, and improved surveillance. • Peru and Ecuador will establish two new protected areas, respectively. • Oil and gas will not be allowed within protected areas.
Fisheries	• Prohibition of industrial shrimp fisheries. • Fish stocks will recover due to new protected areas and compliance to regulations. Two countries will launch joint management of shared species and set fish quotas. • There will be conflicts in the traditional fishing grounds between local fishing vessels and foreign boats due to lack of surveillance.
Aquaculture	• Prohibition of new shrimp aquaculture development in mangrove areas. Offshore aquaculture will be not allowed in protected areas. • Management protocols will be improved, which will reduce environmental impacts.
Tourism	Sustainable tourism will be encouraged.
Oil & gas	• Prohibition of new projects of exploration and exploitation of oil and gas. • Oil and gas will not be allowed in protected areas. • Decommissioned platforms will be removed.
Maritime transport & ports	• Shipping will continue increasing due to growing demand for commodities and goods. However, boats will reduce speed to avoid collision with cetaceans. Shipping lines will be rerouted to not pass through protected areas. • Prohibition of the dredging deposit site inside the 1 NM Reserve Area for species Reproduction in Ecuador. • Prohibition of discharge of dredging material without treatment. • Green port strategies will be in place.
Deep-sea mining	Research on mapping deep-sea ecosystems will be in place to understand their connectivity and functions.
Renewable energy	Research on offshore renewable energy will be in place to contribute to a low-carbon economy.

Source/ [4]

Scenario III: the integrated scenario

The integrated scenario refers to both sides agreeing to the integrated use of marine space. It represents a situation in which there is a balance between sectoral and environmental goals. In this scenario, based on the ecosystem-based approach, multi-uses are pursed in maritime space.

Table 3/ Future conditions of sectors in the integrated scenario of the Gulf of Guayaquil

Sector	Future conditions
Conservation	• The mangrove coverage will increase due to reforestation, prohibition of new shrimp aquaculture developments, and improved surveillance. • Peru will establish two new protected areas. • Oil and gas will not be allowed within protected areas.
Fisheries	• Industrial shrimp fisheries will only be allowed within their original established zones. • Fish stocks will recover due to new protected areas and compliance to regulations. Two countries will launch joint management of shared species and set fish quotas. • Due to strong surveillance at sea, conflicts between local fishing vessels and foreign boats would decrease. • Development of the efficient and environmental-friendly fishing methods will be encouraged.
Aquaculture	• Prohibition of new shrimp aquaculture development in mangrove areas. Offshore aquaculture will be allowed in protected areas when it does not jeopardize their ecological objectives. • There will be multi-uses (e.g., tourism) coexisting with offshore aquaculture. • Management protocols will be improved, which will reduce environmental impacts.
Tourism	Sustainable tourism will be encouraged and investment in infrastructure will be increased to attract more national and foreign visitors.
Oil & gas	• New oil and gas will be allowed in protected areas. • Some decommissioned platforms will be used by other sectors, such as tourism and aquaculture.
Maritime transport & ports	• Shipping will continue increasing due to growing demand for commodities and goods. However, boats will reduce speed to avoid collision with cetaceans. Shipping lines will be rerouted to not pass through protected areas. • Prohibition of the dredging deposit site inside the 1 NM Reserve Area for species Reproduction in Ecuador. • Prohibition of discharge of dredging material without treatment. • Green port strategies will be in place. • A new port will be developed in order to improve cabotage in Peru.
Deep-sea mining	• Research on mapping deep-sea ecosystems will be in place to understand their connectivity and functions. • Research on mapping deep-sea minerals and how to sustainably exploit deep-sea resources will be in place.
Renewable energy	Research on offshore renewable energy will be in place, including the potential of multi-uses (with aquaculture and tourism, for example), to contribute to a low-carbon economy.

Source/ [4]

Figure 2/ In the integrated scenario, multi-uses coexisting with offshore aquaculture (e.g., tourism) are the future potential conditions
Image by Chung-Ling Chen

Conclusion

The Gulf of Guayaquil is a cross-border water under jurisdiction of Ecuador and Peru. Besides, Ecuador and Peru have many common goals on the 17 SDGs. These two conditions pave the way for both sides to collaboratively engage in cross-border MSP. Ecuador and Peru have their own existing and potential uses in the Gulf, respectively, including conservation, fisheries, aquaculture, oil & gas, maritime transport & ports, dee-sea mining and renewable energy. The future conditions of these uses could be predicted when spatial demands of uses are identified as well as the future scenarios for the region of the Gulf of Guayaquil are set. The information derived herein serves as a foundation for both sides to cooperatively engage in cross-border MSP.

