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海洋科技在海域遊憩活動的創新服務試驗
Innovative Trials of Information Service for Marine Recreation

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Continuing to Salute to the Seas in the Year of Renewed Confidence and Strength

Translated by Linguitronics

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Achieving balance between the environment and the economy and sustainably managing the oceans are issues that the entire global community needs to face. Malaysia, located in Southeast Asia, is rich in marine resources and is of great reference value in terms of its marine strategies and industries. In this issue, therefore, Malaysia is taken as an example with "International Issues" introducing Malaysia's National Policy on Biological Diversity 2016-2025 which declares the government's determination and action taken to protect land and marine biodiversity. Furthermore, "Industry Dynamics" shares the case of Malaysia's blue economy, while "Latest News" introduces Malaysia's active development of ocean thermal energy conversion, a policy that can serve as a reference for the marine resource development strategy of Taiwan. As ocean governance is predicated upon sound legislative and regulatory planning, this issue also unveils Malaysia's commitment to diverse maritime development and maritime law enforcement from the perspectives of ocean policy and maritime law enforcement.

Taiwan started promoting the "Salute to the Seas" policy in 2020 and began to plan for active opening, effective management, and diversified use of marine resources so that even as we open up the ocean, balancing marine recreation and safety remains the first priority. With the Taiwan Open of Surfing that takes place in JinJun, Taitung, as an example, this issue's "Special Report" introduces various dynamic information services that utilize marine environmental monitoring technology to support marine recreational activities, demonstrating how marine scientific information can be applied and innovated to facilitate the vibrant development of marine recreational activities, thereby contributing to the positive cycle of growth for Taiwan's marine recreational industry.

Looking forward to 2021, the Ocean Affairs Council will continue to implement the six policy objectives of the "National Ocean Policy White Paper" (2020), and remain committed to carrying out tasks in nine major aspects including strengthening the maritime legal system. It will also take the initiative to perform important work pertinent to the "Salute to the Seas" policy so that, under the vision of "sustainability", "marine security", and "industrial prosperity", Taiwan's maritime development will flourish and the goal of becoming a sustainable maritime nation is realized at the earliest time possible.

Lionfish in the waters of Pulau Layang-Layang (in Malay), Malaysia
Image by Arhnue Tan from Pixabay
https://pixabay.com/photos/lionfish-scuba-diving-underwater-1430225/

Innovative Trials of Information Service for Marine Recreation ~ An example on the Taiwan Open of Surfing

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Keywords: Marine information services, Marine recreational activities, Safety risk assessment of recreational sea, Salute to the Seas

The purpose of this article is to report that the National Academy of Marine Research (NAMR), in conjunction with the Taitung County Government who held the Taiwan Open of Surfing in November 2020, is experimenting with the use of marine environment monitoring technology to support marine recreational activities on the JinJun Coast, and to kick off a forward-looking infrastructure project in tribute to the sea with a "dynamic information system for the safety of marine recreational activities. We hope to use technology to bring us closer to the ocean.

Figure 1/ Five principles and its specific strategies of the "Salute to the Seas" policy
Source/ Redrawn in accordance with the OAC Policy Briefing

Following the successful experience of "Salute to the Mountains", the Executive Yuan is planning to promote "Salute to the Seas" in 2020, encouraging people to "know the ocean", "close the ocean" and "into the ocean", so that we can enjoy the beauty of the mountains and the ocean. In order to implement the "Salute to the Seas" policy, and in accordance with the five principles of "openness, transparency, service, education, and responsibility" revealed by the Executive Yuan. The Ocean Affairs Council has coordinated with relevant sea-related ministries and commissions to jointly plan various administrative actions to actively open, effectively manage, and diversify the use of marine resources to ensure the sustainable development of the ocean.

On December, 2020, the Ministry of Science and Technology (MOST) held the "Scientific Development Strategy Consultation Meeting" to draw up a blueprint for future scientific research and development, with a view to developing "people-oriented" science and technology, strengthening exploratory scientific research and developing emerging technologies through open innovation and alliances and collaborations, nurturing high-quality high-level talents, and strengthening the research and innovation ecosystem.

After the release of the open ocean message, the first issue that has aroused widespread concern is safety. In the records of the seminars held by the Marine Council in various counties and cities, it can be found that the management of recreational activities in the waters and the conflict over the use of sea space are often the most heated topics of discussion. Therefore, it is important to draw up concrete action plans to improve our relationship with the ocean, guided by the five principles of the Seaward Tribute Policy and its strategies.

As reported by Chen et al. (2020) [1], modernized maritime countries have made active efforts in recent years to integrate information that is important for water safety, such as beach hazard classification and beach safety information network. In the past two years, the Ocean Affairs Council and its NAMR have been actively exploring the environmental risk factors of various recreational activities in our ocean through the integration of marine environmental information, cross-disciplinary data collection, and stakeholder interviews in order to identify recreational risks and improve coastal management strategies in our ocean.

Progress in the designation of recreational risks in the sea in recent years

For example, in 2019, the environmental threshold values of low, medium, and high recreation risk levels were established to link various recreational activities with marine environmental factors for risk assessment [2]. Based on this, the risk classification of 57 coastal seas in the country for various types of recreational activities will be evaluated in 2020. For example, in Table 1, the risk classification results of the four townships of Beinan, Donghe, Chenggong, and Changbin in Taitung are evaluated as high risk for surfing and wind surfing activities during the winter monsoon period (October to March) [3].

Such classification results are subtle in relation to the International Surfing Competition held in November every year in JinJun, Taitung. This also highlights the fact that the results of such work, although providing more academic criteria for analysis of recreational activities and safety management measures in the sea, are based on the assumptions that 1. the risk tolerance of the majority of the population is assessed, regardless of individual differences; 2. historical data are compiled on a monthly basis and the dynamic variances in the marine and atmospheric environment are not considered. Therefore, it is the core spirit of the project "Dynamic Information System for the Safety of Recreational Activities in the Ocean" hosted by NAMR to provide the participants of marine recreational activities and sea area management units with the destructive and innovative marine information services they need in the context of people-oriented and dynamic changes in the ocean.

Month / Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Swim												
Surfing												
Diving												
Windsurfing												
water ski												
Parasailing												
Jet ski												
Kayaking												
Banana boat												
Rubber boat												
Floating tire												
Kite surfing												
SUP												
Fishing												

Table 1/ Results of the risk classification of various marine recreational activities in the northern waters of Taitung County
Red: High risk
Yellow: Medium risk
Green: Low risk
Source/ NAMR (2020) [3]

New state of the art of dynamic environments information service for the marine recreational activities

In recent years, with the government's efforts to promote marine sports, the development of marine sports has been booming. However, these marine sports usually generate behaviors through marine water, environmental or climatic factors, so many studies have been conducted in the past to investigate the causality and interaction between the two [4][5][6][7][8][9][10][11][12].

Taking surfing as an example, Walker (1974) proposed recreational surf parameters [4], and Jackson et al. (2001) [8], understanding that the skill level of the surfer and the safety needs of all surf consumers also have a significant impact on the surfing experience, further proposed a classification of surfing ability and the relationship between wave height (Hb), wave direction (α) and wave travel speed (Vs) was further proposed as shown in Table 2. Subsequently, Scarfe et al. (2003) went further with the title "The Science of Surfing Waves and Surfing Breaks" [11], hoping to convey the basic knowledge of surf science to surfers and non-surfing coastal planners, scientists and engineers.

In the past 10 years, the Taiwan Open of Surfing, an international surfing event hosted by the Taitung County Government at the JinJun Fishing Port in Donghe Township, has brought the surfing culture and international popularity of Taiwan to a new era.

Wave params. / Surfers' skill	Hb (m)	α (deg)	Vs (m/s)
Beginners	<1.2	60~90	<3.0
Intermediate	<2.5	60	<7.5
Experienced	<8.0	>30	<12.0

Table 2/ The relationship between surfers' skill level and wave parameters
Source/ Adapted from Jackson et al. (2001) [8]

The 10th Taiwan Open of Surfing was held from November 18 to 22, 2020. The NAMR and the Taitung County Government cooperated to set up a high-resolution X-Band wave observation system in the JinJun beach during the event (Figure 2). The system also integrated the prediction information of the Central Weather Bureau and the NAMR, and provided the surfers and the organizers with the information of the surfing environment in an easy-to-understand graphical interface (Figure 3). This time, with reference to the description of wave conditions by surfing experts and communities, the traditional marine science description of the marine environment was translated into a dynamic information service as below:

Figure 2/ Temporary wave/current monitoring system at JinJun Beach
Image by Jian-Wu Lai

Figure 3/ Environmental Information Service for the Taiwan Open of Surfing
Image by National Academy of Marine Research

I. Wave Information

Surfers lie on the surfboard and wait for a suitable wave for the challenge. In order to provide surfers with useful information about the marine environment, the authors find out corresponding information from the perspective of marine science, which includes wave height, period, direction, energy, uniformity of the swell, as well as tide, sea temperature and bottom topography, bed characteristics, etc. Since waves suitable for surfing are usually longer period swells, wave information for this activity is mainly based on X-Band wave current radar information from the temporary measuring station in JinJun and WaveWatch wind and wave model operated by the NAMR. The correlation between relevant information and surfing is explained as below.

