Feasible Study on the Aquaculture Development in Palau

By

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I. Preface

In response to a request by the Bureau of Marine Resources (BMR), Ministry of Resources and Development, and Embassy of the Republic of China in Palau, a feasible study on aquaculture development potential in Palau was conducted from 7 to 14 September 2004. The survey was made in accompany of Mr. Theo Isamu, Director of BMR, Mr. Ming-Lii Hseu, Leader of the Technical Mission to Palau, the relevant State Governor, and the secretary at Embassy. On the basis of author's personnel viewpoint, the appraisal is reported as follows.

II. Field survey and comments

(I) Angaur State

The proposed site in Angaur, although large in area (around 10 ha) and never dried up so far, seemed not be appropriate for future development of fish farming under current situation, unless the following disadvantageous factors are solved firstly:

1) Inconvenient transportation and access pathway.
2) It seemed that there was no water inlet and outlet system, which making water exchange and water quality control impossible.
3) This pond was too deep (15-18 feet) to harvest, furthermore, no drainage facility resulted in the difficulty for harvesting.
4) The source of pond water seemed to be the seepage of underground water, in such case, water salinity was very

difficult to maintain or control.

5) The fry shipped from Peleliu were stocked into this pond, no feedstuff was fed, therefore, the pond served as stock fish, the growth of fish mainly relied on the natural productivity (nutrient, phytoplankton in the wild) which was lower as compared to those in feeding condition.

However, for the purpose of subsistence, milkfish were currently produced in extensive method without feeding. This kind of stocking milkfish was very important in terms of the food supply during the rough season.

(II) Peleliu State

The state-owned site in Peleliu was located in the mangrove area. As you have known, mangrove is a natural habitat for mangrove crabs、lobster、certain reef fishes and is a complex ecosystem that function as a shelter and nursery ground for juvenile and immature marine organism. In addition, it serves to protect the land from wind and wave erosion. Consequently, the construction of pond in this area is accordingly not allowed by Palau national government. This is a key point that should be indicated in advance.

Judging from the fact that the water of raceway was less in quantity and inferior in quality, the water exchange of pond seemed to be insufficient. Usually, frequent and suitable water

exchange is necessary for water quality control and fish growth. Therefore, the inlet and outlet water raceway and sluice gates system should be designed to facilitate water interchange and to assure complete draining for fish harvesting and pond management. Besides, based on the brownish color of pond water, the water might be too acidity to raise fish, in such case, the growth of fish would be retarded. To this point, the water quality should be checked prior to the construction of pond. If the above-mentioned problems are overcome, the aquaculture project will be possibly carried out.

Another site I visited was a private fish pond. This pond was also located in mangrove area. The fringe part of the mangroves had been cut down to construct circular canal-like pond, and the center part of mangroves were enclosed by the pond. Both the situation of water drainage system and the color of the pond water were similar to those of the previous site. Moreover, no feeding would result in stunting in fish growth and reducing impound productivity. Integrated milkfish farming with mangrove is beneficial to bloom feed algae for the growth of milkfish at larval or juvenile stage, but which may not be appropriate for grow out stage. Although better water raceway was found in this pond, the same problems encountered should be tackled in order to ensure further development.

(III) Ngiwal State

In regard to the aquaculture project of Ngiwal State, the existing environmental status and alternatives to the proposed action were described, furthermore, both the positive and negative impacts as well with regard to environmental, economical and social consequences were evaluated in the assessments. So, it is well-designed, and theoretically, is considerable and feasible. However, the following recommendations should be taken into consideration:

1) The elucidation of relevant facilities and construction methodology and management should be included, in order to evaluate the feasibility of this project.
2) The main challenge is to balance the environment and economic sustainability, to this concern, any impact resulted from aquaculture practice should be avoided or reduced by implementing properly the project and incorporating the recommended mitigation measures which proposed in the assessments.
3) Due to the main concern with respect to environmentally friendly implementing aquaculture, polyculture or integrated culture system is strongly recommended, for instance, filtering organism coexisting with fish in culture will help reduce waste accumulation in bottom of ponds. However, both grouper and Napoleon (*Cheilinus undulates*) would not

be compatible with milkfish, because they are different in feeding habit.