Figure 3/ Existing and potential uses in a marine space and the future scenario of this space is the first step of marine spatial planning
Image by Chung-Ling Chen

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Heading towards the Blue Ocean Vision: From the G20 Report on Actions against Marine Plastic Litter to the Global Plastic Treaty

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Keywords: Marine Plastics, G20, United Nations Environment Programme

Marine plastic waste is a serious global environmental problem that affects marine ecosystems and biodiversity and has negative impacts on human health and the economy. According to the United Nations Environment Programme, approximately 8 million metric tons of plastic enter the oceans each year. Without effective measures, the weight of plastic in the oceans is projected to exceed that of fish by 2050. To address this challenge, the G20 member countries adopted the "Osaka Blue Ocean Vision" during the 2019 G20 Osaka Summit. This vision aims to achieve additional pollution from marine plastic litter to zero by 2050 through a comprehensive life-cycle approach, including improving waste management and innovative solutions to reduce unmanaged plastic waste emissions, as well as preventing and reducing plastic waste generation and littering, and promoting sustainable consumption and production [1][2].

The G20 Report on Actions against Marine Plastic Litter 2022 is a document published in 2022. It summarizes the policies and measures taken by G20 member countries, as well as other nations and regions that share the Osaka Blue Ocean Vision, in preventing, reducing, and managing marine plastic waste [3]. The report also includes contributions from international organizations and non-governmental organizations in addressing the issue of marine plastic waste. This report was developed based on the G20 Implementation Framework for Actions on Marine Plastic Litter established at the G20 Ministerial Meeting on Energy Transitions and Global Environment for Sustainable Growth held in Karuizawa, Japan in 2019. The framework is a voluntary, non-binding, multilateral cooperation platform1. This is the fourth report since 2019 and reflects the actions taken or planned by various parties from June to August 2022. The report was led by Indonesia, which held the G20 Presidency in 2022, with support from Japan, which initiated the Osaka Blue Ocean Vision in 2019.

Introduction to the different dimensions of G20 Marine Plastic Waste Action Report

The report covers four dimensions: I. policy frameworks and implementation, II. innovation and research, III. communication and awareness raising, and IV. international cooperation and coordination. It showcases the practices and challenges of each country and region, as well as the progress made since 2021. The report also provides recommendations for future actions and cooperation to achieve the Osaka Blue Ocean Vision. To realize this vision, G20 member countries have developed the G20 Action Plan on Marine Plastic Litter and the G20 Implementation Framework for Actions on Marine Plastic Litter. They encourage countries to take voluntary actions based on their national circumstances and share information and experiences. Following we will review the efforts made by various countries in this report from four aspects: policy framework and implementation, innovation and research, promotion, and awareness raising, and international cooperation and coordination:

I. Policy frameworks and implementation: Countries have implemented policies and measures to regulate and supervise the generation, handling, recycling, and disposal of marine plastic waste. Some countries have banned or restricted the production and use of single-use plastic products and implemented extended producer responsibility (EPR) systems. Others have used economic measures such as taxes, subsidies, labeling, and certification to encourage reduced plastic consumption and increased plastic recycling. Enforcement, monitoring, evaluation, and reporting activities have also been strengthened to ensure effective policy implementation and continuous improvement.

II. Innovation and research: Efforts have been made to support or conduct innovative research projects to develop new technologies, products, and solutions that reduce the sources or impacts of marine plastic waste. Some countries have invested in or collaborated on the development of degradable or recyclable alternative materials to reduce reliance on traditional plastics. Others have researched or applied technologies that convert waste plastics into energy or other products to increase the resource value of plastics. Advanced technologies such as artificial intelligence, remote sensing, and drones have also been explored or utilized to improve the detection, cleaning, and management efficiency of marine plastic waste.

III. Communication and awareness raising: Various communication activities have been carried out to raise awareness of the issue of marine plastic waste among stakeholders and encourage them to take action. Education, training, competitions, exhibitions, and other activities have been organized or supported to raise public awareness of the hazards of marine plastic waste and promote solutions. Volunteer organizations, communities, religious groups, and others have organized or encouraged coastal cleaning activities to enhance their sense of responsibility for marine protection. Additionally, various platforms such as initiatives, commitments, and alliances have been established or joined to demonstrate their determination and actions in addressing the issue of marine plastic waste.

IV. International cooperation and coordination: Efforts have been made to participate in or promote various international or regional cooperation and coordination mechanisms to enhance information sharing, capacity building, technical assistance, funding support, and monitoring of marine plastic waste. Some countries support or comply with relevant international or regional maritime conventions such as the International Convention for the Prevention of Pollution from Ships (MARPOL) by the International Maritime Organization (IMO) to regulate and reduce plastic

Figure 1/ Marine plastic pollution is one of the serious global environmental problems
Image by Pride Advertising Agency Ltd.

waste emissions from ships. Others provide or receive official development assistance (ODA) or other forms of financial or technical support to help developing countries improve waste management and reduce marine plastic waste. Additionally, various multilateral or bilateral cooperation projects or initiatives have been participated in or initiated to facilitate dialogue and collaboration among stakeholders on the issue of marine plastic waste.

