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Process and Prospect of Marine Ranching Project in Korea

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General aspect of marine ranching programme in Korea was introduced. It contains the status of Korean fisheries industry, background and the scope of ranching project being conducted by KORDI since 1996. Long term plan for the marine ranching programme as a national project is also introduced including socio-economic analysis of project as well as economic impact of investment.

Keywords: Marine Ranching, Tongyeong

Introduction

Coastal fisheries in Korea have shown significant growth from 1950 to 1970. It was due to improvement of locomotion power, development of fishing gear and growing demand of sea food along with economic growth. Result of such technical development and market demand, fishing force in Korean need to expand its fishing ground from East sea to East and South China sea. However, not only Korean fishing fleet was expanding its fishing force during these time, also Chinese and Japanese fishing force have been strengthened enough to explore the east-north region of Asia. In consequence of powerful fishing activities among those countries, fisheries resources of the far-east Asia sea has shown rapid declines.

Again coastal fisheries in Korea, major fish resource was over exploited mainly due to rapid development of fishing industry recording the highest catches in mid 1980. In this respect, aquaculture has being developed to meet the demand of seafood although experimental aquaculture has been conducted by National Fisheries Research and Development Institute (NFRDI) since 1970. But, in fact, it was after 1990, the production of fin fish through aquaculture has shown significant increase. However, Korean fish farmer has got the great difficulty to produce the sustainable and healthy fin fish. It is because of the production costs, mainly from feed costs, are increasing year after year, the environmental deterioration in coastal area due to long term use of site for intensive cage culture and mis-management of fattening. Currently fish disease outbreak in fin fish aquaculture is becoming serious.

Moreover, after having shrunk of fishing ground by the agreement among Korea-Japan-China, the requirement for the coastal fisheries management has being increased. Although the vulnerable coastal environment has been claimed by the scientists continuously, intensive aquaculture, increase of pollutant input and enforcement of coastal fisheries is still the fact. Regarding this Korean government took action to monitor and plan to manage the coastal environment based on "Coastal Management Act" in 1996. It is obvious that environmental deterioration would influence to the fisheries resources and might end up with low productivity, in consequence, low incomes of local fisherman. There are growing concerns globally on the prevention of coastal environment and they try to keep the sustainable production from the coastal fisheries. Particularly in Korea, it has been started since 1970 that government released the fish juveniles into the bay and put artificial reef into the selected sites in the terms of restocking marine resources.

The concept of 'restocking marine resources' has developed toward the idea of marine ranching which adopted new technology to manage the coastal fisheries resource in environment-friendly and ecologically sound way. After feasibility study on the marine ranching project in 1998, KORDI has implanted this idea in Tongyeong area, southern part of Korea, aiming the ground role for marine ranching.

In this paper, the general concept and prospective plan of marine ranching in Korea was addressed. The early stage of plan for marine ranching was reassessed to find out if feasible for long term operation.

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Status of Marine Ranching in Korea

Background of marine ranching project in Korea

Based on 'the national plan for developing coastal fisheries' (1977~1981) in 1997, the primitive way of marine ranching has been carried out from 1982 to 1989. After then, dropping the artificial reef, release of fin fish fry, development of aquaculture techniques, promoting the freshwater aquaculture and environmental management for the fishing ground are prepared in the national plan of coastal ranching project (1994~1995).

Meantime, KORDI (Korea Ocean Research and Development Institute) has tackled to develop the mass production technique for the migratory species, which could be the best species for releasing into coastal water. It is use of their life cycle returning back to the place of released. KORDI, where has already transferred the mass production technique to the aquaculture industry, has started marine ranching project from 1994 to 1996 in Tongyeong area. It was a part of feasibility study of making the model case for marine ranching programme in Korea so that it would eventually expand to other areas. For the stock enhancement, demersal species such as black rockfish (*Sebastes schlegeli*), dark-banded rockfish(*Sebastes inermis)* and abalone(*Haliotis discus hannai*) has been recommended to be released. Currently KORDI assess the first stage of marine ranching project before expanding project to other area.

Aims of marine ranching project

The aim of marine ranching is to recover the productivity of coastal environment, to enhance the incomes of fishing village as well as to supply the sea food so as to meet the market demand in environment friendly way.