(IV) Ngchesar State

As to the site of Ngchesar State, it was located in mangrove area and far away from seashore. A small raceway with shallow salt water access to this area. If this area will be planned to develop aquaculture, solution of the following problems should be done at first priority:

1) Mangrove deforestation will be the result of aquaculture development of this area, therefore, it won't be allowed by national government. Although inland mangroves are less detrimental to environmental deterioration, deforestation of mangrove is considered as minimal as possible in order to lower down the construction costs and to protect marine environment.
2) Influent and effluent water system will be designed and renovated. A best site suitable for aquaculture is the location will allow natural inflow and movement of marine water to supply fresh water and direct waste effluent.
3) Land cleaning and all relevant facilities will be designed and constructed.
4) Water quality should also be determined before the start of fish farming.

There was a private milkfish pond close to the proposed site. In view of the fact that pond water was turbid and some fish swimming on the surface, possibly due to lack of oxygen, these phenomena revealed the degradation of water quality. Aside from this, water exchange was not sufficient. High water turbidity over long period of time may be detrimental to microorganisms, plants, bentic algae and other aquatic species whose growth depend on photosynthesis or clear water condition, and consequently results in low productivity and slow growth of fish.

The suggestions are that the increase frequency in fresh water exchange and fed diet with sweat potato and wheat flower or boiled rice. In doing so, the fish growth will be enhanced.

(V) Ngatpang State

The last place I visited was the site located in the Ngatpang State. This site already had enclosed pond available for aquaculture, although there were quite a lot of dead mangroves remained in the pond. The aquaculture project was designed in very details with regard to the technical aspect, for example, the site situation, methodology, construction, management, transportation, marketing and even in financial analysis, however, only a few words in relation to environmental protection.

With a view to achieving the goal of this project, the following issues should be concerned and solved:

1) To avoid mangroves deforestation to minimize impacts to local environment.
2) In extensive culture system of milkfish farming, shallow depth is needed to grow the benthic algae, and diatoms. In other words, deep water will inhibit the blooming of natural food available for fish.
3) In an attempt to increase milkfish production for local consumption, the construction of channel with sluice gates would be needed to control water quality and to facilitate the water exchange.
4) Polyculture is recommended to milkfish culture, for instance, culture oysters, clams or other filter organisms to reduce waste accumulations.
5) The high stocking density should be avoided; otherwise, the fish must be fed with feedstuff. In such case, the excessive feedstuff and excretes of fish will result in water deterioration.
6) The feedstuff, if necessary, should use locally available agriculture byproducts.
7) In cage or pen culture system, the waste of effluent discharged directly to surrounding water without any control treatment, this operation will have adverse impacts to natural

environment. However, the small-scale cage culture may be practiced to some extent, of which the eutrofication won't be possibly occurred.

III. General elucidation

According to the data of FAO, the potential of aquaculture to meet the demand of food security and to promote employment and foreign exchange is clearly shown by the rapid expansion of this sector, which has grown at an average annual rate of around 10% (followed by 3% for live stock; 1.6% for capture fishery).

The main reasons why aquaculture growing fast in global are:

1) Supplies from capture fishery are decreasing due to over-fishing and pollution.
2) Demand for quality seafood is elevated, owing to population increase and health consideration.
3) The needs of consumer in consistency of quality and availability at right prices.