Achieving the Osaka Blue Ocean Vision

In reality, countries face many challenges in dealing with the issue of marine plastic waste, including improving recycling systems, proper waste management, data collection on general waste and marine plastics, lack of awareness among civil society and local governments, lack of financial incentives for waste treatment and technological development, and delays in work projects due to COVID-19. These challenges must be addressed through international collaboration. In the future, countries should strive towards the following directions to achieve the goals of the Osaka Blue Ocean Vision:

I. Continuing to promote the realization of the Osaka Blue Ocean Vision and encouraging more countries and regions to join and share their actions and achievements.

II. Strengthening information sharing, capacity building, technical assistance, funding support, and monitoring of marine plastic waste. Establishing a global database and indicator system to assess the progress and impact of various parties.

III. Continuing to carry out or participate in various innovative research activities to develop new technologies, products, and solutions for addressing marine plastic waste. Enhancing knowledge transfer and technology diffusion to promote the popularization and utilization of innovation and research.

IV. Continuing to conduct or participate in various communication and awareness-raising activities to raise public awareness of the hazards of marine plastic waste and promote solutions among various stakeholders such as the public, students, businesses, and media. Strengthening their sense of responsibility for marine protection.

V. Continuing to support or comply with relevant international or regional maritime conventions to regulate and reduce plastic waste emissions from ships. Exploring the feasibility of establishing a new global agreement to address the issue of marine plastic waste.

VI. Continuing to participate in or initiate various multilateral or bilateral cooperation projects or initiatives to facilitate dialogue and collaboration among stakeholders on the issue of marine plastic waste. Ensuring integration and coordination with other relevant global or regional agendas and frameworks.

The G20's efforts have also led to a significant achievement. In March 2022, a historic resolution, the Global Plastic Treaty, was adopted at the United Nations Environment Assembly [4]. The draft of this treaty was jointly proposed by Peru and Rwanda and received support from nearly 200 countries. It formally launched an Intergovernmental Negotiating Committee (INC) responsible for developing a legally binding international agreement to establish a comprehensive approach covering the entire life cycle of plastics, including production, design, and disposal. Its goals are to reduce plastic consumption, increase plastic recycling rates, prevent plastic leakage and dispersion, promote plastic circularity, and the development of alternatives. The draft proposed by Peru and Rwanda also emphasized that the agreement should be in line with the Osaka Blue Ocean Vision, which aims to achieve a plastic-free ocean by 2050. Currently, representatives from various countries are discussing the content of the agreement at a series of meetings, to finalize it before 2025 [5][6].

Conclusion

There is a close relationship between the G20 Report on Actions against Marine Plastic Litter 2022 and the Global Plastic Treaty. Firstly, both initiatives were launched to achieve the Osaka Blue Ocean Vision, which was proposed at the G20 Summit in 2019 to achieve a plastic-free ocean by 2050. Secondly, both involve the participation and cooperation of various stakeholders, including governments, businesses, civil society, and the scientific community. Thirdly, both emphasize the importance of innovation and transformation to achieve more sustainable and environmentally friendly plastic management practices.

However, there are also some differences and challenges between the G20 Report on Actions against Marine Plastic Litter 2022 and the Global Plastic Treaty. Firstly, the G20 Report is a voluntary and non-binding platform for multilateral cooperation. It does not have mandatory targets, timetables, or monitoring and evaluation mechanisms, so its effectiveness may be limited. In contrast, the Global Plastic Treaty is an international legal agreement that will have clear obligations and responsibilities as well as corresponding oversight and enforcement mechanisms, making it more binding and impactful. Secondly, while the G20 Report focuses on marine plastic waste issues, the Global Plastic Treaty addresses issues related to the entire life cycle of plastics, making its scope more comprehensive. Thirdly, while the G20 Report includes G20 member countries, other countries, and regions sharing the Osaka Blue Ocean Vision, as well as international organizations and NGOs as part of its stakeholders, the Global Plastic Treaty aims to include all countries and regions globally as well as more stakeholders, making it more inclusive and representative.

The G20 Report on Actions against Marine Plastic Litter 2022 and the Global Plastic Treaty are both actions initiated to address plastic pollution but differ in terms of formality, content, scope, and participants. Both face challenges such as coordinating interests among stakeholders, balancing economic development with environmental protection, improving resource efficiency, and reducing waste. Both require enhanced cooperation and communication to achieve common goals and visions for protecting marine ecosystems and human health while creating a better world for us and future generations.