Swell is especially preferred by surfer, because swell is the wave caused by the wind field in the remote area, which has the characteristics of longer wavelength, smoother waveform, faster transmission speed and long transmission distance. There is a wave quality assessment index (Surf Quality Index), the surfer believe that if the wave height exceeds 0.9 meters, this index indicates the impact of various periods of waves on the surfing experience, i.e., period 6-8 seconds belongs to "Average surf condition", period 8-10 seconds belongs to "Go for it", and period 10-12 seconds belongs to "Wax up", and period longer than 13 seconds is classified as "Epic session", this indicator highlights the surfer's pursuit of long wave/swell.

As for how to collect long wave information by observation, the NAMR operated an ocean radar to measure the roughness of the sea surface remotely for the wave information service at the JinJun surf site. The wave age criterion proposed by Hanson and Philips (2001) [13] was used to separate long waves from wind waves in the directional spectrum of the sea surface echo signals, so as to provide the swell information of most interest to surfers, including wave height, period and direction. It is worth mentioning that this kind of information can be further combined with the topographic characteristics of regional water depth to develop into a part of the coastal long wave warning mechanism.

II. Meteorological information

Surfing is a recreational activity on the surface of the sea, and how surfers find the best balance on the board is also influenced by the wind speed and direction. The meteorological information for this event was mainly obtained from the integrated meteorological observatory at the temporary station in JinJun and the WRF weather research and forecasting model operated by the Central Weather Bureau.

The wave quality for surfers also depends on the speed and direction of the wind. When the wind blows from the shore to the ocean, the wind inhibits the speed of wave breakup and makes them sharper, which is the wind preferred by surfers. On the contrary, winds blowing from the ocean to the shore accelerate wave breakup and are less preferred by surfers. Of course, wind speed is the key to wave shape. Strong winds can change wave conditions quickly, generally from 4m/s to 8m/s or more, resulting in confusing wave conditions.

III. Information Simplification and Translation

During the event, we explained the content of the information and conducted questionnaires for the observers, athletes and event organizers. 252 valid questionnaires were received, and the demand for information on the marine environment was fully responded. We can find that the direct provision of ocean observation data is a cognitive barrier for non-marine science users, especially for beginners. In the future, we will classify the waves according to their energy, frequency and direction, and concentration, and provide information to surfers with different skill by green, yellow and red lights for their reference.

Conclusion

The Executive Yuan is promoting the policy of "Salute to the Seas", and the relevant departments are integrating information on all of the country's beaches, establishing risk classification, and building a one-stop service information platform for marine recreational activities in order to enhance the safety of our beaches. This will increase visitors' understanding of potential risks in the sea and help them to take appropriate measures when they encounter dangerous situations.

While encouraging the public to get closer to the ocean, we are not only improving coastal management strategies, but also actively working towards helping the public and related industries to understand the ocean, and strengthening innovative services to facilitate the flourishing of marine recreational activities, enhance the strength of our country in international sporting events, which in turn will drive the development of sports tourism, service industries and related peripheral industries, and promote the positive cycle of marine recreational activities in our country.

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Moving Toward a New Age of Biodiversity: Malaysia's National Policy on Biological Diversity 2016-2025

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National Policy on Biological Diversity 2016-2025 is a national document dedicated to protect terrestrial and marine ecological environments. The leading agency in charge of this Policy is the Ministry of Natural Resources and Environment (NRE). It specifies five principles, five goals, 17 targets and numerous actions and measures. It details the implementation framework which involves the establishment of various coordinating platforms at the federal and state levels. To ensure effective implementation of this Policy, the NRE reviews the progress periodically and publish reports.

Introduction

Malaysia, a country of Southeast Asia, lying just north of the Equator, is composed of two noncontiguous regions: Peninsular Malaysia (also called West Malaysia) and East Malaysia, which is on the island of Borneo. The climate is subtropical rainforest. The total land area is 330,345 square kilometers, including the area of 879 outlying islands. The length of the coastline is 4,809 kilometers and the sea area is 453,186 square kilometers. Malaysia has rich terrestrial and marine ecosystems. To date, there are an estimated 15,000 species of vascular plants, 307 known species of mammals, including at least 30 that are endemic to Malaysia, 785 species of birds, 242 species of amphibians, 567 species of reptiles and a total of 2,068 species of freshwater and marine fishes. The rich biodiversity constitutes an extraordinary natural capital that gives Malaysians food, water and numerous economic benefits.

The first National Policy on Biological Diversity was formulated in 1998. Since then, the nation has undergone significant population increase and social-economic changes; the population has increased from 23 million in 1998 to 30 million in 2015; the per capita GDP and country's exports have tripled and grown seven folds, respectively. Following housing and industrial areas, townships and infrastructure having been built, the country's transition to become a developed, high-income nation has exerted enormous pressure on biodiversity, leaving many species vulnerable with some facing threats of extinction.

Habitat fragmentation, invasive alien species, pollution, poaching, increasing competition for land as well as climate change all pose threats to biodiversity. Furthermore, there is a general lack of awareness on importance of biodiversity throughout the country as well as significant knowledge gaps. There are also weaknesses in management capacities and shortage of funding – both which are crucial to ensure that Malaysia's biodiversity is effectively conserved. Therefore, following the 1998 Policy, the National Policy on Biological Diversity 2016-2025 (hereafter the Policy) provides the direction and framework to conserve biodiversity and use it sustainably in the face of the increasingly complex challenges. (Most of the content relating to the National Policy on Biological Diversity 2016-2025 is excerpted from [1].)

Principles, Goals and Targets

The Policy states that Malaysia is committed to conserve its biological diversity, promote its sustainable use and endure the fair and equitable sharing of benefits arising from the utilization of biological resources. It has five principles, five goals and 17 targets. Each target comes with corresponding actions and measures. The targets will be achieved by 2025.

I. Principles

Principle 1: Heritage

- Biological diversity is a national heritage. It must be sustainably managed, wisely utilized and conserved for future generations.

Principle 2: Precautionary

- The lack of full scientific certainty should not be used as a reason to postpone measures to minimize biodiversity loss.

Principles 3: Shared responsibility

- The conservation and sustainable utilization of biodiversity are the shared responsibility of all sectors of society.

Principle 4: Participatory

- Planning and management of biodiversity must be carried out in a participatory manner.

Principle 5: Good governance

- Good governance, including accountability and transparency, is crucial to biodiversity conservation.

II. Goals and Targets

Goal 1: We have empowered and harnessed the commitment of all stakeholders to conserve biodiversity.

- Target 1: More Malaysians are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.
- Target 2: The contributions of indigenous peoples and local communities, civil society and the private sector to the conservation and sustainable utilization of biodiversity have increased significantly.

Goal 2: We have significantly reduced the direct and indirect pressures on biodiversity.

- Target 3: Biodiversity conservation has been mainstreamed into national development planning.
- Target 4: Production forests, agriculture production and fisheries are managed and harvested sustainably.
- Target 5: Tourism is sustainably managed and promotes biodiversity conservation.

Goal 3: We have safeguarded all our key ecosystems, species and genetic diversity.

- Target 6: At least 20% of terrestrial areas and inland waters, and 10% of coastal and marine areas, are conserved through a representative system of protected areas and other effective area-based conservation measures.
- Target 7: Vulnerable ecosystems and habitats, particularly limestone hills, wetlands, coral reefs and seagrass beds, are adequately protected and restored.

- Target 8: Important terrestrial and marine ecological corridors have been identified, resorted and protected.
- Target 9: The extinction of known threatened species has been prevented and their conservation status has been improved and sustained.
- Target 10: Poaching, illegal harvesting and illegal trade of wildlife, fish and plants are under control and significant reduced.
- Target 11: Invasive alien species and pathways are identified, priority species controlled and measures are in place to prevent their introduction and establishment.
- Target 12: A comprehensive biosafety system inclusive of a liability and redress regime is operational to manage potential adverse impacts of modern biotechnology on biodiversity and human health.
- Target 13: The genetic biodiversity of cultivated plants and farmed and domesticated animals and of wild relatives is adequately conserved.

Goal 4: We have ensured that the benefits from the utilization of biodiversity are shared equitably.

- Target 14: Malaysia has an operational access and benefit sharing (ABS) framework that is consistent with the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization.

Goal 5: We have improved the capacity, knowledge and skills of all stakeholders to conserve biodiversity.

- Target 15: Capacity for the implementation of the national biodiversity strategies, the CBD and other related Millennium Ecosystem Assessment (MEA) has significantly increased.
- Target 16: Knowledge and the science base relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are significantly improved and applied.
- Target 17: There is a significant increase in funds and resources mobilized for the conservation of biodiversity from both government and non-government sources.

Measures of marine ecological protection

The Policy has 17 targets. Each target comes with a series of actions and measures. This section dwells on the measures related to marine ecological protection. They are presented below.

- Develop and implement community engagement programs that enable indigenous peoples and local communities living in marine and terrestrial protected areas and within buffer areas to be involved in biodiversity conservation.
- Reduce water pollution from various sources though the use of new technologies, increasing coordinated enforcement and by imposing deterrent penalties.
- Promote and provide incentives for fisheries certification, e.g., Marine Stewardship Council.
- Develop a program to control illegal, unreported and unregulated (IUU) fishing.
- Eliminate the use of detrimental fishing gear and enforce the use of Turtle Exclusion Devices (TED) to protect marine turtles.
- Formulate a program for strengthening the national MPA network with a focus on expanding the under-represented ecosystems, in particular coral reefs, seagrass beds and turtle nesting beaches.
- Establish new transboundary MPAs cooperation involving Indonesia, Brunei and the Philippines – giving priority to those critical for the success of the Coral Triangle Initiative (CTI).
- Formulate and implement management plans for all MPAs and fisheries prohibited areas (FAPs) to ensure reestablishment of targeted species population.