Marine ranching project in Korea was motivated by following backgrounds

- Continuous demands for the seafood, which have been reduced both by the EEZ policy in world wide and by the fisheries agreement among Korea-Japan-China.
- Growing requirement of the management skill for coastal fisheries resource which must be the foundational concept to maintain the sustainable captures.
- Technical development for the coastal management skill to rehabilitate the marine habitat chronically destroyed.
- Feasibility of the recreational and game fishing through enhancement of fish fry in the coastal area which is the main activity of marine ranching project.

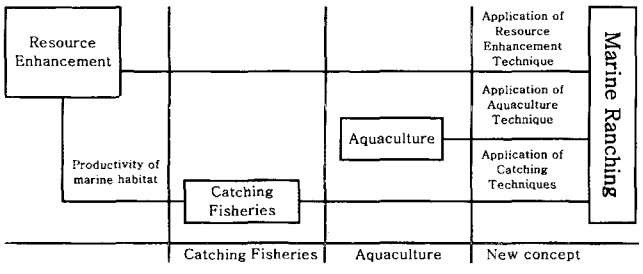

Fig. 1. Development of fisheries techniques toward marine ranching as a new concept of coastal fisheries.

Constraints of marine ranching

Technical difficulties

As the marine ranching project needs different fields of marine science, such as: ocean engineering, coastal engineering, sonar system, automatic measuring system, construction, aquaculture, ecological monitoring, environmental assessment, marine biology and underwater engineering etc., the best efficiency and production through ranching programme could be achieved by collaborative network among specialist involved. However, basic science and technology on these fields have not so far ready for such complex marine project. In this respect, additional budget to develop the associated technique has to be required out of marine ranching project itself.

Since the behaviour or survival of released fish are affected by environmental changes as well as by oceanographic profile of the ranching area, the recovery of released fish must be monitored to assess the efficiency of stock enhancement. In order to increase survival rate of released fry in the marine ranching area, producing healthy fry is obviously required. With this respect, the selected parents must be maintained under optimal condition for many generations and so far, brood stock management has established in very limited species.

Socio-economic constraints

Understanding and commitment of marine ranching project must be agreed from local fisherman, although the fact is practically difficult in the field.

First: installation of analytical instrument or any structures into the marine ranching area must not interfere the local fishing activity. As near shore area is used to be owned by the village based co-operatives, it must be compromised when other party want to access those area. In this regard, fishermans understanding and involvement is often key point to make marine ranching project successful.

Second: who is going to be the group of benefit through marine ranching ? As the released fish could move into out-

boundary of marine ranching area, the ownership, the right of catching these fish is also sensitive issue against neighbouring area. It is matter of fishing right, who put investment and effort into marine ranching area and who is going to make smile at the end ? This matter is still doubt to define and must be solved out soon through legislation.

Third: how local fisherman can take care of released fry up to adult size of fish in the marine ranching area ? Otherwise who is the main body of supervising and managing the area ? As the marine ranching area is opened for other fishing activity, management of the small fish released by marine ranching project is the most delicate issues having technical difficulties.

Case Study of Marine Ranching in Tongyeong Area

Geology of studied area

As shown in Fig. 2, marine ranching area is located in southward of Tongyeong area, southern part of Korea, and many islands are scattered within the area. Water temperature in the area ranged 9~26°C during the year and salinity, 33~34 ppt. There has been strong tidal current near the site. Capture fisheries and aquaculture activity in this area is sort of active due to ideal geological location.