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Protection of Marine Genetic Resources in the United Nations (BBNJ Agreement) and Taiwan's Response

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Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (The BBNJ Agreement) includes four main topics: "Marine Genetic Resources" (MGR), "Area-Based Management Tools" (ABMT), "Environmental Impact Assessment" (EIA), and "Capacity Building and Technology Transfer." The purpose is to designate marine protected areas in the "Areas Beyond National Jurisdiction (ABNJ)," that is, the Open ocean ecosystem and Deep-sea ecosystem in the High Seas, and to stipulate that in the High Seas, activities such as resource exploration and mining on the seabed and subsoil, as well as waste discharge, all require environmental impact assessment and permission. It is hoped that this can improve the pelagic fishery resources that continue to decline due to overfishing and prevent many unknown, fragile, but rich genetic resources on the deep seabed from being destroyed by humans. Since an average of 17.8% of the world's "Areas Within National Jurisdiction" (AWNJ) or "Exclusive Economic Zones" (EEZ) have been designated as Marine Protected Areas (MPAs), only 1.18% of the high seas in ABNJ are too low. Therefore, promoting the designation of protected areas in the high seas has become an irreplaceable part of the high seas protected area in terms of the most important 30x30 goal in the "Kunming-Montreal-Global Biodiversity Framework (GBF)" adopted by the CBD-COP15 meeting in December 2022. Therefore, the BBNJ Agreement is often called the High Seas Treaty.

The preamble of the BBNJ Agreement also emphasizes that the world is currently facing the problems of biodiversity loss and marine ecosystem degradation, especially the impact of global warming, ocean deoxygenation, ocean acidification caused by climate change on the ocean ecosystem, and pollution, including plastic pollution. All these require improving marine scientific research standards and capacity building, so the fourth topic of the Agreement also aims to promote scientific research globally.

This article provides a comprehensive introduction and discussion of the second part of the treaty: MGR and Digital Sequence Information (DSI) in the high seas, including Fair & Equitable Sharing of Benefits. There are 8 articles in this part. Finally, some personal opinions on Taiwan's possible responses and contributions are provided for everyone to discuss and correct.

Definition of Marine Genetic Resources and Digital Sequencing Information

MGR refers to any material from marine plants, animals, microorganisms, or other sources that contain genetic functional units and have actual or potential value. It differs from the term "marine biological resources" used in United Nations Convention on the Law of the Sea (UNCLOS) because it has not been defined, and whether it includes genetic resources is unknown. It only talks about the conservation and management of highly migratory fishery resources in the high seas and does not involve Genetic resources and benefit-sharing issues.

With the advancement of science and technology and the enhancement of exploration capabilities in marine research, the number and types of MGR that can be obtained are steadily increasing, which makes countries how to design the utilization, management, and benefit-sharing mechanism of MGR obtained by AWNJ or ABNJ. It can balance multiple goals such as marine scientific research, conservation and utilization of marine biodiversity, and MGR's "Access and Benefit Sharing" (ABS) and has initiated many discussions and debates. The scope of MGR discussions is also gradually expanding, so DSI is also included. DSI is not a term used by academic community. It refers to genetic or genomic sequence information from marine biological specimens, particularly large amounts of sequencing (nucleic acid) data generated from environmental samples by e-DNA or high-throughput biotechnology.

Why do Deep-Sea Ecosystems Need Protection?

The function and value of the services of the deep-sea ecosystem include provisioning services, including seafood, medicines, daily necessities, industrial raw materials, and biological materials. For example, aquaculture breeding, reagent testing, seedlings, feed, anti-cancer, anti-viral, diagnostic reagents and drugs, as well as some special chemicals that anti-biofouling, enzymes, detergents, or adhesives; therefore, the development and utilization of MGR can be an emerging industry with unlimited potential for future development and unlimited business opportunities. The deep-sea ecosystem is also very important in maintaining environmental health in regulating ecosystem services, including biological control and waste absorption; in particular, it plays the role of carbon sink and carbon cycle. "Blue carbon" or "Fish carbon" can slow down the impact of global warming. In recent years, scientists have discovered that carbon produced by the photosynthesis of phytoplankton in the upper ocean will enter the bodies of zooplankton, shrimp, fish, other swimming organisms, and even cetaceans through the food chain. These organisms' excretions, secretions, or carcasses will sink to the seabed, which can sequester excess carbon dioxide in the atmosphere to the seabed. In terms of cultural or intangible aspects, the deep-sea ecosystem also has educational, aesthetic, spiritual, and understanding importance of the existence of marine resources for present and future generations.

Life in the deep sea is also the origin of life on earth. After billions of years, almost all biological groups have evolved in the ocean. Marine organisms are approximately twice as diverse as terrestrial organisms regarding phylum diversity. In other words, marine organisms have significant genetic variation, and their potential to be exploited by humans should be higher, which is crucial to the long-term development of human society and economy. In particular, many deep-sea creatures have evolved to adapt to the dark, stressful, and cold deep-sea environment. They have the characteristics of long lifespan, late maturity age, and slow population recovery. For example, the orange roughy can live at 125 years and will not mature and reproduce until over 30. The population is the most difficult to recover, so it is easily affected by overfishing, habitat destruction, pollution, etc. For another example, deep-sea cold-water corals or precious corals have lived for thousands of years, but their living conditions are quite fragile. They belong to fragile ecosystems (Vulnerable marine ecosystems, VMEs), including deep-water corals, hydrothermal vent, cold seep, seamount, and other ecosystems.

