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# PROPOSAL FOR A FLOATING OFFSHORE BASE FOR DISASTER PREVENTION AND MULTIPURPOSE USE

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**ABSTRACT:** Currently, various policies for resource protection, global warming countermeasures, surveys and research, and energy development are being implemented in the oceans. The United Nations Convention on the Law of the Sea has been established to protect resources, and each country has established EEZs to deal with this issue. Therefore, international monitoring of fishery resources is required to manage resources offshore. In marine development, it is important to integrate appropriate management of fishery resources with research and development in the aquaculture industry. Instead of fishing with inefficient small fishing boats, aquaculture can contribute to resource conservation and reduction of greenhouse gas emissions through integrated production from processing to shipping. Research and development include further technological development of the aquaculture industry and tsunami countermeasures. In addition, exploration of seafloor resources, ocean thermal energy conversion, and tidal power generation will be essential for future research and development. However, as indicated above, ocean-related research and development has become too fragmented and diversified. Therefore, we believe that there is a need for a place where various research results can be collected and further discussed in a cross-sectional manner. For this reason, this paper advocates the need for an international workshop venue at sea.

*Keywords: Floating base, Tsunami monitoring, Resource management, Marine research, Integrated research*

## 1. INTRODUCTION

Use of marine resources has been mainly catching of fish and shellfish as part of fisheries. However, in recent years, wind over the sea is being utilized worldwide. With a goal of reducing greenhouse gas emissions to counter climate change, use of seawater itself is being promoted. In addition, there is worldwide research and development on power generation using ocean current and seawater temperature differences, and there is an urgent establishment of technologies and profitability for rare metals in seawater and minerals on the seafloor. As such, there are many marine resources that are not dependent of fish and shellfish, and their development is anticipated.

However, technological development in the oceans using a country's exclusive economic zone has only intensified, and the struggle for leadership among countries continues.

The United Nations Convention on the Law of the Sea entered into force on November 16, 1994, and as of July 2020, 167 countries and the EU have signed the Convention. However, the Convention makes it an obligation to make every effort to promote fishing, research, development, and utilization outside of the exclusive economic zones, and the current situation is that overfishing and overexploitation have not yet been curbed. Unlike on land, the effects of overfishing and overexploitation in the ocean are expected to be far-reaching due to ocean currents. Marine organisms and minerals on the seafloor are limited and precious resources, and are the treasure of all people in the 21st century.

Therefore, this study proposes an Open Innovation Workshop Facility for public access and centralized use of the results of technological development and research in the ocean.

## 2. RESEARCH SIGNIFICANCE

Researchers are tasked with narrowing the scope of their research and delving deeply into it, but today's research is too fragmented. However, today's research is too fragmented. In an increasingly complex society, there is a lack of consideration and experimentation on how to utilize such narrow and deep findings.

This study seeks to synthesize and discuss the results of a wide range of marine research. To this end, we propose a workshop venue that repurposes disused oil drilling rigs. The establishment of an international methodology for ocean utilization is essential in order to link the various research findings in the ocean space to a sustainable future, and this paper plays a part in this endeavor.

## 3. BACKGROUND

### 3.1 Global Fisheries and Aquaculture Production

Global yield in fisheries has dramatically increased since 1990s. In 2000s, the yield continued to grow in China and other Asian countries. China, especially, accounted for 15% of the world's yield at about 14 million tons in 2010 to 2018. In terms of the aquaculture production, China and Indonesia showed most notable increase. China accounts for about 68 million tons while other Asian countries account for about 20 tons. The total accounts for over 70% of the world's yield (Fig. 1, 2).

### 3.2 Relationship Between Decreasing Yield and Decreasing Number of Fishery Workers in Japan

Around Japan, there are marine areas with high potential for fishing grounds, such as Northwest and Midwest Pacific Ocean. Furthermore, Japanese EEZ extends about 4.47 million km2, which is 12 times Japan's land area, which is the 6th widest in the world.

With such favorable fishing grounds, Japan has been operating diverse fishery work in open seas, offshore areas, and coastlines. However, the number of fishery workers in Japan was about 152,000 in 2018: 14,000 reduction in the last 20