- Develop a complete spatial database of all terrestrial and marine protected areas – including information related to legal protected status, known threats to their biota, biodiversity and key ecosystem services.
- Identify, map and protect known migratory pathways of marine life.
- Implement provisions of the International Maritime Organization (IMO) Ballast Water Management Convention to safeguard against marine invasive species.
- Undertake a comprehensive review of all national and state legislation related to fisheries, marine parks and marine biodiversity including examination of the gaps and overlaps pertaining to jurisdiction over marine biodiversity and assess the feasibility of expanding the role/jurisdiction of the Department of Marine Park Malaysia.
- Undertake the national marine and freshwater life stocktaking survey encompassing detailed assessments of marine and freshwater resources.

Implementation Framework

The Federal government via the Ministry on Natural Resources and Environment (NRE) is a leading role in implementing the Policy. This includes providing overall direction, coordinating stakeholder actions, establishing appropriate institutional platforms, facilitating resource mobilization and initiating review of the Policy. State governments have jurisdiction over the management of inter alia land, water and forests and play crucial roles in delivering the actions. There will be many opportunities for civil society, indigenous peoples and local communities, and private sectors to be active partners in the implementation of this Policy.

The National Biodiversity Council, under the auspice of the NRE, is the highest decision-making body, under which several other coordinating platforms are established. They include the National Steering Committee (NSC), the State Steering Committee (SSC), the Meeting of Ministers of the Environment (MEXCOE) and the National Biodiversity Roundtable (NBR). While these various platforms serve different functions, they collectively maximize synergies and reduce conflicts in implementing and monitoring the Policy.

The NSC is the primary coordinating platform, in which various working groups (WG) have been established to facilitate the implementation such as WG Community Based Natural Resources Management and WG Biodiversity Research. The SSC is the main coordinating platform at the state level for the implementation of the Policy. The MEXCOE is a coordinating and information-sharing platform for state ministers and state executive committee members responsible for environment and biodiversity. The NBR is led by civil society and the private sector and provides technical advice and supports to the NRE and the NSC in the implementation of the Policy.

Monitoring the implementation of the Policy is a crucial task. NRE is in charge of monitoring progress which is deliberated by the NSC and the NBC. NRE will review the actions of the Policy and publish reports on the implementation of the Policy at the end of each implementation phase.

Marine ecosystems

Malaysia's Exclusive Economic Zone overlaps with the Coral Triangle area which is thought to have the greatest diversity of marine life in the world. Therefore, the marine and coastal areas are rich in biodiversity, including mangroves, corals and seagrass beds. The shoreline is rich with mangroves, which are feeding and nursery grounds for fisheries, as well as the habitats of several important commercial fishes and shrimps. The area is 544,032 ha. Five mangrove areas are designated as Ramsar sites. Among them, the Matang Mangrove Forest Reserve has been acknowledged as one of the best-managed mangrove ecosystems in the world.

Coral reefs are found in shallow marine waters, mostly in Sabah and along the east coast of Peninsular Malaysia. Coral diversity is highest in Sabah and Sarawak, which is estimated to have over 550 species while Peninsular Malaysia has over 480 species. The value of ecosystems services provided by coral reefs is estimated at USD$45 billion every year. Seagrass beds are diverse marine habitats. Studies have shown that about 100 fish species and 20 prawn species are dependent on seagrass beds for nursing, feeding and breeding. They are crucial for the survival of the endangered dugong and sea turtles.

Besides, Malaysia is well-known for nesting grounds of four species of marine turtles: Green, Hawksbill, Olive Ridley and Leatherback turtles. In particular, Leatherbacks were once a prime tourist attraction. Now their numbers have declined significantly due to uncontrolled overharvesting of their eggs that they are considered to be extinct. Conservation efforts now focus on ensuring successfully nesting of the remaining three marine turtle species.

Marine Protected Areas

Malaysian waters cover approximately 453,186 square meters, of which 1.4% is currently designated as marine protected areas (MPAs), including marine parks, turtle sanctuaries, fisheries prohibited areas. There are currently 47 marine parks with a total area of 456,336 ha, 14 turtle sanctuaries and fisheries prohibited areas covering a further 207,723 ha. Among them, Pulau Sipadan Park is one of the world's best diving spots.

Sipadan, a tiny coral island of just 12 ha, lying off the east coast of Sabah, is Malaysia's only oceanic island, rising 600 meters from the seabed. It features rich marine ecosystems. 70 genera of hard and soft corals and over 3,000 species of fish are recorded in its water, a diversity similar to Australia's Great Barrier Reef [2]. This tiny island attracts many divers annually. With the consequent destruction of terrestrial and marine environments brought about by tourists, Malaysia closed all resorts in 2004 and moved them to the nearby Mabul island. It further implemented a diving permit system in 2008, allowing only 120 divers per day and since April 2019 allowing 176 divers per day. Moreover, for one month, starting yearly from 1st till 30th November 2020, Sipadan is closed to all tourists [3].

Dive spots of Sipadan island
Source/ http://www.sabahparks.org.my/index.php/the-parks/sipadan-island-park [4]

Conclusion

The Policy embodies Malaysia's commitment and action to protect terrestrial and marine biodiversity. It specifies several measures related to fisheries, water pollution, protected areas, and ballast water, etc. This shows the protection of marine biodiversity is inherently involves cross-sector cooperation, which can serve as a reference for our endeavors in promoting marine ecological protection.

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The Blue Economic Way to Taiwan: Reflection from Malaysia's Case

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Keywords: Sustainability, Blue Economy, Oceans Policy, Maritime Transport

As the global population continues to grow, the creation of sustainable resources is a crucial issue that must be considered in advance when facing crises in resource scarcity, environmental pollution, and climate change, etc. With global economic, trade and technological development, marine resources have become a priority for both public and private stakeholders. While pursuing industrial development, the preservation of the environment and sustainable resources should not be ignored. Thus, the concept of Blue Economy refers to a sustainable marine economy that maximizes economic benefits and minimizes environmental burdens, as well as emphasizing the harmony and coexistence of human activities and the ocean [1].

The Definition and Issues of Blue Economy

The term "Blue Economy" refers to a circular economic model that emphasizes not only conservation but regeneration, leaving no waste or energy consumption. Its goal is to create an ideal society with limited resources and to achieve a zero-emissions environment for the earth's ecology, thereby achieving the goal of sustainable use and zero emissions [2]. A report from the UNCTAD defines "Blue Economy" as an ocean economy that improves human well-being and social equity while reducing environmental risks and ecological disasters [3]. The World Bank specifies it as the sustainable utilization of marine resources to promote economic growth, improve livelihoods and employment, along with maintaining the stability of marine ecosystems [4].

Due to the preference of stakeholders, the interpretation of Blue Economy is often biased towards specific interests, which may even lead to conflict issues. Therefore, it is committed to protecting the world's marine resources through cross-border and cross-sectoral cooperation among stakeholders [5], and be implemented through various evaluations and target-setting. By incorporating the value of the ocean into the economic activities, marine industry's benefits are increased and costs are reduced through the Blue Economy strategies. The goals and objectives of the Blue Economy are shown in Table 1.

Therefore, it is clear that the Blue Economy encompasses key issues including "economic growth, environmental sustainability, social inclusion, government and institutional mechanisms, and technical capacity."

Opportunities and Challenges of Blue Economy

The implementation of the Blue Economy requires information from marine industries to explore their potential contribution to revenue, people's welfare, and ecosystems. This will affect the calculation of Blue Economy's benefits, even if the industries are excluded from the Blue Economy strategies [1].

Table 1/ Goals and Objectives of the Blue Economy

Theme	Goals and Objectives
Economic growth	Employment, livelihoods, income generation, resource utilization, blue growth, and marine spatial planning (MSP)
Environmental sustainability	Environmental protection and restoration, natural capital, climate change mitigation, and community health and well-being
Social inclusion	Food security, poverty alleviation, community engagement, inclusiveness, and resilient small-scale fisheries (SSF)
Governance and institutional mechanisms	Coordination, integrated planning, monitoring, and resilient partnership
Technical capacity	Maritime security, research and development (R&D), investment, and financing

Source/ Johnstone and Vaghefi (2019) [1]

Therefore, the coordination, planning and integration of the Blue Economy are the critical factors. Currently, many countries have already established Blue Economy departments, and integrated their responsibilities into government agencies to coordinate interdepartmental programs.

With the rise of environmental awareness, people are gradually concerned about the increasing pressure on the oceans and their importance to human well-being, thereby raising concerns for the oceans and developing policies for their sustainability. The implementation of Blue Economy should follow its sustainable concept, regardless of its scale, or whether at sea or onshore. This will not only contribute to the evaluation of the public and private sectors, but also assist in examining the deficiencies in the elements of sustainable development of the oceans; hence improve the developing model to solve ocean issues [6].

Blue Economy in Malaysia

According to a research conducted in Malaysia, the benefits of developing a Blue Economy include Penang's advantageous location, abundant water resources, job creation, stable food supply, and improved livelihoods [1]. The alternative and emerging sectors of Penang' Blue Economy are illustrated in Table 2.