It is well known that terrestrial food resources throughout the world are limited and restricted. More than half of world's population cannot get the minimum food required. It seems that in order to survive, mankind must utilize the resources of the seas, rivers and fish farms. It would be beneficial to develop aquaculture to improve the livelihood of farm families, to

promote economic development, to enhance the production of fish as human food and to provide employment opportunities for local people, etc.. However, the following criteria are suggested and should taken into account for making a feasible aquaculture project:

1) Climate factors: temperature, sunshine, rainfall, evaporation, winds, etc..
2) Soil: structure, texture, specific gravity, colloidal properties, etc..
3) Water supply, quality and dynamics, sources of water-ground water, rainwater, irrigation water.
4) Topography and ground elevation.
5) Chemical features of water: pH, DO, salinity, etc..
6) Physical features of water: temperature, turbidity, color.
7) Transportation and communication facilities.
8) Availability of infrastructure: drainage, farm roads.
9) Accessibility of other related and supporting facilities and technique, paddle wheel, water pump, formulated feed, etc..
10) Source and adequate supply of broodstock and fry.
11) Techniques and experience of working group.
12) Local and international market.
13) Fish processing technique
14) Storage facility and technique

Palau's national development strategies therefore identifies

aquaculture as one of the three vital sectors in need for expansion to strengthen local economy. (Other two sectors are tourism and agriculture)

The following goals will be achieved as a result of aquaculture development in Palau.

1) To increase sustainability of fish production.
2) To support the objectives of natural resources conservation.
3) Maintaining adequate level for subsistence fishery.
4) Protection of the natural marine environment for the tourism development.

On the other hand, the expansion of tourism industry for economic development in Palau will also place more demand for fish consumption. Growth in tourism will consequently trigger the market for seafood. In addition, the aquaculture development will be able to supply local fish stock for consumption so over-fishing or exploitation of certain marine species should decline to some extent.

IV. Recommendations

Generally, the lack of organized aquaculture extension service— the indispensable link between researcher (specialist), administrator (government officer) and producer (farmer)—was therefore considered to be a consequence of the general scarcity of trained specialist personnel, and was a factor contributing to low levels of development, particularly, of the small-scale rural

sector. Accordingly, in the initial stage of aquaculture development, it is important to get government support, for example, supply of free or cost-priced fish seedling, and technical guidance on farming methods, to fulfill the aquaculture development project. In this regards, it is recommended that the hatchery at PMDC (Palau Mariculture Demonstration Center) should play an important role for demonstration purpose. This is because the location closes to the capital and has convenient transportation, which can facilitate holding workshops, training courses, and any type of extension service. Furthermore, the hatchery already has plenty of facilities and equipments, which will result in saving investment of installation.

(I) Actively carry out the demonstration of mariculture project at PMDC

1. In the initial stage, milkfish and grouper are the target species to be developed.

In Palau, milkfish is gaining popularity and demand among local consumers. The milkfish production is in short supply in local market and highly demand in tourism industry and public sector. Besides, due to the following attributes, the milkfish will then be chosen as candidate species to be cultured at first priority:

1) Based on its commonality and adaptability to inshore marine environment.

2) It has high market potential for human consumption and juvenile milkfish can be sold as tuna bait.
3) The culture methods are relatively easy and cost effective.
4) It is herbivorous and feeds on benthic alage, diatom, and other similar food items, so food production is quite simple.
5) Broodstock can be raised and matured in captivity, and be able to produce larvae, thereby eliminating capture of fry or fingerling in the wild.

Eating live seafood is a tradition among the people along South-East Asia countries, especially in Taiwan, China, Japan and Korea, due to their culture and customs. Among the live fish species, the groupers are most acceptable and popular, for instance, in Hong Kong, about 35% by weight and 50% by value of live fish consumed are groupers. Market prices for different species of groupers are comparatively high, and are in a range between US $ 20 and US $ 42 per Kg. Moreover, most of the tourism in Palau are Taiwanese and Japanese, hence, it has high market potential for tourism consumption. To this concern, grouper farming is therefore regarded as the target item to be developed at second priority. Currently, according to the statement of Mr. Isamu, the director of BMR, the experimental results of grouper farming project at BMR conducted by Japanese experts was not so promising.