Issues to be Resolved after the Adoption of the Agreement

Adopting the BBNJ Agreement is a significant breakthrough and milestone for global ocean conservation. However, the current content of the Agreement is mainly at the structural level, and more detailed specifications and actual implementation still need to be further established by the Conference of the Parties (COP) and its subsidiary bodies after it takes effect. In addition, it takes a lot of effort to reach a consensus on which sea area to designate MPAs and who will be responsible for supervision, ban, and penalties for violations after the designation, who should review the environmental impact assessment, etc., in particular:

I. The Agreement will not undermine the mandates of existing international frameworks and bodies (IFBs). For example, the "Regional Fisheries Management Organizations" (RFMOs) have established regulations on responsible fisheries by using quota management method. If BBNJ COP intends to set up protected areas in the high seas to prohibit fishing in the future, its relationship with existing RFMOs remains to be discussed.

II. Besides conserving marine biological diversity, we must also consider the rational or sustainable use of resources, which is the goal of the BBNJ Agreement (Article 2). However, how to achieve these two goals and how to balance the two, especially whether the BBNJ Agreement can play a leading role in conservation, curb overfishing in high seas pelagic fisheries, and even further guide countries to limit the scale of their pelagic fisheries, none of it can be achieved overnight.

Of course, the BBNJ Agreement is not just a theory. It should still have room for improvement. For example, suppose a protected area can be established in the sea areas under the jurisdiction of each RFMO. In that case, it only needs to exclude highly migratory tuna and other fishery resources already regulated by the RFMO and use different fishing gear and fishing methods or restrictions on target fish species. The zoning planning and management of core areas, buffer zones, and sustainable utilization areas should still have some protective effects on other groups of fish.

As for the protection of deep seabed organisms under the BBNJ Agreement, it is relatively easy to promote. After all, deep-sea trawling fisheries, mining, or scientific research have not yet become popular on the high seas. Currently, the International Seabed Authority (ISA) and the International Maritime Organization (IMO) are responsible for some management work. Therefore, the designation of high seas protected areas should effectively protect deep-sea biodiversity or MGR.

"BBNJ Agreement" - How Taiwan Should Respond and Contribute

Because Taiwan is not a member of the United Nations, it has no opportunity to participate in various meetings of the BBNJ Agreement. Once the "BBNJ Agreement" is passed and implemented, non-member parties such as Taiwan must also comply with the Agreement's provisions. Otherwise, there is the possibility of being subject to international sanctions and harming our rights and interests. In particular, the economic value of Taiwan's annual fish catch in high sea fisheries currently ranks second globally, second only to China [1]. Taiwan's high sea fisheries also account for 70% of Taiwan's total annual fish catch. Therefore, it is necessary to pay close attention to the subsequent development and international effects of the "BBNJ Agreement" to adjust Taiwan's high sea fishery policies, including the possibility of further reductions in vessels and total fishing limits. To reduce overfishing pressure, strengthen supervision, ban "illegal, unreported and unregulated" (IUU) fishing activities, and reduce negative subsidies. These three are precisely the requirements of the SDG14.4, SDG14.6, and SDG14.7 sub-goals of the ocean goals in the 2015 United Nations Sustainable Development Goals (SDGs). As for deep-sea scientific research on the high seas, deep-sea bed mining, or deep-sea fishing, Taiwan is still quite behind or small in scale, so it has little impact on Taiwan.

On the contrary, Taiwan is one of the few maritime countries with ocean and deep-sea ecosystems. Therefore, if Taiwan can cooperate with the contents of the BBNJ Agreement in the EEZ waters under our jurisdiction:

I. Manage and restrict excessive and illegal fishing by Taiwanese fishing vessels within the EEZ;

II. About three-quarters of Taiwan's EEZ is open ocean and deep-sea ecosystems (Figure 1). If marine protected areas can be designated, it will not only be Taiwan's contribution to global marine conservation, but also significantly increase the area ratio of Taiwan's marine protected areas, taking a big step towards achieving the 30x30 goal.