Table 2/ Blue Economy Key Sectors in Penang

Existing Sectors	Alternative and Emerging Sectors
Fisheries Aquaculture Seafood processing Shipping Port activities Marine and coastal tourism Marine R&D Marine manufacturing (e.g. boat & food) Marine construction	Resilient small-scale fisheries Sustainable aquaculture Ecotourism Maritime transport Safety and surveillance Renewable energy / blue energy High-tech marine services Biotechnology / bio-products

Source/ Johnstone and Vaghefi (2019) [1]

From Table 2, it is obvious that moving towards a Blue Economy requires investment in economic, social, environmental, and technological aspects, enabling small businesses to gain more development opportunities. The following are some descriptions of alternative and emerging sectors [1].

Figure 1/ Maritime Transport
Image by Cheng-Chi Chung

Figure 2/ Marine Technology
Image by Yu-Sheng Lin (left), Filkcr-Courtesy of Officers and Crew of NOAA Ship PISCES (right)

I. Resilient small-scale fisheries (SSF): Small-scale fisheries are at the heart of Penang's fisheries sector, which are vital to the sustainability of the sector and the livelihood of fishermen. It contributes to food security, and in partnership with isolated fishing villages to sustain the community culture.

II. Sustainable aquaculture: Fish for human consumption from the small-scale fisheries and aquaculture sector can provide low cost, nutritious, high quality aquatic food, which not only enhances economic benefits but also reduces fish harvesting.

III. Ecotourism: Tourism industry produces jobs and helps economic growth; it is also highly dependent on the environment quality. The importance of ecosystems through the Blue Economy will encourage tourism diversification and minimize the impact of eco-tourism on the environment.

IV. Maritime transport: About 90% of global trades are transported by sea. Malaysia exports its goods mainly to East Asian markets, and is expected to be a fish exporter due to its close proximity to the Indian Ocean. Penang, as a transportation and logistics hub in the Indonesia-Thailand-Malaysia triangle, benefits from the connectivity.

V. Safety and surveillance: In recent years, the security challenges of ports, offshore facilities and ships have increased, endangering the crew, ships, cargo, marine life, etc. Therefore, new regulations need to be developed and implemented by different Blue Economic stakeholders to stop various threats and criminal activities.

Figure 3/ Ocean Tourism
Image by neufal54 from Pixabay (left), NTOU Sailing Team (right)

VI. Renewable energy / blue energy: As energy consumption continues to climb, Penang possesses the potential to develop renewable energy sources, such as solar, wind, wave, and tidal energy, to provide sustainable energy through ocean currents and wave energy.

VII. High-tech and biotech marine services: The marine environment offers a new frontier of biological resources to develop a range of products from pharmaceuticals and chemicals to personal care products, including cosmetics, dietary supplements, and painkillers made from marine species.

Reflections on the Development of Blue Economy in Taiwan

Taiwan has established the Ocean Affairs Council in 2018, a specialized authority for ocean issues, and set up the Coast Guard Administration for law enforcement, the Ocean Conservation Administration for conservation and the National Academy of Marine Research for research. The development directions for Taiwan to move towards a blue economy are the following:

I. Talent Cultivation
The public and private sectors integrate teaching and research resources to jointly cultivate talents for the development of the marine industry. Taiwan's offshore wind power industry currently requires insufficient talents. In order to cultivate offshore wind power talents, National Taiwan Ocean University and W&H Ship Management and Consulting Corporation signed a cooperation agreement in October 2020 to provide scholarships and practical internship opportunities, which is the best case of public-private cooperation in cultivating talents.

II. Maritime Transport
Taiwan is strategically located, but lacks natural resources. It is not only advantageous but also essential to develop the shipping industry. In addition, regardless of bulk shipping or container shipping services, Taiwanese own the high rank of ship tonnages. In order to enhance the competitiveness of the operation in the fierce shipping market, it relies on the government's policy support and emphasis on the regulation of marine environmental pollution, so as to strengthen the development of the shipping industry.

III. Marine Technology
Taiwan has rich marine resources and an excellent biotechnology research base, resulting in the potential for the development of marine biological resources. The marine technology industry has already explored offshore wind power and deep water. It is possible to develop wave energy, ocean current energy generation, and deep-sea resource exploitation [7].

IV. Ocean Tourism

The unique topography of Taiwan's coastline and its diverse marine cultural resources are favorable conditions for the development of ocean tourism. In recent years, the cruise industry has been on the rise. It is important to improve the hardware facilities of the terminal and transform it into a passenger terminal and water-friendly space. It should also implement policies beneficial to the cruise industry and deregulate the restrictions on customs clearance and tourist visas, to increase the willingness of cruise operators in visiting Taiwan [8].

V. Marine Fishery

The fishery is one of the major marine industries in Taiwan. However, due to marine climate change and overexploitation of fishery resources, good competitive conditions and ecological environment are no longer available. It is recommended to strengthen fisheries law enforcement, review fisheries subsidy policies and measures, and promote marine ranch to reduce fish harvesting [9].

Concluding Remarks

With severe global warming and shortage of resources, countries are actively investing in the development and utilization of marine resources. The pursuit of marine economic development should be accompanied by social and environmental protection. Regarding the interests of Blue Economy, the industry in Penang, Malaysia can be a guideline for Taiwan's strategic development. In the development of the Blue Economy, close public-private cooperation should be established to nurture scientific and technological talents in the marine industry, to develop high-end intelligent marine transportation, to invest in research and development of alternative energy technologies, to promote the cruise and yacht tourism industries, and to eliminate the problem of depleted fishery resources.

The Blue Economy has entered the stage of practice and exploration. Several countries have proposed strategies and plans for marine development, but a full understanding and protection of the ocean is a prerequisite for the sustainable utilization of marine resources. It is expected to intensify the international exchange of talents, technology and information among countries. Through studying the impact of human and climate on the marine ecosystem, the management of the marine environment will be strengthened. Most of all, it is an imperative that all countries share the global responsibility to create a world with friendly marine environment.

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Introduction to Malaysia's Ocean Policy and Maritime Administrative Agencies

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Keywords: Ocean governance and policy, sovereignty, sustainable development, Malaysia

Malaysia is located at a key point in Southeast Asia, controlling the Strait of Malacca to the west, bordering the South China Sea to the east, and neighboring Singapore and Indonesia across the water. The Malaysian coastline is 4,809 kilometers long, about three times the length of Taiwan's coastline, and the nation's territory comprises as many as 879 islands. Most of the coastal areas are plains with the western coastline nearly 2,608 kilometers and the eastern coastline 2,607 kilometers long. The coastal resources are rich in natural biodiversity. Coastal areas are important regions for social and economic activities, such as agriculture, fishery, aquaculture, as well as oil and natural gas extraction. They also serve as premises for functions such as transportation, tourism, cruises, and entertainment. Whether from the perspective of geographical, economic, or historical development, Malaysia is an important maritime country, and its life and economic production activities are closely connected with the ocean [1].

Malaysia is geographically located in the Strait of Malacca
Source/ Wikipedia
https://en.wikipedia.org/wiki/File:Strait_of_malacca.jpg

Information sharing is the focus when there are many marine administrative agencies

Malaysia's marine policies and regulations are implemented among various government agencies, and each agency has its powers and authorities to formulate regulations or policies to implement the management of specific affairs. The management powers and responsibilities of various agencies appear to overlap or conflict (such as ocean parks and oil exploration), which is prone to raise the management problems, including conflicts in use of multi-purpose facilities, overlapping jurisdictions and competition, and repetitive work. Therefore, horizontal contact and coordination between relevant maritime agencies as well as information circulation and sharing are extremely important, so that ocean governance can be effectively promoted.

The Federal Government of Malaysia has several government units responsible respectively for fisheries and marine parks (Ministry of Agriculture and Food Industries); maritime transportation and ports (Ministry of Transport); maritime law enforcement, search and rescue, maritime safety (Maritime Enforcement Agency), ocean tourism (Tourism Promotion Board); scientific research on climate change, waste, energy, etc. (Ministry of Energy, Science, Technology, Environment & Climate Change); navy (Ministry of Defense); marine scientific research (State Oceanic Administration); marine policy research (Maritime Institute of Malaysia); and environmental monitoring, natural environment, and diversity protection (Department of Environment) [2].

There are more than a dozen management projects and measures for ocean governance in Malaysia overseen by 11 competent ministries (the Ministry of Transport manages ports, transportation, lighthouses, and also manages forestry and wildlife related to the sea), and there are more than 30 agencies and units that are maritime affairs authorities under the ministries [3], as shown in Table 1 below. In principle, all marine affairs government agencies execute affairs in accordance with their statutory powers and approved annual budgets. The budgets of government agencies are compiled every year, and after the federal government submits them to the Parliament for review and approval, they will be used as the next year's funding for various ministries and committees to carry out their duties. In addition to the established regular tasks, sometimes based on the country's development needs for a specific business (such as enhancing maritime law enforcement capabilities), relevant ministries and committees will also cooperate in the development of plans or policies, and set a specific budget to perform this work.