However, in order to effectively conduct this project, the

following suggestions should be evaluated and solved:

1) The Technical Mission of Palau (TMP) may temporarily responsible for the implementation of this project, if it can be carried out at the hatchery of PMDC through BMR agreement.
2) It is suggested that the related aquaculture specialist from Taiwan should be invited to work in TMP to implement this project.
3) The techniques of both rearing and seed production should be established and transferred to local fish farmer.
4) Adequately supply superior fry or fingerling to fish farm.

In doing so, farmers would get on-hands technique on aquaculture practices and government administrators would get extension experience through such subsistence practices. These kinds of experience and technique are conducive to further national development.

2. In the successive stage, development of shrimp culture is suitable item to be chosen

For the successive aquaculture development, the cultured organisms will diverse into crustacean species, which including *Penaeus monodon, Litopenaeus vannamei,* and *Macrobrachium rosenbergii.* Being international aquaculture organisms, both *P. monodon* and *L. vannamei* possess various advantages for culturing, such as delicious and nutritious seafood, fast growth

(*L.vannamei* grow more faster), eurythermal and euryhaline, omnivorous-require only low feed cost, and attractive reddish color after being cooked. *P. monodon* is native species, the fry can be caught from the wild, whereas the fry of *L. vannamei* can be easily imported from Taiwan. In fact, the technique of artificial propagation in both species had been developed in Taiwan. Similarly, the freshwater shrimp, *M. rosenbergii*, is suitable to conditions of the Palau environment. It also has several favorable characteristics like fast growth rate, larger size and easy to culture and to reproduce, etc.. Prawn farming in Palau seemed economically feasible because of high market price and high demand for both domestic and global markets.

Likewise, as mentioned above, it is recommended that Taiwanese specialist in the field of shrimp culture should be dispatched to be a member of TMP to take charge of shrimp farming project at hatchery of PMDC, if BMR is approved.

For future development, clam culture such as oyster and trochus, should also be concerned, because they are indigenous species and have great market potential. In addition, the culture method should be improved from extensive to semi-intensive and even intensive culture system in order to increase fish production.

(II) Restoration and Stock Enhancement of jiant clam culture at PMDC

The jiant clam is the special sea product in Pacific Ocean countries, especially in Palau, in which the PMDC is working on the culture and conservation of the seven species of local jiant clam. The technique in mass production of seedling had been established in PMDC, and the superior seeds were disseminated to local farmers. The farmed clams not only for domestic consumption of resident and tourism, but also for exportation. According to Mr. Isamu, the center was facing the problems of high maintenance cost and low production. It is strongly recommended to strengthen the production activities through more efficient pond management, in order to restore the production potential to the level of the previous year. For instance, both pumping machine and aerator were simultaneously operated day and night, it is suggested that pumping machine operated alone during daytime, while aerator during the night. By doing so, the maintenance cost will be lower down. Additionally, the stock enhancement by way of sea ranching (releasing farm-reared seedlings to the wild) should be conducted as soon as possible.

(III) Other related suggestions

According to the governor of Peleliu State, milkfish fry could easily be captured at the gate of the pond throughout the year, it is recommended that a scientific survey on milkfish fry availability should be accomplished by BMR, then its collection

and discrimination could be demonstrated to fisherman, if it is available.

According to the director of BMR, the water sources of hatchery at PMDC might be contaminated by surrounding water due to the site of sewage treatment closed to PMDC. This is why the BMR has strong intention to move hatchery to the site of Ngnemedue bay in Ngatpang State.

In the past, government efforts seemed to be made primarily on research level, though it was essential for long-term development. It is suggested that the government would shift the focus towards basic development at production level. From this viewpoint, it is prerequisite to involve Palauan participation in aquaculture development and training programs. The training course should be continued until trainees are able to take over the development project alone. On the other hand, without strengthening the manpower in BMR, the implementation of aquaculture programs might be also difficult to achieve.

In conclusion, to teach a man how to catch fish is better than giving him fish to eat. Furthermore, it is even more important to teach a man how to raise fish than just to catch fish.

V. Acknowledgement

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