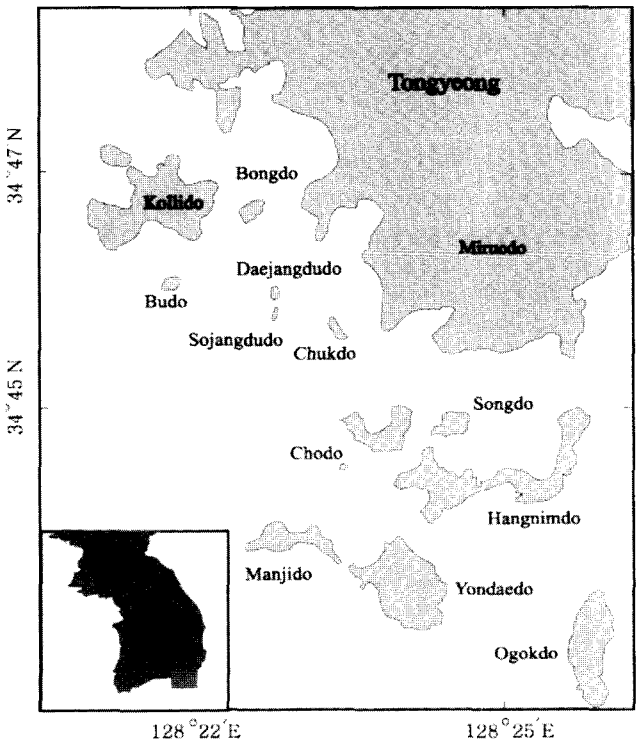

Fig. 2. Map of marine ranching area (20 km² water surface area of Tongyeong, Kyeongsangnam-do, Korea).

This area composes of 7 administrative unit and have 14 fishing villages and 12 local fisheries cooperatives.

Scope of project

The purpose of project is to conduct feasibility study and develop the techniques for marine ranching project successful and to give a model case for marine ranching project, though increase the fisheries product to support the local fisherman (Fig. 3).

The period of project is from 1998 to 2006 (9 years) and institutions involved are

- KORDI (Korea Ocean Research and Development Institute)
- NFRDI (National Fisheries Research and Development Institute)
- KMI (Korea Maritime Institute)
- Kyeoungsang nam province
- Tongyeong city

Fish stock

- Released black rockfish(*Sebastes schlegeli*), dark-banded rockfish(*Sebastes inermis*), abalone(*Haliotis discus hannai*)

Objectives and procedure

Main purpose of marine ranching project is to

- increase the incomes of local fisherman,
- supply of sea food in stable base,
- contribute for developing the fishing village

though marine ranching project aims to enhance the marine stock and develop the proper management skill of fishing ground and increase the socio-economic impact of marine ranching project.

To achieve the goal of marine ranching project, collaboration among research, academic, industrial sectors and government would be strongly required. Also marine ranching would be expected to expand toward other place, so indirectly as to contribute for better living condition of fishing village.

Research step

Since this project is the first trial with systematic approach for marine ranching in Korea, research priority was designed for developing the techniques in associated fields, and building up the infrastructure for further research activity to tackle the every step of difficulty (Table 1). Marine ranching project requires tight collaboration among other sector of science and technology.

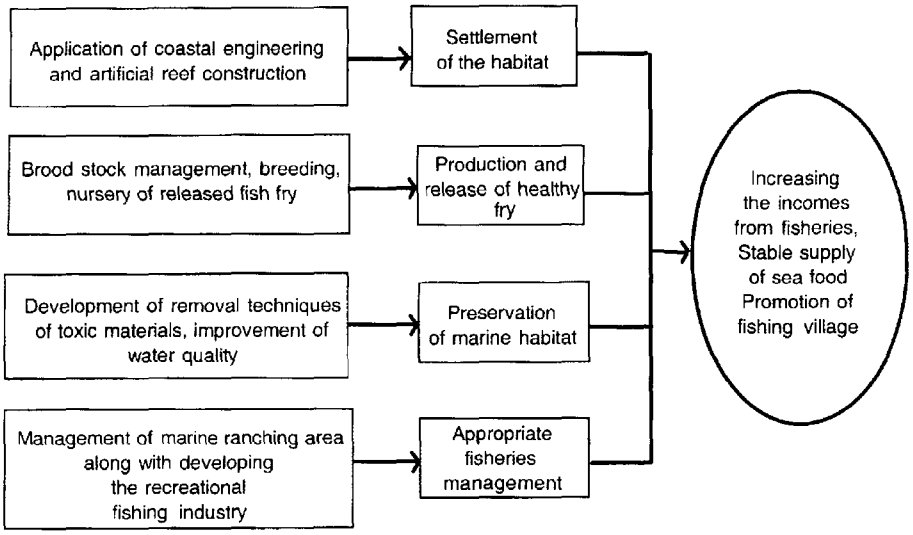

Fig. 3. Conception flow of marine ranching project toward project objectives.