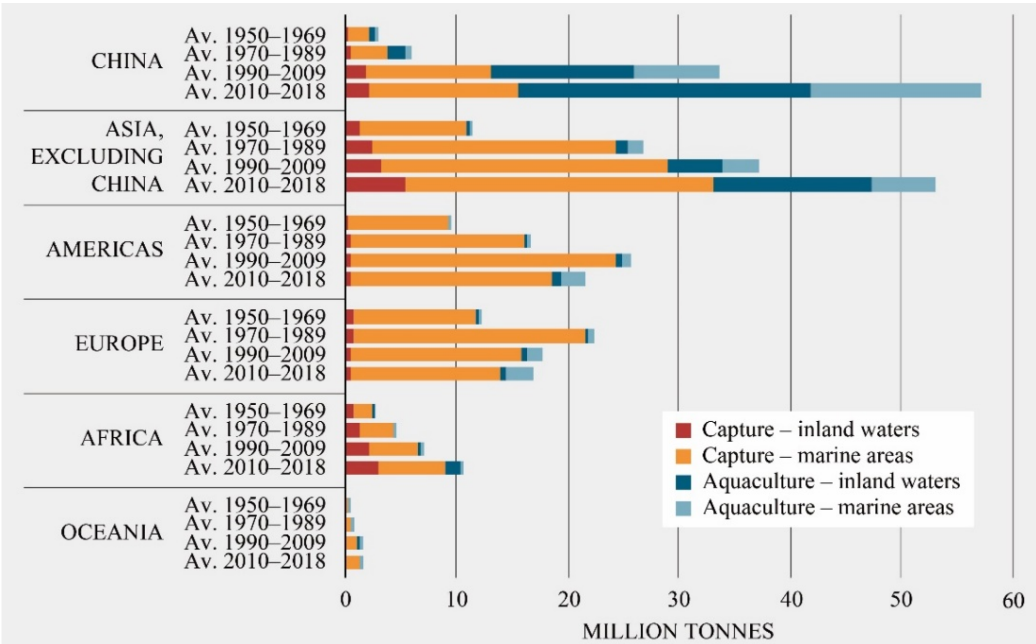


Fig. 1 Changes in the global yield and aquaculture production [1]

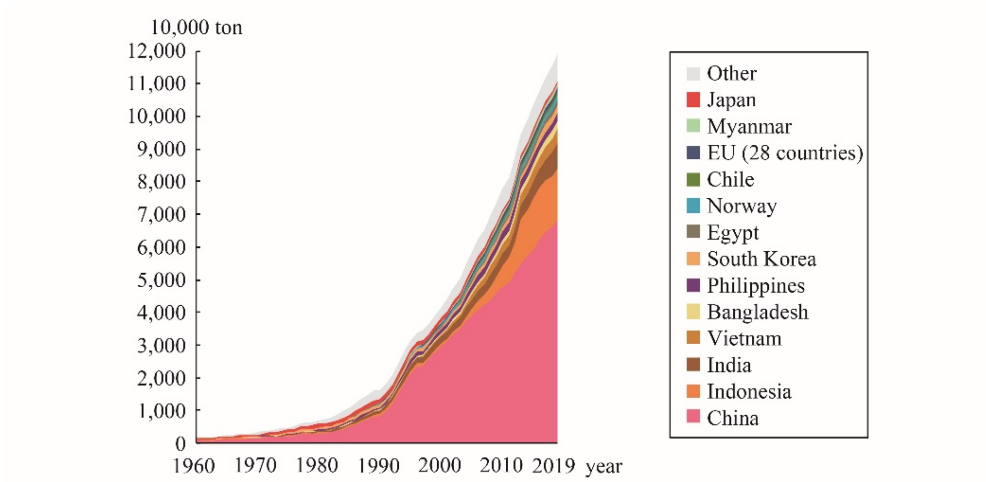


Fig. 2 Changes in the world aquaculture production by country [2]

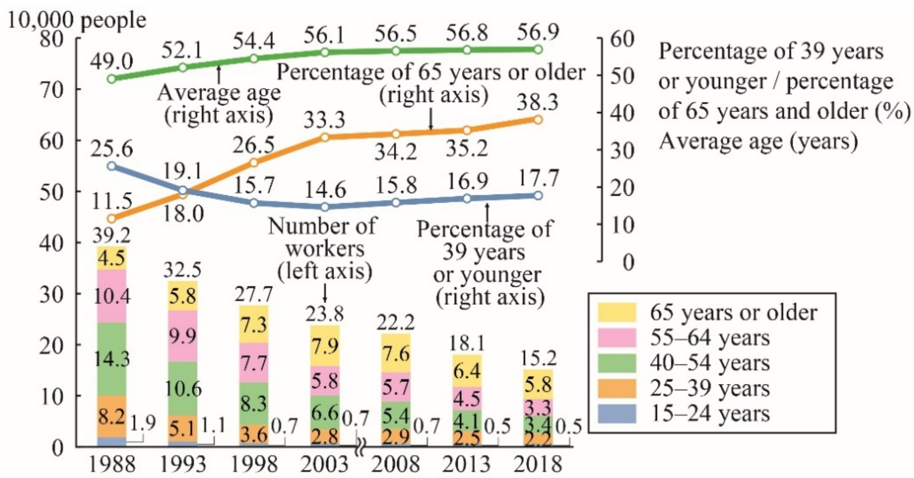


Fig. 3 Changes in the fishery workers [3]