Table 1/ Malaysia's Marine Management and Competent Authorities

Management item	Competent authority
Ports	Ministry of Transport Ministry of International Trade and Industry
Transportation	
Lighthouses	
Non-biological resources	Ministry of Science, Technology and Innovation
Biological resources, fisheries	Ministry of Agriculture and Food Industries
Forestry	Ministry of Energy and Natural Resources Ministry of Transport
Wildlife	
Jurisdiction, law enforcement	Ministry of Interior Ministry of Defense
Travel	Ministry of Tourism, Arts and Culture
Cultural sites	
Telecommunications	Ministry of Communications and Multimedia
Education	Ministry of Education
Trade and Services	Ministry of Economic Affairs
Dispute handling	Judicial agencies

Source/ Hisham Omar et al. (2015) [3]

Ensuring sovereignty and sustainable development is the core of Malaysia's ocean policy

Malaysia has vast sea areas and abundant resources, and therefore assumes huge responsibilities in the management and handling of various maritime affairs and issues in the sea areas under its jurisdiction, especially to ensure the sovereign integrity of maritime territories and the sustainable development of marine resources. The ocean holds considerable strategic interests for Malaysia, therefore special

attention needs to be paid to ocean affairs management. Malaysia has a large sea area, and sometimes it has to compete with neighboring countries or jointly use marine resources, including animals, plants, transportation, and open use of sea areas, such as entertainment zones, scientific research, and mining of minerals and hydrocarbons. In view of this, Malaysia's maritime policy covers multiple aspects. The marine policies currently being promoted mainly fall into four categories: Political and economic strategies, education strategies, ecological conservation strategies, and environmental protection strategies. Political and economic strategies include anti-smuggling and illegal immigration policies, blue economic policies, South China Sea policies, maritime military development policies, international cooperation policies with neighboring countries, and vessel modernization policies. Educational strategies include marine education policies; ecological conservation strategies mainly include the establishment of marine parks; while environmental protection strategies include marine pollution prevention and control policies, coastal protection policies, and ship gas emission policies.

I. Anti-smuggling and illegal immigration policies

Through Operation Dragon project, Malaysia combats smuggling and other activities to safeguard the security of its national waters. The implementation units of the operation are the Malaysian Maritime Enforcement Agency (MMEA), the Marine Police Force, the Royal Malaysian Navy, and the Ministry of Agriculture and Food Industries.

II. Blue economy policies

Under the concept of blue economy, Malaysia selects key marine industries, focuses on the problems faced by the marine industries, and formulates follow-up industrial action plan and recommendations to establish the core capability of blue economy. In 2018, Malaysia launched a comprehensive plan for marine economic activities, such as aquatic fishing and aquaculture, port management, shipping management, etc., and will conduct follow-up discussions and planning on overall issues.

III. South China Sea policies

In order to resolve and respond to the issues of disputes in the South China Sea, Malaysia established a committee on managing potential conflict in the South China Sea and participated in the South China Sea International Symposium, which has been held since 1990 to explore cooperation between China, Taiwan and the Association of Southeast Asian Nations, and collect information on various frictions or potential problems in the South China Sea.

IV. Marine military development policies and international cooperation policies with neighboring countries

In addition to attaching importance to maritime military development, Malaysia has also been actively promoting military cooperation with neighboring countries in recent years, such as cooperation on fisheries, navy, and maritime guards with the Philippines in the Sulu Sea, and conduct regular exercises especially for crime types such as hostage taking, robbery, drug smuggling, arms trafficking, theft of treasures at sea, illegal fishing, environmental pollution, and other activities. After the global financial tsunami in 2008, Malaysia became cautious in defense procurement. Many plans have been pending, such as amphibious ships that have been suspended for almost ten years. Despite financial difficulties, the Navy proposed the 15-5 plan in 2015. The first 15 refers to the 15 types of ships currently in the Malaysian Navy, which are too diversified and cause logistical difficulties, so they tried to simplify them to 5 types.

V. Vessel modernization policies

Malaysia's modernization plan included the creation of a submarine force as part of the Malaysian Plan in the mid-1980s (1986-1990). Although the plan was suspended due to financial problems in the 1990s, preliminary research on submarine demand was resumed in May 2000. The following year, the

Malaysian Ministry of Defense established a submarine research team and conducted preparatory operations.

VI. Marine Education Policies

Malaysia actively promotes domestic maritime education, with particular emphasis on domestic academic research and regional security-related initiatives and research. In addition, it is worth mentioning that in terms of sovereignty activities, Malaysia also focuses on fundamental school education through the joint promotional efforts of government agencies including the Royal Malaysian Air Force, the Marine Police Force of the Royal Malaysia Police, Royal Malaysian Customs, the Marine Department and air team, etc., which are responsible for implementing and exercising all national maritime laws and provide maritime education to students.

VII. Ocean conservation policies

In order to protect marine natural resources and biodiversity, set up marine protected areas and implement legislative control, Malaysian federal laws and state laws or regulations stipulate management regulations. After Malaysia declared the Tunku Abdul Rahman Park in Sabah as the country's first marine protected area in 1974, man-made threats and biodiversity protection have become the standards for establishing marine protected areas. For example, according to the Fisheries Act 1985, Rantau Abang was declared a fishery restricted area to protect sea turtle populations and landing areas, especially for endangered giant leatherback turtles. Most marine reserves are open for to the public to enjoy and appreciate the heritage of nature, and relevant rules and regulations have been formulated to ensure the protection of resources.

VIII. Marine pollution prevention and control policies

According to a 2015 study published by Science Magazine, Malaysia ranks eighth in the world for plastic waste with the top five plastic pollutants being China, Indonesia, the Philippines, Thailand, and Vietnam. The above five countries are all in Asia and part of them are close to the territory of Malaysia. As the spread of plastic waste has no borders, this will inevitably increase the problem of plastic waste in the oceans of Malaysia. Huge floating plastic may only account for 5% of the plastic trash in the ocean, while the rest may continue to destroy the marine ecosystem and strangle marine life underwater. At the same time, a large amount of plastic is decomposed into fine particles, and eventually falls on human dinner plates due to the food chain. Therefore, the relevant policies of Malaysia mainly address the problem of marine plastic pollution to solve the problem of marine debris. The pollution caused by coastal garbage not only negatively affects the aesthetics of beaches and coastal areas, but also negatively affects the global economy.

IX. Coastal protection policies

The Malaysian government initiated the national coastal erosion study from 1984 to 1985, a study that became a major national concern. The Environmental and Natural Resources Unit of the Prime Minister's Office is responsible for the study, the purpose of which is to make recommendations for long-term planning to prevent coastal erosion. In 1987, two important agencies related to coastal area management were established to follow-up on subsequent policy implementation, namely the Coastal Engineering Technology Center (CETC) and the National Coastal Erosion Control Committee (NCECC).

X. Ship gas emission policies

The International Maritime Organization's initiative to reduce SOx emissions from ships is based on Annex VI of the "International Convention for the Prevention of Pollution from Ships" (MARPOL) that entered into force in 2005. The latest emission regulation is that starting from January 1, 2020, the sulfur content in fuel used by ships sailing outside of designated emission control areas (DESC) must be

reduced to 0.5% to maintain port environments and the health of residents in coastal areas.

In summary, the above policies can be summarized as marine policies that can be divided into four aspects: political and economic strategy, education research and development, ecological conservation and environmental protection [4].

Ocean governance depends on comprehensive laws and regulations

The laws and regulations related to maritime affairs in Malaysia can be roughly divided into 6 categories: maritime jurisdiction regulations, fishery management regulations, shipping management regulations, environmental protection regulations, ecological conservation regulations, and maritime safety regulations. Maritime jurisdiction laws include the formulation of territorial sea law, exclusive economic sea area law, maritime zone baseline law, and continental shelf law. Fishery management regulations comprise mainly the Fisheries Act and its supporting regulations. Customs management laws and regulations mainly regulate supervision and inspection of incoming and outgoing postal items, goods, passenger luggage, currency, gold and silver, securities and transportation vehicles along coastal areas, at the border or at inland port, collection of customs duties, and enforcement of anti-smuggling tasks. Environmental protection laws and regulations mainly focus on preventing, reducing and controlling pollution and improving the environment. Ecological conservation laws and regulations mainly focus on protecting wildlife, setting up national parks or marine parks, preventing sea turtle interference, and prohibiting the hunting of sea turtles and other marine life. Maritime safety regulations mainly focus on ensuring maritime safety, preventing and combating maritime crimes, and conducting maritime search and rescue operations [5].

As issues such as climate change, marine pollution, habitat destruction, and marine debris have attracted the attention of the international community, private non-governmental organizations in Malaysia are showing increasing concern about marine-related issues and taking actions such as participating in ICC beach cleaning activities every year. Organizations include the Coral Reef Observation Association which is dedicated to the conservation and research of coral reefs and sea turtles; the Sea Turtle Research Unit of the Universiti Malaysia Terengganu (UMT); the Turtle Conservation Society of Malaysia; the World Wildlife Fund for Nature in Malaysia, which is engaged in habitat and marine life conservation; and the MNS Marine Group - Selangor Branch that promotes ecotourism and conservation, etc.

Malaysia's maritime governance focuses on maritime safety and law enforcement, naval ship modernization, South China Sea oil and gas exploration, marine tourism and recreation, marine protected areas, cooperation, and interaction with neighboring countries in the South China Sea, and participation in international organizations. Although each country has its own maritime issues, there are many commonalities. Malaysia attaches great importance to South China Sea oil and gas field exploration and maritime security strategies in its external maritime affairs as they constitute important economic lifelines for the nation, demonstrating that Malaysia has priority considerations on diversified maritime affairs by highlighting those of major national interests and designating cost-effectiveness as the sole focus of policy planning.