Table 1. Research objectives by research stage

Stage	Duration	Objectives	Research goal
First stage	1998~2000 (3 years)	Build up infrastructure	-Environmental monitoring -Investment for target species -Develop the hydro-acoustic application -Improvement of habitat -Production fry for the released -Analysis of socio-economic feasibility and supporting system
Second stage	2001~2004 (4 years)	Field application	-Environmental monitoring -Behaviour study for the released fry -Released fish fry -Install the artificial reef -Investment plan and management plan
Third stage	2005~2006 (2 years)	Field management Efficiency analysis	-Assessment of efficiency of project -Stock management in the site -Commercialization of structure and device applied in ranching project. -Analysis of investment efficiency

Investment plan

Investment by fields

To build up the artificial habitat to attract more fish, following structure was suggested to be installed under water, 5500 ea of artificial reef, 60 sites of artificial plantation, 3 sets of audio signal feeding buoy and 3 sets of environment monitoring buoy.

Stock enhancement was planned to release 7.5 million fry of rockfish and abalone, which are known to be demersal species.

Released fry was nursed in a pond for adaptation before release into the marine ranching area. Rockfish released during 1998 and 1999 was adapted in the nursery pond by sonar and light sensor for 2~3 months being released.

Financing plan

MOMAF(Ministy of Maritime Affairs and Fisheries) is so far the main body to conduct this project spending 86% of total budgets, whereas local municipal has to produce the fish fry to support stock enhance programme (Table 2). Commercially only one company took part in the project to supply the artificial reef made of iron frame

Long Term Plan for Marine Ranching

Marine ranching project is expected to play a great role of restructuring the fisheries policy in Korea due to the internationally accepted EEZ policy. Strategically, TAC regulation must be employed for regulating the over-fishing activity and sustainable aquaculture must be applied through environmental management in coastal area. According to the fact, objectives of long term plan for marine ranching must focus on the

Table 2. Investment of marine ranching project in Tongyeong area

(million won, 1 US$=1300 won)

	Total	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total	24,007	1,100	1,457	2,910	4,155	4,465	3,060	2,860	2,000	2,000
Marine habitat	13,423	283	510	1,390	4,155	3,235	1,960	1,760	1,000	1,000
Resource enhancement	2,370	-	150	420	2,285	300	300	300	300	300
R & D	8,214	817	797	1,100	300	930	800	800	700	700

Table 3. Investment plan by each source of revenue

(million won, 1 US$=1300 won)

	Total	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total	24,007	1,100	1,457	2,910	4,155	4,465	3,060	2,860	2,000	2,000
MOMAF	20,807	900	1,057	2,000	3,245	4,345	2,940	2,680	1,820	1,820
Local govern	1,760	200	400	430	430	60	60	60	60	60
Fisherman	540	-	-	30	30	60	120	120	120	120
Commerical	900	-	-	450	450	-	-	-	-	-

following direction.

- Allow the area management to produce fisheries product in sustainable base.
- Readjust the structure of fisheries industry from the coastal fisheries to capture fisheries under environmentally controlled area.
- Manage the marine ecosystem and apply the poly-culture system
- Modernise the method of capture fisheries
- Encourage the recreational fishing industry

Expansion of the marine ranching project

In order to achieve the goal, the project would be conducted by three phases (Table 4).

First phase (1998~2010): As the experimental stage, central government played the major role to conduct this project by financial support. Demersal species were candidated as the main stock released into marine ranching area. Period of project would be 13 years and total production from 5 experimental marine ranching sites was expected to be 15,000~20,000 m/t.

Second phase (2005~2014): The duty of ranching project will be replaced by provincial government and stock enhancement activity will be expanded toward pelagic fish along with demersal species. Project will continuously carry on another 10 years and production will be expected 150,000~200,000 m/t during second stage of project. Marine ranching project will be expanded up to 50 sites along the south coast of Korean peninsular.

Third phase (2015~2030): During this stage, the technique and management skill will be transferred into commercial or fisherman and those who will take part in the major role of fishing and related commercial activity. In this stage, 500 sites are going to be established during the 16 years project. Total production from the marine ranching during this stage will be 1,500,000~2,000,000 m/t.