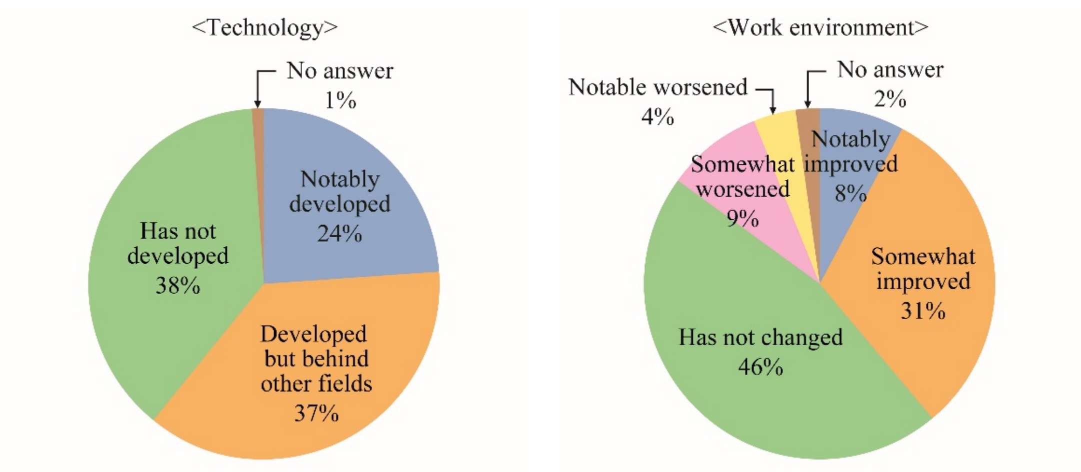


Fig. 4 Survey on attitudes/intentions toward food, agriculture and fisheries 2019-2020 [4]

years. Thus, the average age of fisher workers is high, 56.9 years, clearing showing aging (Fig. 3)

A possible cause of this is the low productivity of the fishing industry. When compared to other countries (2013 fishery census by Ministry of Agriculture, Forestry and Fisheries and 2014 fisheries employment survey)—production per fishing boat of 791.7 (ton/boat) for Iceland, 637.9 (ton/boat) for Norway, and 404.2 (ton/boat) for New Zealand—Japan's production is about 20 times lower at 31.2 (ton/boat). As production per a fishery worker, the difference is about 10 folds as well. As such, this is linked to a decrease in the number of fishery workers.

### 3.3 Relationship Between Employment of Fishery Workers and Consumption of Fish and Shellfish as Food in Japan

Changes in technologies and the work environment of the fisheries industry since 1990s show the changes in Japan over the last 30 years. Technologically, 75% say "not developed" or "development is behind other fields." In other words, fishery workers feel that technological development is unlikely. If we add "work environment in fisheries worsened, somewhat worsened, or has not changed," over 60% felt that there is no improvement (Fig. 4).

Changes in the consumption of fish and shellfish as food per person per year in each major country and region (Fig. 5) shows that Japan is the only country that shows a decrease in the entire graph. In other words, in the last 30 years, the consumption of fish and shellfish in Japan has decreased and work environment for fishery workers has not improved. Hence, fishery workers cannot feel hopeful in the industry.

### 3.4 Current Situation of the Fishing Industry and Distribution

One of the reasons the future of Japanese fishing industry is grim is the distribution style of fish and shellfish. It is part of Japanese culture to eat fish and shellfish raw, and the main style of distribution is to

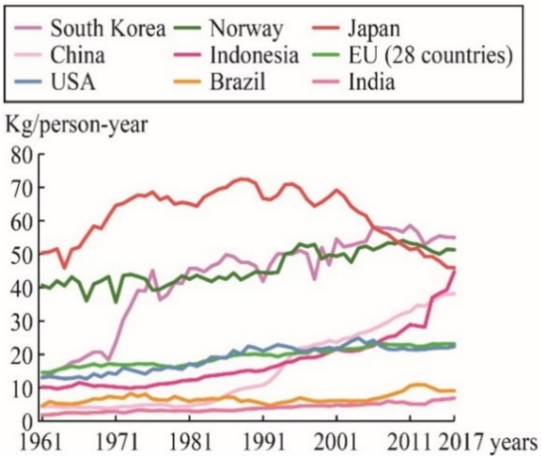


Fig. 5 Changes in the consumption of fish and shellfish per person per year in each major country and region [5]

keep the products raw. This is because in Japanese food culture, people consume fish and shellfish near the sea where such products are caught. However, today, the complex and diverse distribution structure suppresses profits for fishery workers, where products only arrive to consumers at a high price.