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Malaysia's Ocean Thermal Energy Conversion Technology

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Translated by Linguitronics
Keywords: Ocean thermal energy, ocean thermal energy conversion

In the face of rapid changes in the international political and economic environment and the challenge of how to balance energy, environment, and economic development, all countries regard energy transition as an essential key to growth for the next generation. As energy will be an important factor that directly affects all countries' economic development, green energy technology has also become an important engine driving countries to establish emerging industries and create green jobs. From this perspective, it is clear that energy and green energy technology have become common worldwide topics.

As Taiwan lacks self-produced energy, its energy supply is highly dependent on imports, making the nation vulnerable to international energy turbulence and fluctuations in energy prices. To reduce dependence on imported energy and increase energy independence and diversification, Taiwan is actively developing and promoting offshore wind power and other marine green energy technologies [1]. At the same time, in response to energy shortages and environmental issues, advanced countries across the world have invested heavily in the research and development of various renewable energy sources and accelerated their energy transition. Global industries are also increasing the use of renewable energy to reduce their carbon footprint. These new changes have led to great leaps forward in green energy technology and renewable energy industries. Taiwan actively develops green energy technology and promotes green energy construction, and has passed new bills such as the "Green Energy Technology Industry Innovation Promotion Program," completed the amendment to the "Guidelines on Energy Development," and successfully prompted advancements in the green energy technology industry with policies and laws that serve as new engines driving energy transition and economic development. In the face of more challenges in the future, Taiwan must learn from neighboring countries' development plans and utilize the nation's inherent characteristics to become a full-fledged player in the world's green energy development [2].

Malaysia is located in the tropics. With a warm climate and abundant resources in the South China Sea (Figure 1), Malaysia is perfectly poised to develop ocean thermal power generation [3]. In recent years, the country has invested in ocean energy research and actively moved towards greater utilization of ocean thermal energy conversion [4][5].

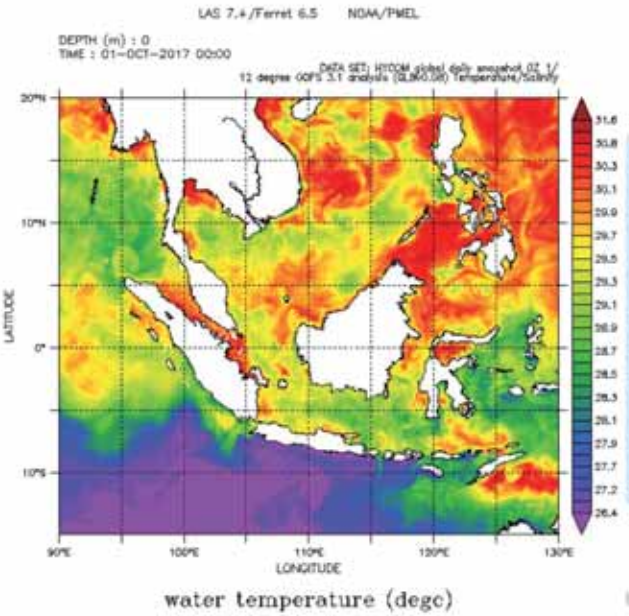

Figure 1/ 2017/10/01 00:00
The sea temperature in the waters of Malaysia; the waters near Malaysia remain at about 30°C
Source/ http://apdrc.soest.hawaii.edu/data/data.php

Ocean thermal energy conversion

About 70% of the earth's surface is covered by the ocean. As the sun continuously transmits heat energy to the planet, the surface seawater effectively absorbs and stores the sun's energy, making the ocean the largest natural heat collector. In the tropics, surface seawater temperature can reach above 28℃ day and night continuously. Warm seawater from the tropics also flows to the poles to produce cold seawater with high density and low temperature, while this cold seawater flows along the bottom of the ocean back to the tropics. Meanwhile, the deep ocean water is a block of water that remains low temperature and stable throughout the year, rarely changing due to external environmental influences. In most parts of the world, seawater temperature at a depth of 1,000 meters maintains about 5℃ all year round. There is a large temperature difference between the surface warm seawater and the deep cold seawater in tropical and subtropical regions, harboring the potential for developing ocean thermal energy conversion (Figure 2).

Thermal energy is an important research topic in the field of renewable energy. Many research reports have pointed out that ocean thermal energy conversion has great potential, especially in tropical and subtropical countries, and research institutions have invested considerable resources in this field. At present, the United States and Japan, and Republic of Korea have all constructed ocean thermal power plants.

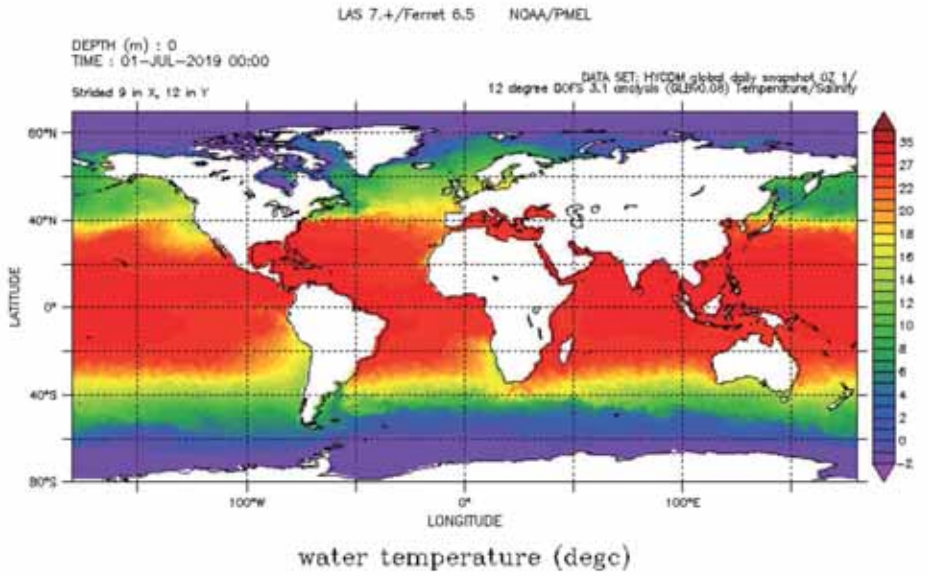

Figure 2/ 2019/07/01 00:00, the global ocean temperature; it can be seen that the sea surface temperature in tropical and subtropical regions is high, harboring the potential for developing ocean thermal energy conversion
Source/ http://apdrc.soest.hawaii.edu/data/data.php

Types of ocean thermal energy conversion

The principle of ocean thermal energy conversion is similar to that of thermal power plants. First, surface seawater with higher temperature is used to evaporate and gasify a low boiling point working fluid, and the vapor thus generated is utilized to drive the turbine generator. The vaporized vapor is then condensed by low-temperature deep seawater and returned to the liquid state, and the cycle is repeated to produce energy. There are three ocean thermal energy conversion systems: closed-cycle, open-cycle, and hybrid system. In terms of location, there are three types of ocean thermal energy conversion plants: land-based, shelf-based, and floating type plants.

A closed-cycle ocean thermal energy conversion system uses a low boiling point working fluid to drive a turbine to generate electricity. The warm seawater on the ocean surface passes through a heat exchanger to evaporate the working fluid. After the vaporized working fluid turns the turbine, it is condensed into a liquid through deep ocean water, thus forming a complete cycle (Figure 3).

Open-cycle ocean thermal energy conversion system (Figure 4) is to pump warm surface seawater into a low-pressure cabin to vaporize into a gas that drives turbines to generate electricity. Deep ocean water is then used to condense and liquefy the gas. As the vaporized gas has been desalinated, the condensed liquid can be used in many applications.

Hybrid ocean thermal energy conversion system combines the characteristics of the two ocean thermal energy conversion systems mentioned above. It is similar to an open-cycle as warm surface seawater is introduced into the vacuum chamber to vaporize into water vapor at the beginning of the cycle. The water vapor enters the ammonia evaporator for vaporizing the working fluid, which turns the turbine to generate electricity. Therefore, it is generally conceived that the hybrid cycle features both the open- and closed-cycle characteristics.

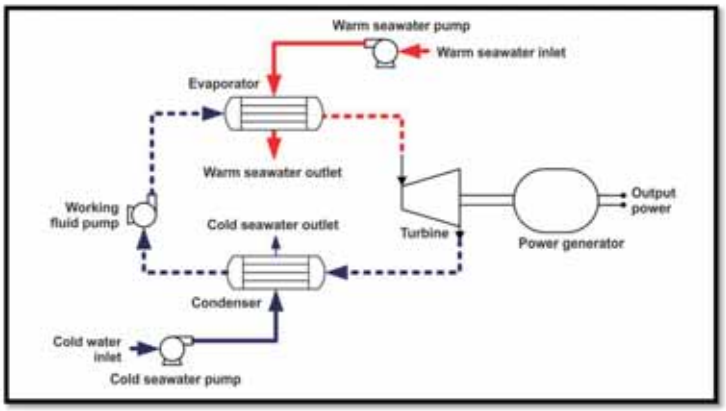

Figure 3/ Schematic diagram of the working principle of closed ocean thermoelectric power generation
Source/ Azhim et al. (2013) [6]

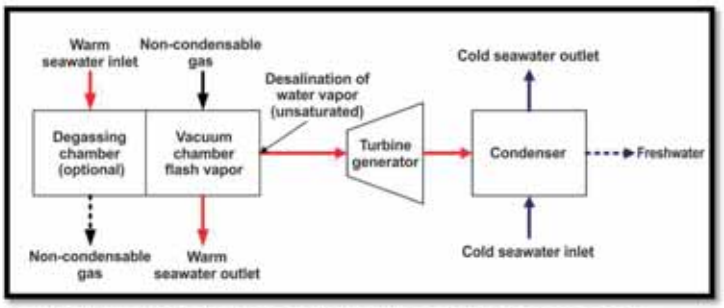

Figure 4/ Schematic diagram of the working principle of open ocean thermal energy conversion
Source/ Azhim et al. (2013) [6]

However, both closed-loop and hybrid systems may use ammonia as a working fluid, and ammonia is toxic at moderate concentrations. Since ocean thermal energy conversion plants are usually located in harsh natural environments (such as salt and humidity), the risk of toxic fluid leakage is high for prolonged periods. For example, metal pipes may corrode and cause toxic fluid leakage. Hence, the risk of environmental impact is an issue that developers and operators of ocean thermal energy conversion must face.

