

Analysis of the Construction Progress of Haiyang Fuhan National Marine Ranching Demonstration Area

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Marine ranching is gather artificially released economic marine organisms, like grazing sheep and cows on land, to carry out planned mariculture for marine resources such as fishes, shrimps, shellfishes and algas based on large-scale fishery facilities, systematic management system, and marine ecological environment. Shandong Fushun Marine Science and Technology Co. Ltd. construct national-level marine ranching demonstration area in the external waters of Pipakou. This company integrates key technologies, including basic research and development, standardized production management, normalized operation and maintenance, demonstration and promotion, and so on, to build a centralized and large-scale marine ranching, which is beneficial to the ecological improvement, social stability and economic development of the surrounding areas. This article analyzes the status and effects of marine ranching construction, aiming to provide references for maintaining ecosystem health of the Yellow Sea.

I. Introduction of marine ranching construction project

1.1 Source of the project

Haiyang Fuhan National Marine Ranching Demonstration Area, and construction area is in the external waters of Pipakou, eastern part of Haiyang city. The construction organization is Shandong Fushun Marine Science and Technology Co., Ltd..

1.2 Schedule

This project will be implemented in 2018 with an implementation period of 1 year (Table 1). Environmental factors such as wind and waves in the ocean have certain

influence on **marine ranching construction**. The on-site working time should be fully utilized during the construction, and the construction procedures should be simplified as far as possible when the construction plan is determined. Advanced technologies and construction techniques should be fully integrated and used during the construction. Arrange the flow construction of each process around the key lines of the construction plan to ensure the smooth flow of key paths and project completion. In addition to implement the safety technical regulations for various marine construction projects according to the **routine**, the warning signs will be set in the construction site, and the duty trawler will be equipped on site as needed.

Table 1. Project Schedule

Time	Project schedule
1st month to 2nd month	Completion of project implementation program
3rd month to 4th month	Complete project bidding and sign contract
5th month to 10th month	Complete the fabrication and deployment of structural reefs
9th month to 11th month	Complete the construction of marine ranching observation network
12th month	Project summary, preparation of project acceptance report

1.3 Content and scale of construction

We plan to construct 7.8408 hectares of artificial reef area in the unbuilt region with an area of 163.3900 hectares in Fuhan National Marine Ranching Demonstration Area, Haiyang city, Shandong province. Specific content and scale of construction are as follows:

- (1) 1800 square steel-integrated monolithic reefs ($3 \times 3 \times 3\text{m}$) are placed;
- (2) Establish one set of marine ranching observation network system.

2. Construction content of marine ranching

2.1 Data source

Shandong Marine Science and Technology Co., Ltd.

2.2 Construction functions and objectives

Project area locates in the external waters of Pipakou, Haiyang city. This area is a natural feeding, spawning, and hatching ground for fishes in the Yellow Sea. This project is of great significance for the restoration of marine ecosystem, protection of marine resources, optimization of marine ecosystem structure, and participation in marine carbon cycling, improvement of carbon sink ability, and prevention of eutrophication. It can also lead to the development of commercial fisheries and other related industries, and form a multi-functional, ecological and stereoscopic marine ranching, thus realize the multi-trophic comprehensive development of marine ecosystem.

This project aims at building commercial marine ranching, which mainly including species such as *Sebastes schlegelii*, *Acanthopagrus schlegelii*, *Hexagrammos otakii*. In accordance with the construction plan of "reef, fish, vessel, shore, and service", marine ranching focus on the development of whole industry chain, and realize the transformation and upgrading of fishery industry. It improves the quality and efficiency of seafood, and promote the development of related industries such as aquaculture, nursery, processing, circulation, sale, tourism.

2.3 Construction plan

Square steel mixed integral component are selected to design appropriate shapes and heights of reef based on the actual situation of project area, local biological resources, and sea depth. The layout of unit reefs can be arranged regularly or irregularly according to the reef material. Reef group and reef belt should be arranged downstream. Taking full advantage of the local resources, reefs are made up of square steel mixed integral components in this project.