However, looking at the world, the countries in Figure 5 where seafood consumption is growing are Norway, South Korea, and China. Norway, in particular, has a population of 5.4 million, less than one-twentieth that of Japan, yet its value is steadily increasing. This is the result of a country-wide fisheries policy effort. Figure 6 shows the amount of investment in fisheries in OCED and Norway. Although Norway does not have the infrastructure in place, it invests enough in management control & surveillance to match the OCED average, and more notably in research & development, where it invests 1.8 times more than in the OECD. This is certainly a significant investment for the fishery. This is certainly reflected in the fish catches.

Figure 7 shows that Norway's seafood exports have increased rapidly since 2005; in 2018, Norway accounted for 3.113% of global fisheries production exports, and in terms of global fisheries and aquaculture exports, it has reached the point where it leads the world with 7.697%. What this means is that in addition to research and development in the aquaculture industry, it shows the importance of strengthening the management system and monitoring of its fishery resources. This means that it is possible to increase catches while protecting fishery resources. A major contribution to this is the Norwegian technology of sea aquaculture.

## 4. PLAN POLICY

As such, Japan has considered marine life, such as fish and shellfish, as resources for a long time, but it has become difficult to continue in the same manner. Under such a circumstance, in this Chapter, we propose the following five items as the plan policies. It means that it is time to stop considering the ocean as the biological resource only.

### 4.1 Proposal to Consider the Ocean as a Place of Complex Resources and Use Such Resources Sustainably

In this paper, we propose to consider diverse marine resources as comprehensive resources. We must build a sustainable system in a comprehensive manner.

As comprehensive marine resources, the energy potential of wind and current might be used.

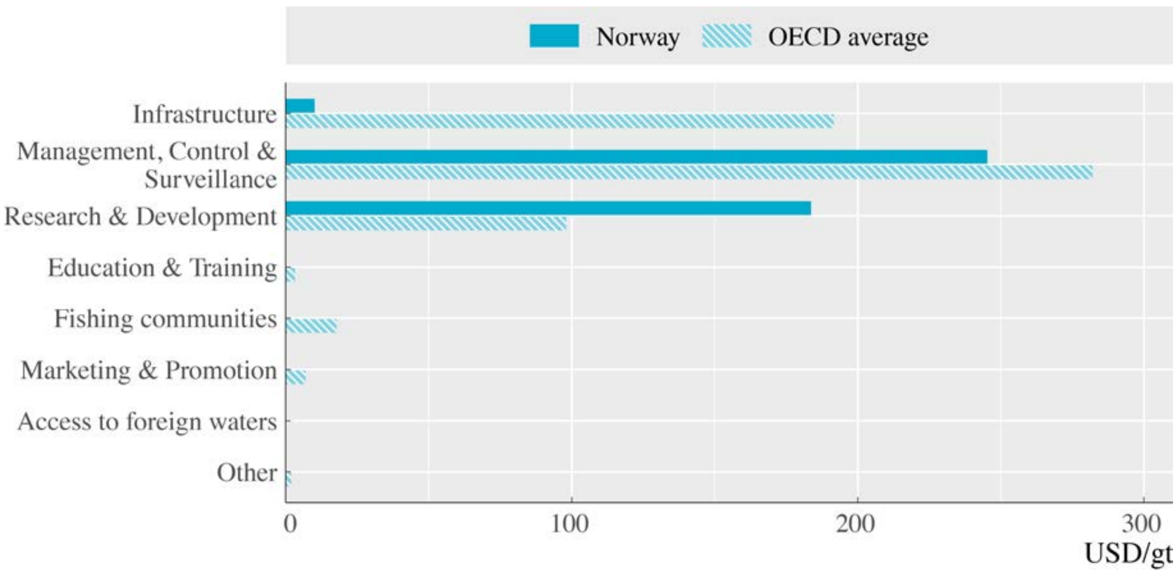


Fig. 6 Financing of services to the fisheries sector, 2018 [6]