According to the MPAtlas official website, Taiwan's current marine protected area ratio is only 0.8% if the denominator is two hundred nautical miles of the EEZ. If the denominator is the waters containing internal and territorial waters, it is about 8.17%. Not only does it fall short of the "Aichi Biodiversity Targets" of 10% in 2020, it is still far away from the 30x30 target of 30% in 2030. Therefore, it is recommended that in Taiwan's roadmap to achieve the 30x30 goal, in addition to adding protected areas in different ecosystems near coastal areas, the following should be required within the EEZ:

I. Accelerate the exploration and investigation of the location, species composition, and distribution of biodiversity hotspots in the ocean and deep sea ecosystems, such as deep-sea hot springs, cold springs, seamounts, deep-sea corals or precious corals, and even whale falls habitat;

II. Awards to support investigation and research on deep-sea biological diversity, including taxonomy, ecology, physiology, and life history. The collected specimens, identification results, and ecological distribution data shall be archived in the format required by the BBNJ Agreement and submitted to international databases that may be involved in the Clearing House Mechanism (CHM) of the Agreement. Taiwan currently has national-level databases such as the Taiwan Catalog of Life (TaiCOL), the Taiwan Encyclopedia of Life (TaiEOL), the Taiwan Biodiversity Information Facility (TaiBIF), and the Taiwan Frozen Genetic Material Collection & Barcode of Life (TaiBOL). It includes species information on many open ocean and deep-sea creatures. Because these data directly correspond to and are in line with international COL, EOL, GBIF, BOL, and other global databases. Therefore, enriching these databases means that Taiwan has directly contributed to MGR and DSI in BBNJ;

III. Collect and integrate data on marine biological and non-biological resources, as well as hydrology and water quality, and other environmental factors in the EEZ sea area, and establish an integrated database to provide the basic data required for marine spatial planning (MSP), which will help based on cumulative impact assessment (CIA) or ecosystem services management and decision-making;

IV. After the "Marine Conservation Law" is passed, the 7 criteria of the "Ecologically and Biologically Significant Areas" (EBSA) for the designation of protected areas in the high seas can be used to select our country's open ocean and deep sea areas that can be designated as Marine sanctuary potential site or official marine protected area;

V. In maritime areas with disputed sovereignty, such as the Diaoyutai Islands and Nansha Islands, we propose to all claimant states: replace the principle of joint development with joint conservation and establish a "Transboundary MPA Network" or The Marine Peace Park (MPP) not only reduces the risk of war or conflict but also complies with the purpose of the High Seas Treaty to conserve and sustainably utilize marine living resources.

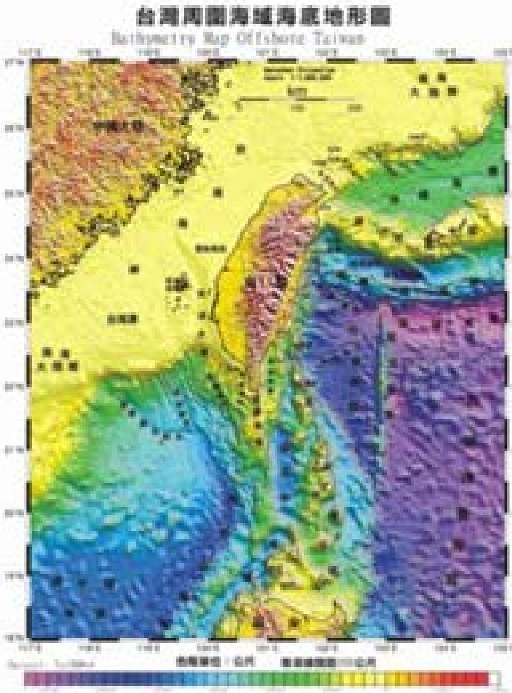

Figure 1: Map of Taiwan with its Exclusive Economic Zone (EEZ).

Figure 1/ The left picture is a seabed bathymetry map mapped by the National Science Council's Ocean Data Bank, and the right picture is Taiwan's EEZ range mapped by UBC's SAUP website. By superimposing the two maps, it can be roughly estimated that about three-quarters of the area within Taiwan's EEZ is open ocean and deep-sea ecosystems

Source/ [2]

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BBNJ Agreement: Capacity-building and Technology Transfer

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In recent decades, it has been recognized that the high seas contain some of the planet's most precious ecosystems, but these ecosystems are threatened and affected by many human activities, including shipping and pollution. While the United Nations Convention on the Law of the Sea imposes an obligation on member States to cooperate in the protection of the marine environment, there has long been consensus that there are gaps between its provisions and reality, and that a new framework for the protection of the world's oceans and seas and the equitable sharing of their resources is essential. In response, the United Nations initiated this work in 2004, established a preparatory committee in 2005 and formed an intergovernmental conference in 2007 to commence development of a new agreement. The "Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction" (abbreviated as the BBNJ Agreement) was finally passed late in the evening in New York on March 4, 2023 after a marathon final negotiation [1].

In addition to upholding the principles of Freedom of the Seas and the Common Heritage of Mankind, the agreement mainly regulates "Marine genetic resources (sharing of benefits for the benefit of the nation and all mankind)", "measures such as area-based management tools including marine protected areas", "environmental impact assessment", "capacity-building and transfer of marine technology" and cross-cutting issues [2][3]. Although the agreement marks an important milestone for biodiversity conservation on the high seas, many media outlets refer to it as the "High Seas Treaty", or "the high seas will include 30% of the world's marine area in protected areas by 2030", which may oversimplify its main thrust or connotation [4]. The purpose of this article is to describe the capacity-building and technology transfer components of the brand new agreement.