Current status of ocean thermal energy conversion in the world

In the 1930s, the first ocean thermal energy conversion power plant was built in the Caribbean Sea. Due to technological limitations, the world's first ocean thermal energy conversion power plant failed to generate electricity and produced negative power. It was not until the 1970s that the first ocean thermal energy conversion power plant officially successfully output electrical energy. Several countries use ocean thermal energy conversion to generate electricity, such as Hawaii, the United States, Kume Island, Japan, and Republic of Korea. The latter two are at higher latitudes than Taiwan. Ocean thermal energy conversion is usually combined with other industries, such as desalination, air conditioning, aquaculture, and deep ocean water production. According to a survey conducted by the Industrial Technology Research Institute, there are several ideal ocean thermal energy conversion potential sites on the east coast of Taiwan, such as Nan'ao, Heping, Qixingtan, Shiti, Zhangyuan, Jinlun, Ludao, and Lanyu, etc. At these locations, the distance from the shore to a depth of 1,000 meters is only about 10 kilometers.

Current status of Taiwan's ocean thermal energy conversion

At present, Taiwan's ocean energy development mainly comprises offshore wind power west of the island within the Taiwan Strait. However, Taiwan is surrounded by sea and has abundant ocean energy.

For instance, the eastern sea has a Kuroshio current with surface seawater temperature above 24 ℃ all year round. A steep continental shelf along the coast with depths up to 1,000 meters and seawater temperature as low as about 5℃ just 3 or 4 kilometers from the shore. As such, Taiwan has one of the most suitable geographical environments in the world to develop ocean thermal energy conversion. Effective development can improve power safety and create a marine green energy industry. Since the 1980s, the Bureau of Energy of the Ministry of Economic Affairs, TaiPower Company, the Industrial Technology Research Institute, and other units have successfully completed a number of research projects related to ocean thermal energy conversion.

Development and current status of ocean thermal energy conversion in Malaysia

Malaysia is located in a tropical region with surface water, reaching a stable temperature above 28℃ throughout the year. According to data, the sea area of approximately 130,000 square kilometers around Malaysia has a depth of 700 meters or more. The temperature difference at this depth has a potential energy content of 800kW/km^2 according to calculations, and the estimated ocean thermal energy conversion content is about 100,000 MW. The feasible locations for ocean thermal energy conversion in Malaysia are mostly the South China Sea and its surrounding areas. For example, the Nansha Trough has a depth of 1,000 meters or more and is one of the ocean thermal energy conversion power plant sites actively researched by Malaysia. Existing research reports assess that several areas near Malaysia may have ocean thermal energy conversion power generation potential, such as Pulau Layang-Layang (in Malay), Kuala Baram, Pulau Kalumpang, and Kuala Penyu, among others.

Pulau Layang-Layang is a circular coral reef in the Spratly Islands that is a haven for diving enthusiasts. There are also Malaysian naval bases, resorts, diving schools, airports, and other facilities located on the reef. Currently, the floating-type ocean thermal energy conversion power plant is proposed for this site. It is estimated that 1.5 kilometers away from the edge of the reef, the bottom seawater temperature can reach 5℃.

Kuala Baram is located in Sarawak State, close to the border of Borneo and Brunei. This area has natural resources such as oil and natural gas. At present, land-based fixed ocean thermal energy conversion power plants are proposed for this site. Due to the distance to the deepwater area, the length of the cold water pipe must be approximately 28 kilometers, presenting technical challenges that must be overcome.

Universiti Teknologi Malaysia (UTM) is an important academic institution in Malaysia promoting ocean thermal energy conversion. The Ocean Thermal Energy Centre (UTM-OTEC) is actively engaged in this field. The center has signed a joint research agreement with the Institute of Ocean Energy of Saga University, Japan, to jointly develop a hybrid system for experimental stainless steel heat exchangers. They will also study new 3 kW turbine generator sets, nano-level working fluids, extract eDNA from seawater, and study how to improve high-value seafood production capacity [7].

Laws and regulations on ocean thermal energy conversion in Malaysia and around the world

Countries around the world have drafted related bills for regulating ocean thermal energy conversion. The United States has given the National Oceanic and Atmospheric Administration (NOAA) the legal basis for ocean energy management through legislation. The NOAA of the United States has the authority to authorize ocean thermal energy conversion power plants. The US House of Representatives passed the "Ocean Thermal Energy Conversion Act" in 1980 to regulate the location, construction, and operation of ocean thermal energy conversion power plants on the coast of the United States and provide a certain degree of financial assistance to promote ocean thermal energy conversion. Another legal bill is the "Ocean Thermal Energy Conversion Research, Development, and Demonstration Act" signed by President Carter of the United States.

Currently, in the Malaysian legal system, the Constitution of Malaysia clearly stipulates that all energy-related affairs are under federal jurisdiction rather than local jurisdiction. Therefore, the Malaysian Parliament has the right to formulate national energy-related laws in Malaysia. Malaysia's "Renewable Energy Act 2011" lists several types of renewable energy; ocean thermal energy conversion is not included. However, ocean thermal energy conversion can be broadly summarized as thermal power generation and can be regulated by this Renewable Energy Act [8].

Malaysia declared 200 nautical miles of exclusive economic waters and formulated several bills such as the Exclusive Economic Zone Act and the Continental Shelf Act, which are expected to establish the legal basis for the exploration, development, management, and conservation of marine resources in Malaysia, especially the development of the Nansha Trough and the South China Sea which are key areas for Malaysia' development of ocean thermal energy conversion. These bills may apply to a certain extent in ocean thermal energy conversion in Malaysia.

The future of ocean thermal energy conversion in Malaysia

UTM-OTEC, a Malaysian research institution, and the Institute of Ocean Energy of Saga University, a Japanese research institution, will collaborate on ocean thermal energy conversion, turbine generator sets, nano-level working fluids, extracting eDNA from seawater, and methods to increase high-value seafood production capacity as well as research on other related topics. It is believed that Malaysia will be able to put the large amounts of low-temperature deep seawater within its oceans, an indispensable feature of ocean thermal energy conversion, to more diversified uses, such as 1. Raw water utilization: Deep seawater, which has the characteristics of being low temperature, clean, and rich in minerals, can be used for farming and fishery-related industries such as cold-water fish breeding, seed cultivation, seedling propagation, and temperature-controlled agriculture; 2. Water utilization: Deep seawater can also be divided into raw water, freshwater, mineral water, etc., which can be used for packaging drinking water, beverages, alcohol, food, seawater therapy, medical treatment, cosmetics, and other related industries; 3. Secondary energy utilization: Deep seawater can be utilized to promote the growth of algae, which can, in turn, be used to produce biomass energy; 4. Air conditioning utilization: After power generation, deep seawater retains its low-temperature characteristics and can be used in buildings or factories that require cooling or agriculture that requires temperature control [9].

Conclusion

Taiwan has the potential for the development of ocean thermal energy conversion in the eastern seas and the South China Sea. The electricity generated on the east coast of Taiwan can be directly incorporated into the grid for use, while energy extracted from the South China Sea can be transported back to Taiwan using hydrogen energy. Malaysia is actively investing in ocean energy development. It is believed that Taiwan, with an even greater abundance of natural conditions, can discover more possibilities if resources can be invested in the ocean thermal energy conversion industry.

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The Maritime Law Enforcement Agencies and Maritime Laws and Regulations in Malaysian

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Keywords: Malaysia, Maritime Enforcement Agency, United Nations Convention on the Law of the Sea, Maritime laws and regulations

Malaysia attaches great importance to marine resources, it signed the 1982 "United Nations Convention on the Law of the Sea" in 1994 and was approved and entered into force by domestic procedures in 1996. Malaysia has been actively strengthening marine management for a long time. Therefore, by understanding Malaysia's maritime law enforcement agencies and related law enforcement actions can provide Taiwan reference, and help to improve maritime policy.

Introduction

Malaysia's coastline is about 4,089 kilometers long and has an exclusive economic zone of 418,000 square kilometers. Fishery resources are the main source of animal protein and have played an important role for decades. According to 2017 statistics, the country's total fishery production was 1.7 million tons, nearly 1.5 million tons came from marine fishing [1]. It can be seen that the ocean is important to Malaysia, and how to protect marine resources has also become an important issue.

Malaysia established the "Malaysian Maritime Enforcement Agency" (MMEA) or also known as the "Malaysia Coast Guard", in 2005, as the main maritime law enforcement agency, and is also responsible for maritime law enforcement and rescue missions. In addition, the government has also successively formulated relevant maritime laws and regulations to defend maritime rights.