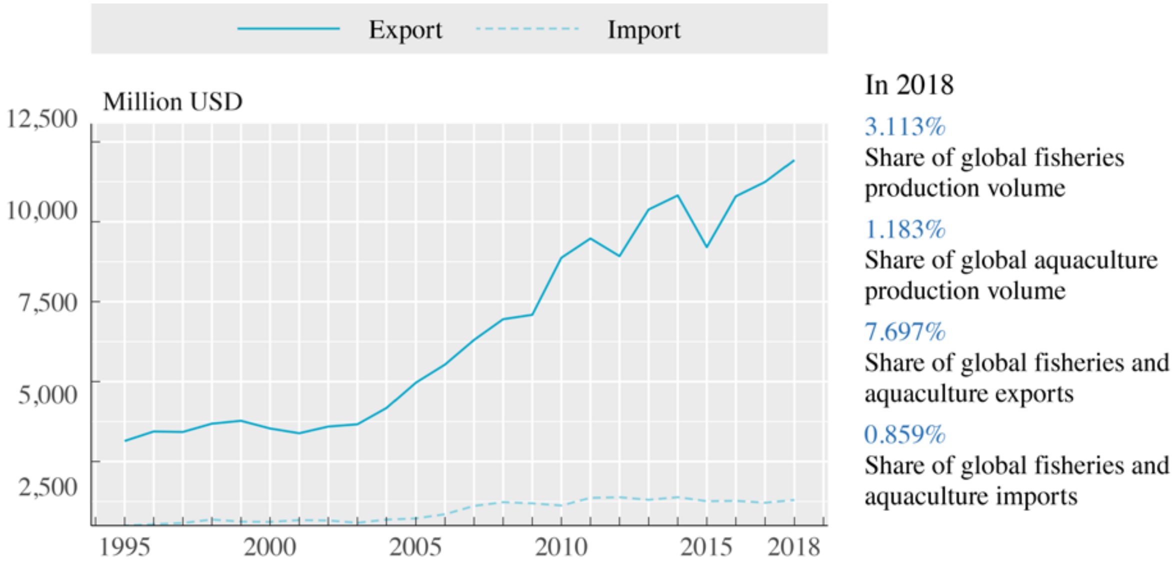


Fig. 7 Trade in fish and fish products [7]

Recently, wind power has been used worldwide. Furthermore, tidal and ocean current power generations are being studied, and Japan's Mitsui O.S.K. Lines, Ltd. is planning to start an operation of an "ocean thermal energy conversion (ocean thermal energy conversion is a renewable power that generates power through a dramatic change in the seawater temperature between the surface and depth)" power plant with a 1,000-kw output by around 2025.

### 4.2 Toward Sustainable Fishery Environment

We propose to change from the traditional fisheries that only caught fish and shellfish to fisheries that starts from production and ends with distribution. This is because wasteless use of fish and shellfish is needed in terms of resource protection. Thus, management based on Hazard Analysis and Critical Control Point (HACCP: A hygiene management in which food businesses understand the risk factors (hazards) such as contaminations and foreign objects and especially manage important processes to remove or minimize risk factors in the entire process from the procurement of raw materials to the shipment of products for securing the safety of products) as a highly hygienic system is needed for production, processing, and distribution. It aims to maintain the entire process as one, from sealed area for cargo handling, cooling, and freezing facilities. In addition, drones are used to shorten the duration of shipping process. In this manner, making the fisheries well managed, fisheries that were unstable due to weather becomes a routine task with stable income.

### 4.3 Centralized Management of Fishery Resources

In the past 20 years, Asian countries have expanded fishing greatly. When comparing the production per fishery worker, large purse-seine, a type of offshore fishery, is about 200 (ton/person), while large fixed-net, a type of coast fishery, is only about 34 (ton/person). Thus, fishery workers appear to be working offshores. To make fisheries a sustainable industry, marine resources must be sustainably maximized, while evaluating resources based on science and appropriately managing the yield based on the evaluation.

In waters around Japan, foreign boats operate in the EEZ while many foreign boats operate in the waters next to the EEZ based on bilateral agreements. A floating resource-management base for sustainable fishing industry that handles resource management and illegal operation on the sea is necessary.

### 4.4 Proposal for the Fishing Industry and Handling of Environmental Burden

Many ships today were built when there was no environmental measure and have poor fuel efficiency.

International Maritime Organization (IMO) adopted "greenhouse gas reduction strategy" in April 2018. This strategy sets the following numerical goals with the 2008 as the reference: (1) improve the fuel efficiency (greenhouse gas emission per amount transported) of the entire international marine transport by at least 40% by 2030, (2) reduce the total emission of greenhouse gases from international transport by at least 50%

by 2050, and (3) achieve greenhouse gas emission of zero as early as possible in the present century.

However, demand for marine transport by ships is expected to increase further, where a challenge is how to reduce the environmental burden from ships. Meanwhile, about half (45%) of fishing boats of 5 to less than 9 tons is at least 30 years old as of 2018 (Fig. 8), associated with high environmental burden. In the future, new ships will be built as marine transport increases; thus, the use of small ships should be reduced and transitioned to large ships with a less environmental burden.

### 4.5 Installation of a Research Base with a New Use on the Sea

While considering the diverse marine resources as comprehensive resources and building a sustainable system, functions and facilities to research and develop such acquisitions are necessary. In the past marine research, surveys were conducted in the field, but experiments were conducted and papers were prepared on land. When researchers and entrepreneurs are present in the field, it will promote open innovation to develop marine resources.