The main content of the BBNJ Agreement

The preamble to the BBNJ Agreement states that the United Nations recognizes that addressing marine biodiversity loss and ecosystem degradation requires a coordinated and cooperative approach, particularly with regard to the impacts of climate change on marine ecosystems; It is therefore essential to develop a global regime in accordance with the United Nations Convention on the Law of the Sea to enhance the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction. At the same time, it recognizes the importance of a just and equitable international economic order that takes into account the common interests of all mankind, in particular the special interests and needs of developing countries. The preamble also recognizes that capacity-building and the development and transfer of marine technology to support contracting developing countries are essential elements in achieving the objectives of the BBNJ Agreement. The important contents of this Agreement are summarized as follows [2].

I. Definitions

The BBNJ Agreement contains definitions of useful terms, which are referred to the Chinese translation of the United Nations, with the following important examples for reference:

- "Cumulative impacts" means the combined and incremental impacts resulting from different activities, including known past and present and reasonably foreseeable activities, or from the repetition of similar activities over time, and the consequences of climate change, ocean acidification and related impacts.
- "Environmental impact assessment" means a process to identify and evaluate the potential impacts of an activity to inform decision-making.
- "Marine genetic resources" means any material of marine plant, animal, microbial or other origin containing functional units of heredity of actual or potential value.
- "Marine protected area" means a geographically defined marine area that is designated and managed to achieve specific long-term biological diversity conservation objectives and may allow, where appropriate, sustainable use provided it is consistent with the conservation objectives.
- "Marine technology" includes, inter alia, information and data, provided in a user-friendly format, on marine sciences and related marine operations and services; manuals, guidelines, criteria, standards and reference materials; sampling and methodology equipment; observation facilities and equipment for in situ and laboratory observations, analysis and experimentation; computer and computer software, including models and modelling techniques; related biotechnology; and expertise, knowledge, skills, technical, scientific and legal know-how and analytical methods related to the conservation and sustainable use of marine biological diversity.

II. Principles, Methods and Objectives

Article 7 of the BBNJ Agreement regulates the principles and methods to be followed by the Parties to achieve the objectives of this Agreement, including:

- The polluter-pays principle;
- The principle of the common heritage of humankind which is set out in the Convention;
- The freedom of marine scientific research, together with other freedoms of the high seas;
- The principle of equity and the fair and equitable sharing of benefits;
- The precautionary principle or precautionary approach, as appropriate;
- An ecosystem approach;
- An integrated approach to ocean management;
- An approach that builds ecosystem resilience, including to adverse effects of climate change and ocean acidification, and also maintains and restores ecosystem integrity, including the carbon cycling services that underpin the role of the ocean in climate;
- The use of the best available science and scientific information;
- The use of relevant traditional knowledge of Indigenous Peoples and local communities, where available;
- The respect, promotion and consideration of their respective obligations, as applicable, relating to the rights of Indigenous Peoples or of, as appropriate, local communities when taking action to address the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction;

- The non-transfer, directly or indirectly, of damage or hazards from one area to another and the non-transformation of one type of pollution into another in taking measures to prevent, reduce and control pollution of the marine environment;
- Full recognition of the special circumstances of Small Island Developing States (SIDS) and of least developed countries;
- Acknowledgement of the special interests and needs of landlocked developing countries.

The objectives of Part V of the BBNJ Agreement, "Capacity-building and Marine Technology Transfer" (Article 40), are to assist Parties to cooperate inclusively, equitably and effectively and to participate in activities to achieve the objectives of the Agreement. In particular, the Agreement envisages the development of marine scientific and technical capacity, including research capacity, of Parties for the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction; this includes providing and transferring access to and transfer marine technology to developing country Parties; Disseminate and share knowledge on the conservation and sustainable use of marine biodiversity; and achieve the objectives of benefit-sharing of marine genetic resources, zoning management measures for marine protected areas and environmental impact assessment.

III. Capacity-building and Technology Transfer

Article 41 of the BBNJ Agreement provides that the Parties shall cooperate directly or with relevant global, regional, subregional and sectoral bodies to achieve the objectives of this Agreement through capacity-building and the development and transfer of marine science and marine technology. In addition, Parties should cooperate at all levels and in all forms, including partnerships with all relevant stakeholders, including the private sector, civil society, Indigenous Peoples and local communities as holders of traditional knowledge, taking into account, inter alia, the special circumstances of small island States and least developed countries.

Article 42 of the Agreement, on "Modalities for capacity-building and for the transfer of marine technology", states that capacity-building and marine technology transfer must be country-driven, transparent, effective and iterative processes, as well as participatory, cross-cutting and gender-responsive processes. Capacity-building and marine technology transfer should build on, rather than duplicate, existing projects, as appropriate, and should be guided by lessons learned.