2.4 Technical scheme

The project department has one project manager, one technical director, one material staff, one survey engineer, one finance supervisor, one security officer and two shipping officers. Technical director is responsible for the on-site construction, construction coordination, and resources allocation. Material staff is responsible for material supply,

contacting supply centers to ensure regular supply of materials, and coordinating materials transportation on land and at sea, thus ensure the materials supply for production. Security officer is responsible for daily safety inspections on land and at sea.

2.4.1 Precast concrete components

Reef manufacture method is factory prefabrication or on-site prefabrication, and the manufacture process including steel banding, form template, pour concrete, maintenance, and remove template.

The reef formation is prefabricated strictly in accordance with the design criterion. The company selects experienced technical backbones and workers to form a special construction team and to implement the casting of reinforced concrete prefabricated reefs. Material staff strictly control the quality of steel, cement labels, and sand specifications during the construction process. In order to meet the requirements of the molding and strength, professional staffs are allocated to carry out the entire process of quality inspection and tracking, including customizing, cleaning and reinforcing of the mold, bending, welding and binding of the steel bars, stirring and maintenance of the concrete.

The concrete pouring molds are customized by professional mold making company according to design requirements. Check whether the product is qualified before using the selected steel bar. If the cases of brittle fracture and abnormal welding performance occurred during processing, this process should be stopped and the chemical composition will be tested. Surface derusting will be carried out before place the steel. Size and shape should be correct and no cracks at the bending point when bending and forming the steel bar. Joint welding and binding should comply with the national regulations and requirements. Before concreting, it is necessary to clean the dirt, junk, sawdust and water in the mat and template, repair the gaps in the template, and strengthen the template support to prevent mortar leakage. The concrete should reserve enough. Concreting must be carried out continuously. If it must be intermittent, the interval time should be as short as possible, and the second layer concrete should be

poured before the concrete of first layer is setting. When concreting, it is necessary to observe if there are any movement, deformation, or blockage occurred in the template, steel bars, or reserved holes. Problems identified should be solved immediately, and it should be corrected before the setting of concrete.

2.4.2 Transportation and processing on land

According to the actual conditions such as distance, traffic, and site between prefabricated site and loading dock, transport carts, cranes and forklifts are equipped for loading and transporting of prefabricated reefs from the reef prefabricated sites to the dock. All the machines are operated by specially-assigned person to ensure the safe operation of equipment and the completion of project.

Someone is put in charge of loading and unloading at the dock. According to the design requirements, artificial prefabricated reefs of different sizes are stacked after classification, and operating channels of loading machine are reserved to ensure the loading process goes smoothly.

2.4.3 Shipping and delivery

Marine transportation is operated by sailors with shipping qualifications. The sailors should strictly follow the relevant regulations for sea navigation. Offshore dumping construction is done by the operators of excavator on board and the crew. The crew is responsible for finding the target area and anchoring the sea surface mark. The lifting operator is responsible for the delivery.

3. Usage of funds

The total budget is estimated at 26.10 million yuan, of which, the direct cost of engineering construction is 24.4530 million yuan, including 23.1030 million yuan for reef construction and 1.35 million yuan for equipment purchase. Other expenses are 1.647 million yuan (Table 2).