For marine development, a facility that functions as a comprehensive center is desired. Some survey ships have such functions, but considering the livability, floating base would be effective.

## 5. BASIC PROPOSAL PLAN

### 5.1 Advantage of Integrating Functions (Environment, Safety, Disaster Prevention, and Securing of Resources)

Going ahead, a place for open innovation by various countries and organizations is essential. To that end, not only diverse researchers and developers but sometimes tourists should also become involved in discussions. Livability of the facility must be improved so that a wide variety of people can visit and stay at the facility.

### 5.2 Role as a Comprehensive Base That Connects the Northwest Pacific and Midwest Pacific Oceans

To manage and utilize the diverse resources of massive oceans, it is important to cooperate with the fishing industry, which has been regarded as the core industry thus far. Functions should be integrated so that oceans are widely researched and research results are applied to the industry. To that end, we set the Ogasawara Islands and surrounding areas as the planned site to serve as the relay point connecting the Northwest Pacific and Midwest Pacific Oceans, so that people with various purposes can easily access the base (Fig. 9).

The fishing grounds around the Ogasawara Islands are scattered and distributed around the Mukojima Islands, Chichijima Islands, Hahajima Islands, and Io Islands. These areas are blessed with rich fishing grounds, but there is inadequate infrastructure for the fishery industry. Furthermore, these areas are suited for marine renewable energy through ocean thermal energy conversion where the temperature difference between surface water and deep water remains at least 20°C. These areas also have a high reserve potential for ocean floor minerals and natural gas (Fig. 10).

To improve access to these areas, the access by air must be secured. To that end, runways for planes will be secured by connecting floating structures. In this manner, we aim to further expand the flow of people, items, energy, and information.

### 5.3 Reusing Used Semisubmersible Rigs

Since the 2000s, the number of oil drilling rigs

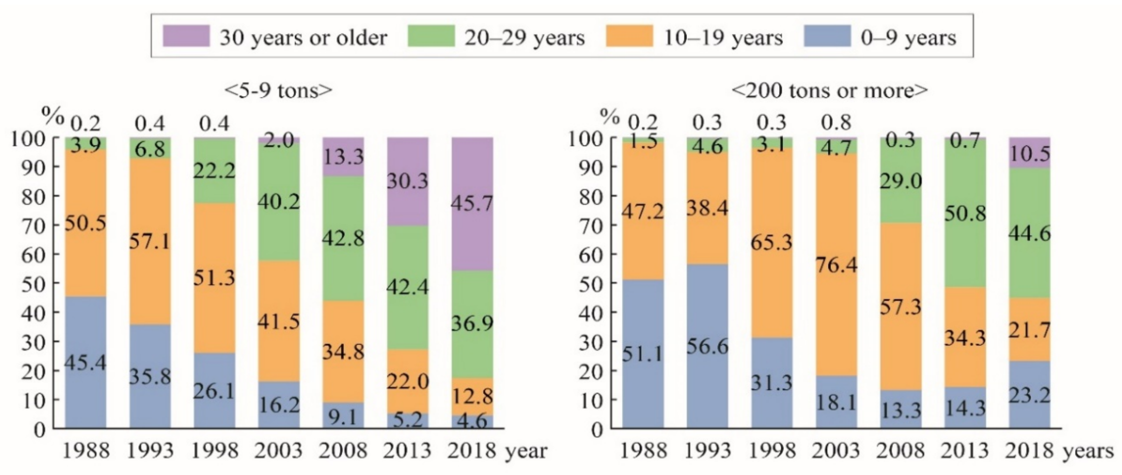


Fig. 8 Percentage of ships by age [8]