With regard to other modalities for marine technology transfer, article 43 of the Agreement provides that the Parties should share a long-term vision for the full implementation of technology development and transfer. Therefore, the activities carried out under this agreement are inclusive, equitable, and effective cooperation and participation. Parties should promote and encourage the economic and legal conditions for the transfer of marine technology to developing countries, including by providing incentives to enterprises and institutions. The marine technology transferred should be appropriate, relevant and, as far as possible, reliable, affordable, up-to-date, environmentally sound and available in a form accessible to developing countries.

Under Article 44, types of capacity-building and marine technology transfer are not limited to supporting the building or strengthening of a Party's human, financial, scientific, technical, organizational, institutional and other resource capacities, and include:

- The sharing and use of relevant data, information, knowledge and research results;
- Information dissemination and awareness-raising, including with respect to relevant traditional knowledge of Indigenous Peoples and local communities, in line with the free, prior and informed consent of these Indigenous Peoples and, as appropriate, local communities;
- The development and strengthening of relevant infrastructure, including equipment and capacity of personnel for its use and maintenance;
- The development and strengthening of institutional capacity and national regulatory frameworks or mechanisms;
- The development and strengthening of human and financial management resource capabilities and of technical expertise through exchanges, research collaboration, technical support, education and training and the transfer of marine technology;
- The development and sharing of manuals, guidelines and standards;
- The development of technical, scientific and research and development programmes;
- The development and strengthening of capacities and technological tools for effective monitoring, control and surveillance of activities within the scope of this Agreement.

Article 45 provides that capacity-building and marine technology transfer shall be monitored and reviewed periodically and shall be conducted by the Capacity-building and Marine Technology Transfer Committee under the authority of the Conference of the Parties, and performance shall be measured against agreed indicators. To support such monitoring and review, Parties should report to the Committee in a format and at intervals to be determined by the Conference of the Parties, and taking into account the Committee's recommendations.

With regard to mechanisms, in accordance with Article 46, this Agreement will establish a "capacity-building and transfer of marine technology committee", composed of members nominated by Parties and elected by the Conference of the Parties who are suitably qualified and specialized and can perform their functions objectively in the best interests of this Agreement. Gender balance and equitable geographical distribution, including the representation of the least developed countries, SIDS and landlocked developing countries, must also be taken into account. In addition, the BBNJ Agreement will establish a Conference of the Parties, the first meeting of which shall be convened by the Secretary-General of the United Nations within one year of the entry into force of this Agreement.

Notably, item 4 of Article 48, "Transparency", states that "Representatives of States not party to this Agreement, relevant global, regional, subregional and sectoral bodies, Indigenous Peoples and local communities with relevant traditional knowledge, the scientific community, civil society and other relevant stakeholders with an interest in matters pertaining to the Conference of the Parties may request to participate as observers in the meetings of the Conference of the Parties and of its subsidiary bodies. The rules of procedure of the Conference of the Parties shall provide for modalities for such participation and shall not be unduly restrictive in this respect. The rules of procedure shall also provide for such representatives to have timely access to all relevant information." In addition, pursuant to Article 49, the Agreement will establish a "Scientific and Technical Body" composed of expert members nominated by Parties and elected by the Conference of the Parties; the members should take into account the need for multidisciplinary expertise, including relevant scientific and technical expertise in traditional knowledge of Indigenous Peoples and local communities, gender balance and equitable geographical representation.

Prospects for the Future

As of September 20, 2023, a total of 82 countries have signed the BBNJ agreement; The United Nations will remain open for signature until September 20, 2025, exceeding the 60 countries required for the agreement to enter into force [5]. Therefore, this new legally binding agreement is imperative. More funding for global ocean conservation, access to and use of marine genetic resources, as well as indigenous peoples and low-development national rights, will receive more attention.

Therefore, this new legally binding agreement is imperative. More funding will be invested in global ocean conservation, and more attention will be paid to access and use of marine genetic resources, as well as indigenous peoples and low-exploitation national rights. On the other hand, capacity-building and technology transfer will have more regulated to support the capacity of marine science and technology in developing countries and to achieve the objectives set out in the sections of this Agreement on marine genetic resources, regional management tools and environmental impact assessment. In particular, the target of so-called "30x30" sea area included in the protected area will be more clear, which will undoubtedly affect Taiwan's fishing interests in the high seas and the planning of shipping routes, and involve the strengthening of marine ecological conservation measures. Regarding the part of capacity-building and marine technology transfer, Taiwan should pay attention to the cultivation of marine talents, research in marine science and biotechnology, the rights and interests of indigenous peoples and the special needs of low-developing countries. In accordance with the meaning of Article 48 of this Agreement, Taiwan also needs to study and analyze relevant the participation planning on an "observer" status, as well as to explore the opportunities and actions for "science and technology diplomacy".

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