Table 2 Budget of the project

Order	Items	Unit	Quantity	Unit-price (yuan)	Total amount (ten thousand yuan)
I	Artificial reef				2310.30
1	Square steel concrete reefs	individual	1800	12835	2310.30
II	Marine Ranching observation network system				135.00
1	CTD	set	1	70000	7.00
2	Underwater camera	set	1	100000	10.00
3	Dissolved oxygen sensor	set	1	60000	6.00
4	Chlorophyll sensor	set	1	40000	4.00
5	Seabed observation platform	set	1	500000	50.00
6	Microwave relay station	set	1	300000	30.00
7	Water control system	set	1	100000	10.00
8	Project integration and operation maintenance	item	1	180000	18.00
Direct cost of engineering construction					2445.30
III	Other expenses				164.70
1	Upfront expense				83.00
1.1	Argumentation fee for sea area use				30.00
1.2	Environmental impact assessment fee				30.00
1.3	Geological exploration fee				13.00
1.4	Seabed side scan fee				10.00
2	Construction unit management fee				36.70
3	Implementation plan preparation fee				15.00
4	Bidding agency fee				10.00
5	Project supervision and insurance premium				20.00
IV	Total project investment				2610.00

4. Expected benefits

The project of construction of Fuhan national marine ranching demonstration area is a high-level commonweal project. Much of the project represent the goal of marine ecological environment protection, fishery resource recovery, and sustainable development of fishery economy for government. This project aims at creating a group of national marine ranching demonstration areas with strong regional representation

and outstanding commonweal functions, giving full play to its typically demonstration and radiation lead role, promoting the construction and management level of marine ranching, actively conserving marine fishery resources, restoring marine ecological environment, promoting the development of aquaculture, commercial fisheries and other industries, facilitating quality improvement and efficiency increase, and structural readjustment of fisheries, thus achieve fisheries sustainable development and increase of fishermen's income. Therefore, the social and ecological benefits are considerably larger than the economic benefits for this project.

4.1. Economic benefits

Economic benefits are as follows: first, substantial increase in fishery resources through the restoration of marine biological resources. According to the investigation, the abundance of fishery resources increased about eight times in three years after the construction of artificial reefs, which exceeds our expectations. Second, developing commercial marine fishing industry, which promotes the development of recreational fisheries and continuously increases fishermen's income. Third, promoting the development of industries such as tourism, accommodation, transportation, manufacture and sale of fishing tackle, shipbuilding, and aquaculture. The operation mode adopted by marine ranching demonstration areas releases fishes, shrimps, crabs, shellfishes, sea cucumbers and other juvenile fish species, while also constructing artificial reefs, which has remarkable economic benefits.

4.2 Social benefits

After completion of the project, protection and propagation for resources, aquaculture structure adjustment, commercial fishery development, commercial fishing tourism and other measures can be organically combined through artificial reefs construction. Fishermen can transfer to other industries, and working in stock enhancement, scientific research, organization and management, rational development and protection in the artificial reef areas, which will promote the development of aquaculture, nursery, processing, sales, tourism and other related industries, and provide employment

opportunities. This project will be beneficial to the adjustment of fishery structure, solving employment problems, promoting the adjustment of fishery industry structure and the transformation of fishery economy, and realizing the transformation of new and old energy in fishery.

4.3 Ecological benefits

Artificial reef construction can improve the marine environment, create a good living environment for animals and plants, and provide good habitats for breeding, growth and feeding for fishes and various zooplankton. The upwelling and eddy currents caused by the reef can improve the ecological environment of **habitats**, thus achieving the purpose of protection, proliferation, and increasing catch yield. The reefs placed by the artificial reef project provide a good breeding ground for marine organisms, and they will effectively protect aquatic organisms and promote the propagation and recovery of marine biological resources. The organisms attached to the reefs can consume nutrients in the sea. A large number of phytoplankton (including red tide organisms) and transplanted algae can absorb nitrogen and phosphorus from the sea, which can reduce the degree of eutrophication, purify water quality, reduce the occurrence of red tide, effectively alleviate the pollution of coastal aquaculture, and optimize the mariculture environment of the surrounding area, thus achieving the purpose of repairing and improving the marine ecological environment. After the completion of the project, the marine ranching area and the surrounding natural rocky areas are interconnected. A new stable ecosystem will be formed after several years of development. The marine ranching observation network system set up in the project can effectively monitor the sea area, provide additional marine environmental monitoring data for the entire province, and provide early warning of marine ecological changes in the regional sea area.