Main Maritime Law Enforcement Agencies of Malaysia- MMEA

MMEA was formed as a result of a study undertaken by the Malaysian government in April 1999. The study revealed that enforcement was not effective because too many agencies were involved that resulted in overlapping functions, overlapping jurisdiction, and uneconomical use of resources [2].

In the past, the "Marine Police Force" was originally under Royal Malaysian Police, the Ministry of Home Affairs which was responsible for the maritime law enforcement. However, in order to save national costs and consider maritime specialization, the National Security Council held a national conference on the feasibility of establishing a special maritime law enforcement agency in May 2004, the meeting resolved to prepare a special agency for maritime law enforcement. Subsequently, the "Malaysian Maritime Enforcement Agency Act" was promulgated on July 1, 2004 and became effective on February 15, 2005. At the same time, the part "Marine Police Force" was merged into the new agency MMEA and started operation. MMEA is directly under the jurisdiction of the Prime Minister of Malaysia at first. In 2018, MMEA was merged into the Ministry of Home Affairs. The current maritime-related execution energy includes MMEA, Navy, Royal Malaysian Customs Department and Marine Police Force (Figure 1). It is the maritime law enforcement agency in peacetime, but it needs to support the air force and navy in wartime.

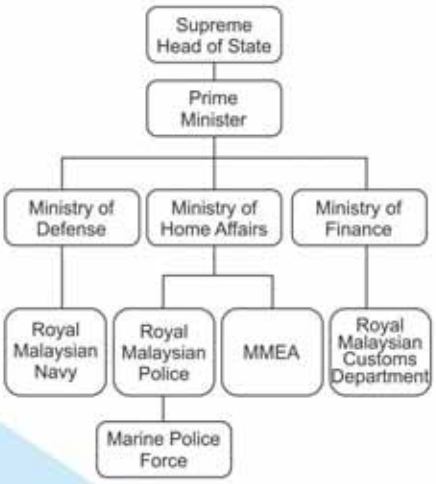

Figure1 / Maritime-related execution energy of Malaysia
Image by Huan-Sheng Tseng

The vision of MMEA is to "be among the best maritime law enforcement agencies in the world", and its goal is to "to enforce laws, saving lives and properties at sea in order to ensure the safety and security of Malaysian Maritime Zone (MMZ)" [3]. The so-called MMZ refers to the waters, territorial sea, continental shelf, exclusive economic zones and fisheries of Malaysia and includes the airspace over the Zone (https://telsat.mmea.gov.my/eng/index.php/en/citizens-and-public/36-malaysian-maritime-zone).

The tasks related to MMEA are as follows [4]:

I. To enforce law and order under any federal law;
II. To perform maritime search and rescue;
III. To prevent any offences in the Malaysian Maritime Zone;
IV. To lend assistance in any criminal matters on a request by a foreign country as provided under the Mutual Assistance in Criminal Matters Act 2002 (Act 621);
V. To carry out coastal and air surveillance;
VI. To prepare a platform for service and support for relevant agencies;
VII. To establish and manage maritime institutions for training;
VIII. Perform any obligation to ensure maritime safety and security or do all matters incidental to its;
IX. To control and prevent of ocean pollution;
X. Prevent piracy and illicit trafficking of narcotic drugs on the high seas;
XI. Placed under the control of the Malaysian Armed Forces during a period of special crisis emergency or war.

MMEA is commanded by navy generals, and other military personnel are also assigned by the Royal Malaysian Navy. MMEA has also set up the "Special Tactical of Action And Rescue" (STAR), whose mission is to be responsible for search and rescue at sea, and carry out anti-terrorist operations in domestic rivers and territorial waters. MMEA divides the coastline to the exclusive economic zone into 5 major areas: the north, south, east, Sabah and Sarawak, and then subdivided into 18 Responsible Areas (Figure 2). MMEA takes the territorial waters and exclusive economic waters as the scope of law enforcement, and protect the buildings and resources of marine scientific research in the territorial waters.

When MMEA patrol ships perform maritime search and rescue missions, the Royal Navy, police, port authority, customs, fishery agency, fire rescue and other departments will also support the needs of MMEA patrol ships. In terms of air energy, MMEA also has fixed-wing aircraft and helicopters. The army, navy and air forces, the Royal Police, civil aviation agencies and fire rescue agencies can also support aviation missions.

Figure 2/ MMEA Responsible Area
Source/ MMEA
https://telsat.mmea.gov.my/eng/index.php/en/citizens-and-public/10-mmea-responsible-area

In order to enhance the law enforcement energy in sea areas, MMEA purchased 6 more frigates equipped with UAV equipment in 2015 [5]. In addition, the Japanese government promised Malaysia in September 2016 to provide MMEA patrol boats, which will be delivered in the first half of 2017 to counter China's military activities in Malaysian waters [6][7]. MMEA also purchased helicopters in February 2020 to strengthen the protection of Malaysian waters [8].

MMEA also often conducts cooperative exercises with neighboring countries. MMEA and the Royal Thai Navy will hold two maritime exercises each year. The focus of the exercise is the water boundary between Malaysia and Thailand. The main purpose of the exercise is to prevent piracy and maritime robbery, and develop a good relationship and cooperation between the two countries. MMEA and the Philippine Coast Guard will also conduct annual exercises, focusing on the maritime border between the two countries. The training area between MMEA and the Indonesian government from Marine and Fishery Department focuses on the Strait of Malacca to prevent arms and drug smuggling [9].

Maritime laws and regulations in Malaysia

Malaysia ratified the "United Nations Convention on the Law of the Sea" (hereinafter referred to as the "Convention") on October 14, 1996 and entered into force on November 14, 1996. Since then, it has successively formulated or revised relevant laws in accordance with the "Convention". Malaysia advocates and delimits sea areas including internal waters, territorial waters, exclusive economic zones, continental shelf, and fishery waters, as well as the scope of MMEA law enforcement.

I. Internal water and territorial sea

Malaysia enacted the "Baselines of Maritime Zones Act" in 2006 to determine the geographic coordinates of the base points. The line connecting the base points is the baseline, and the sea area on the land-facing side of the baseline is the internal water [10]. According to "Territorial Sea Act 2012", the width of Malaysian territorial sea is 12 miles outside the baseline, however, part of the territorial waters adjacent to Sabah and Sarawak do not exceed 3 nautical miles [11].

II. Exclusive Economic Zones

Malaysia declared Exclusive Economic Zones (200 nautical miles) as early as 1980, and enjoys the jurisdiction to explore, develop, conserve and manage the natural resources of the seabed, subsoil and upper waters, and to protect the marine environment. Malaysia enacted the "Exclusive Economic Zone Act No. 311" in 1984 to regulate fisheries, protection and preservation of the marine environment, marine scientific research, artificial islands and reefs, facilities and structures, submarine cables and pipelines. The law also regulates the prevention of marine pollution. According to Article 10 of the law, if any oil, oily mixture or pollutant is discharged from any ship, land source, facility, device, or aircraft, discharged from the air or by dumping Economic sea areas, etc., are all illegal and will be fined up to 1 million MYR (about NT$5.8 million) [12].

III. Continental shelf

As early as 1966, Malaysia adopted the "Continental Shelf Act" to claim the rights of continental shelf to develop offshore oil and natural gas resources [13]. The Act was amended in 2009 in line with the Convention, and hopes to expand the sovereign right over the outer edge of the continental margin. Because coastal countries are allowed to exercise the right to the continental reef layer up to 350 miles from the baseline or 100 miles below the 2,500-meter depth counter [14].

IV. Malaysian fishery waters

Malaysia also enacted the "Fisheries Law" in 1985 to ensure the conservation, management and development of oceans and estuaries in fishery waters. In addition, relevant agencies can establish marine parks and marine reservation to strengthen the protection of aquatic animals and plants, promote scientific research, and regulate recreational activities and other activities in certain areas to avoid irreversible damage to the environment. When crimes occur, authorized officials should take enforcement measures, such as seizing ships, catch, equipment, or arrests.

The targets of the "Fisheries Law" include nationals and foreigners. If the ship is a foreign fishing vessel or the person is a foreign national who violates the "Fisheries Law", it is considered as a crime. The shipowner or captain shall be fined no more than 1 million MYR per person , and a fine of NT$100,000 (about NT$580,000) for each crew member, which is a heavier penalty [15].

Conclusion

MMEA's law enforcement energy includes patrol ships and aircraft, which greatly enhances the effectiveness of sea and air law enforcement. In addition, because Malaysia is located in the Strait of Malacca, there is still a threat of piracy. Therefore, MMEA regularly conducts law enforcement exercises with neighboring countries every year. The purpose is to deter the occurrence of violations and promote opportunities for cooperation with law enforcement agencies of other countries.

Malaysia is rich in oil resources and has declared its claim to the sovereign right of the continental reef long ago. In addition, fisheries and environmental resources are also extremely important to Malaysia, so management measures are implemented by relevant laws. If a foreign fishing vessel violates the "Fisheries Law" in Malaysian waters, the maximum penalty can be 1 million MYR to deter foreign vessels from illegal fishing activities in the waters under their jurisdiction and protect fishery resources. If oil pollution occurs in the exclusive economic zone of Malaysia, it is a violation of the "Exclusive Economic Seas Act No. 311". The maximum penalty can be 1 million MYR to ensure its marine environment.

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