Strategy of experimental marine ranching (First phase)

As Korean peninsular has three different types of coastal environment and topographic profile, experimental ranching area was tentatively set in 5 sites (Table 5).

- Marine ranching type also has to vary dependant upon

Table 4. Long term aspect of marine ranching project in Korea

	First phase	Second phase	Third phase
Objective	Infrastructure	Expansion	Application
Type of project	Feasibility	Development	Comercialization
Main body of project	Central govern.	Local govern.	Fisherman, Commercial
Target species	Demersal species	Demersal and pelagic	Coastal resource
No. of sites	5	50	500
Duration of project	13 years (1998~2010)	10 years (2005~2014)	16 years (2015~2030)
Production (m/t)	15,000~20,000	150,000~200,000	1.5~2 million

Table 5. Basic concept of experimental marine ranching in different provinces

	Tongyeong	Jeonnam	West coast	Jeju	East coast
Type of ranching	Archepelagic	Archepelagic	Mudland	Recreational	Recreational
Target species	Black rockfish, Dark banded rockfish	Flounder, Black porgy	Black rockfish, Shellfish, Crustacean	Abalone, Parrot fish	Abalone, Scallop, Flatfish
Adaptation	Hydroacoustics Light control	Hydroacoustis, Light control	Hydroacoustic	Hydroacoustics	Hydroacoustics
Current controller	Artificial reef, Current controller	Artificial reef, Current controller	Artificial reef, Current controller	Artificial reef, Net-pan,	Artificial reef, Upwelling structure, Net-pan
Installation	Artificial reef, Underwater forest	Artificial reef, Underwater forest	Artificial reef, Net-pan	Artificial reef, Underwater forest, Net pan	Artificial reef, Underwater forest
Constraction	-	-	-	Fishing port, Sea observatory	Fishing port, Sea observatory
Investment	9 years	8 years	8 years	8 years	8 years

the type of coastal environment. For instance, Tongyeong, Kyeongnam and Jeonnam province is designed to maximise the efficiency of stock enhancement by the archi-pelagic profile of southern peninsular.

• West coast has high tidal current and well developed mudland, marine ranching may focus on the shellfish stock enhancement along with fish stocks releasing into the bay.

• Since Kuroshio current pass through Jeju island, some of warm water fish is inhabited around near sea. However, as the coastal line of Jeju island is rather simple compare with southern area of Korean peninsula, it could be not good idea that releasing the fish stock into the near shore. Instead, Eco-diving, game fishing and Eco-tourism associated with marine ranching programme will be suitable to Jeju island. Recreational marine ranching, in this regard, could be the best strategy for Jeju Island.

• Coastal line of east coast is also rather simple but having deeper water depth. Since cold water current is coming through north part of the East sea, the high valued cold water species have to be ranched combined with tourism industry along the Taebaek mountain.

Investment Plan

In total, 150 million US$ of budget will be needed for first stage of project. So far, central government allocates the research and supporting grant to the project, however, more allocation of budgets from industrial sector or local government will be encouraged.

For instance, government support infrastructure and research, local government would rise funds for stock enhancement in terms of releasing fry, resource management and monitoring the environment. Whereas commercial would take part in the ranching project to develop the structures, such as artificial reef, environment monitoring system and wave breaker, etc.

Another source of funding could be attracting the commercial sector in the industrial park near around ranching area. For instance, nuclear power station, reclamation company and steel company etc., which cause the coastal pollution. They can reduce the cost of "environmental safe" campaign as well as advertise their contribution for local community.

Conclusion

Deterioration of coastal environment, declines of fisheries resources and agreement of fishing ground with neighbouring country cause the fisheries industry in Korea very difficult. In this reason, restructuring the fisheries policy was urgently required for sustainable production in coastal area. Also the way of aggressive aquaculture and over-fishing must be changed.

To maintain the fisheries industry in sustainable base, the concept of marine ranching has been adopted since 1998 and KORDI has performed this project in Tongyeong area.

Collaboration among different sector is absolutely required to achieve the objectives of this project, such as marine ecologist, constructor, aquaculturist, coastal engineer, research scientist, government official, etc. and main body of this project must be moved from central government to local community.

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