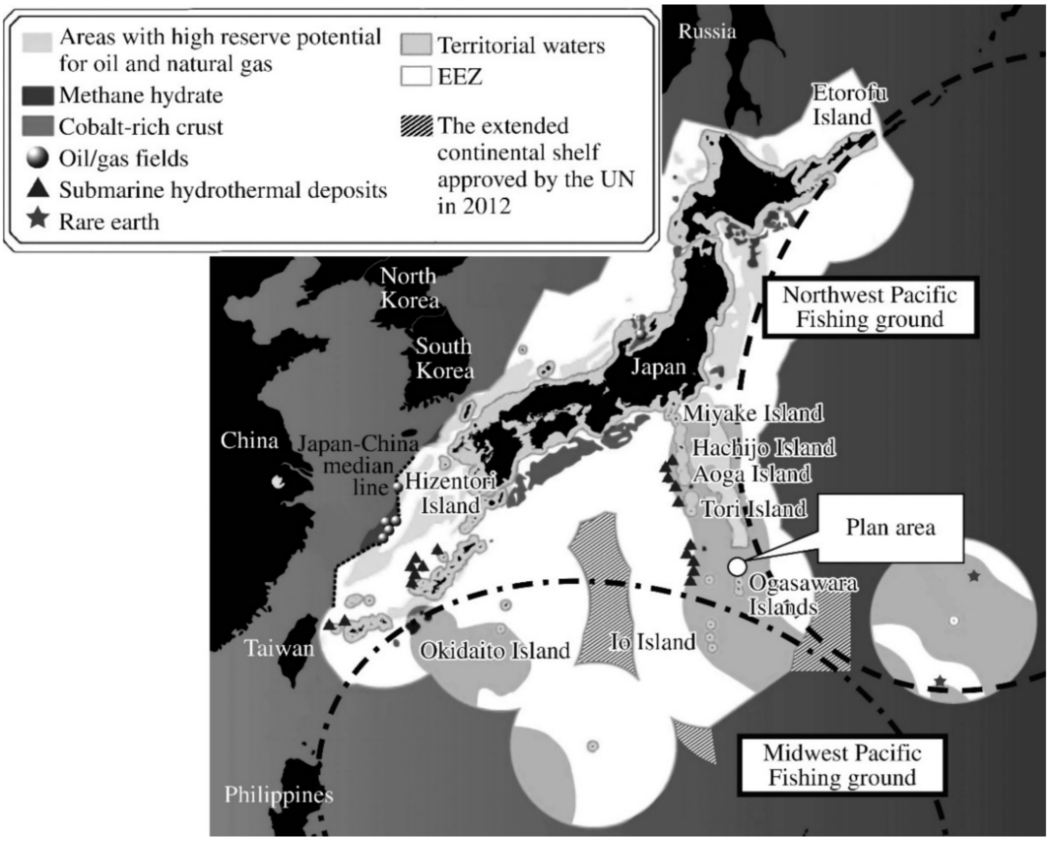


Fig. 9 Relationship between planned area, Japanese EEZ, and fishing grounds [9]

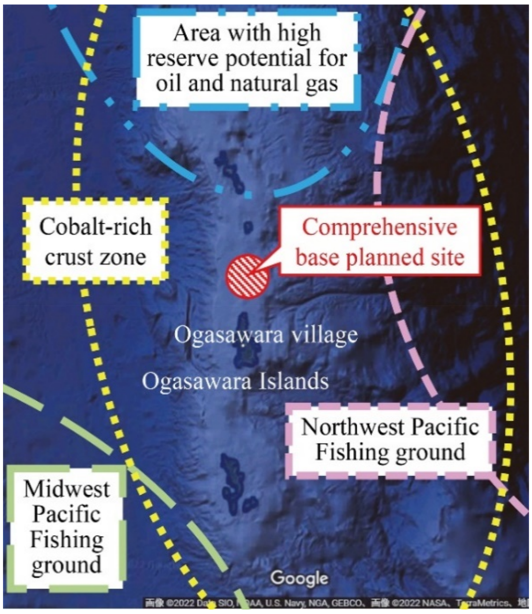


Fig. 10 Locations of ocean floor resources and comprehensive base

has dramatically increased with the rise in crude oil prices; however, in the 2010s, older types of drilling rigs have been replaced due to performance. We propose reusing such used drilling rigs. This would be advantageous in terms of the initial investment,

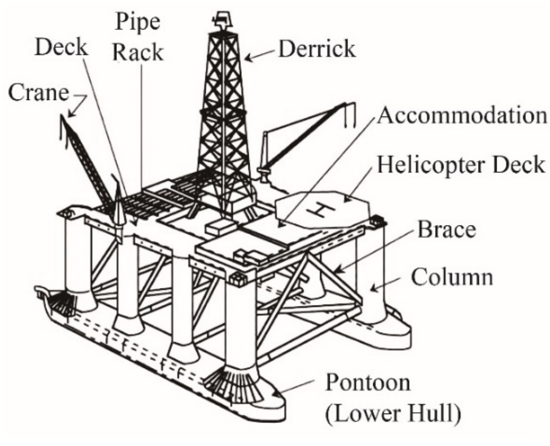


Fig. 11 Semisubmersible drilling rig [10]

leading to environmental considerations as well.

The total number of jackup rigs, semisubmersible rigs, and drilling ships in operation in the world was 822 as of March 2020. Their operation rate has decreased in recent years due to the spread of COVID-19 and plunging oil prices (Fig. 11). Among those, there are about 163 semisubmersible rigs [11].

The pontoon structure of semisubmersible rigs is below the draft, which makes such rigs less susceptible to waves compared with other ships, providing structural stability. In particular, those built in the 1990s and later can accommodate water depths of 1,000 m or more, allowing for a comfortable living environment well above the surface of the water that is not impacted by waves. A good living environment is essential for attracting various people to the facility [12]. When this rig is installed in this area, the problem is how to secure the rig to the seabed, since the oil drilling rig will not be driven into the seabed. The water depth around Chichijima is about 200 m, so the mooring line and DEA "drag embedment anchor" method presented in [13] can be used. In addition, since this project involves the installation of aquaculture facilities and nets on the sea surface, they need to be installed in such a way that they drift to some extent on the surface of the sea [14,15].

### 5.4 Response to Typhoons, Earthquakes, and Other Disasters (Eruption of Submarine Volcanoes)

The planned area is close to the S-net (Seafloor observation network for earthquakes and tsunamis along the Japan Trench) and DONET (Dense Oceanfloor Network system for Earthquakes and Tsunamis), Japan’s submarine earthquake survey systems. These are inline seafloor observation devices to monitor earthquakes and tsunamis in the Pacific Ocean. By working with such observation devices, the facility plays a role as a relay base to share information on submarine earthquakes, crustal movements, and water level changes to prevent disasters.

### 5.5 Functions Introduced and Scale Calculation of the Facility

In addition to its main functions as a fishery base, this facility will be equipped with a marine resource management research wing, aquaculture research wing, and marine energy resource research wing as research functions. In addition, there will be an added open innovation workshops facility function that connects these functions (Fig. 12, Table 1).

## 6. CONCLUSIONS

1. When considering the issue of climate change as a contemporary challenge, as its impact is wide-ranging, it is necessary for various research results to be cross-sectionally analyzed and examined. By bringing together researchers from various fields and holding comprehensive discussions, the environmental impact can be understood from various perspectives.
2. It should be recognized that ocean space is a common resource for the entire world. In other words, it is important to move away from an industry that relies solely on large-scale fishing to date, and to do so under appropriate resource management. Furthermore, as soon as possible, the industry should be converted to one based on scientifically verified aquaculture methods.
3. By opening a research venue and providing a place for more comprehensive discussions, joint research and development with various countries will become possible. This, in turn,

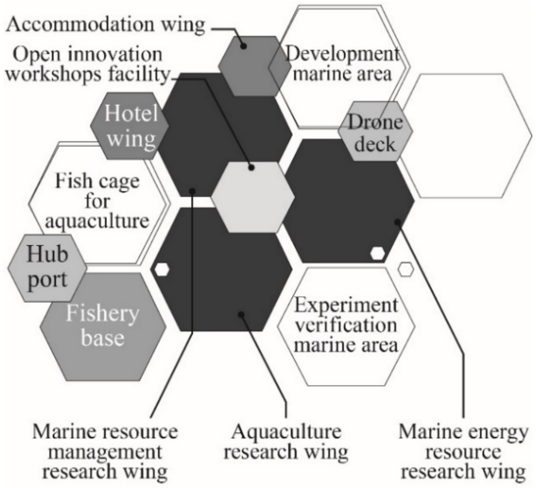


Fig. 12 Plan for the arrangement of introduced functions.

Table 1 Scale calculation table

| | |
|---|---|
| Fishery base functions | (11,500) |
| Fishery landing area | 3,000 |
| Fishery processing area | 5,000 |
| Wholesale area | 2,000 |
| Shipping area | 1,500 |
| Research functions | (29,000) |
| Marine resource management research wing | 5,000 |
| Aquaculture research wing | 5,000 |
| Marine energy resource research wing | 5,000 |
| Accommodation wing | 10,000 |
| Hub port | 3,000 |
| Drone deck | 1,000 |
| Interaction functions | (6,500) |
| Open innovation workshops facility | 2,000 |
| Conference room (s) | 2,500 |
| Restaurant wing | 2,000 |
| Tourism hotel functions | (18,000) |
| Hotel wing | 15,000 |
| Spa and relaxation wing | 3,000 |
| Total area ($m^2$) | 65,000 |

will lead to the centralized protection of marine resources.

4. By reutilizing used semisubmersible rigs, the initial cost and disposal of materials can be reduced. This will also reduce greenhouse gas emissions during the construction of new rigs, improving environmental issues.
5. By living in a comfortable environment directly connected to marine research areas for a long period of time, research will be further deepened. In addition, we will create an open innovation workshops facility at the center where researchers from unfamiliar fields and other people can interact with each other. Such interaction with tourists and fishery workers might lead to new ideas.
6. In the future, a network will be created by building many offshore facilities similar to this one. In addition to its role as a fishery evacuation base, it will be possible for it to serve as a disaster response base for tsunamis. The establishment of an international methodology for ocean utilization is essential in order to link the various research findings in the ocean space to a sustainable future, and this paper plays a part in this endeavor.

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