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COASTAL AQUACULTURE IN THAILAND

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ABSTRACT

The coastal area has been explored for aquaculture and coastal aquaculture has expanded quite rapidly in Thailand. The economically important culture species are shrimp (*Penaeus monodon*), sea bass (*Lates calcarifer*), and two species of grouper (*Epinephelus malabaricus* and *L. salmoides*). The area for marine shrimp culture in 1989 was around 78,209 hectares with a production of 100,000 tons. Approximately 40% of these ponds, by area, is under intensive shrimp cultivation. The average survival rate was reported to be 40-80% with a production of 6 tons per hectare. Sea bass and grouper are mainly cultured in cages. Two cage sizes are used: 10 x 10 x 2 and 5 x 5 x 2 meters. In 1988, the production was about 1,034 and 357 tons for sea bass and grouper, respectively.

INTRODUCTION

The gulf of Thailand has a total coastline of approximately 2,800 kilometers. The coastal area has been explored for suitable aquaculture sites for a long time and this has led to rapid coastal aquaculture development in Thailand.

MARINE SHRIMP CULTURE

History

In Thailand, shrimp farming has been practiced for the last 60 years. Wild shrimp fry either enter during tidal water exchange and are trapped in the salt beds and paddy fields around estuarine areas, or are intentionally gathered from the wild and stocked directly in ponds. Production is dependent on the seasonal abundance of wild fry, which fluctuates widely from year to year.

In 1973, Thailand successfully spawned and partially reared larvae of *Penaeus* spp., such as *P. monodon* and *P. merguensis*. The Department of Fisheries encouraged additional seedstock from hatcheries to supply traditional ponds. Supplemental feed was given in this semi-intensive shrimp farming system. A few years ago, technology for intensive farming of *P. monodon* was developed and have since been practiced in Thailand. The return on investment of intensive farming of shrimp is high, resulting in the rapid expansion of shrimp culture.

Actual and Potential Shrimp Production

At present, the culture techniques can be classified into four categories: 1) extensive (traditional), 2) semi-intensive, 3) intensive, and 4) super-intensive shrimp culture systems. These are classified in terms of pond and production per unit area per crop or per year, (kilograms per hectare per year)—from low production of less than 40 kilograms to high production in super-intensive culture systems with more than 5,000 kilograms per hectare per year.

Approximately, 40% of these ponds is under intensive and super-intensive culture system characterized by higher stocking rates, heavy feeding of quality feed, and aeration. In each crop of four months, the shrimp stock can grow to 30 pieces per kilogram when stocked at 70 individuals per square meter. Although the survival rate varied between farms, the overall average is reported to be 60-90%.

In Thailand, the tiger shrimp *Penaeus monodon* is the most common species because of rapid growth and high export value. It can be reared a length of 336 millimeters, and it is considered to have the fastest growth rate in captivity among the cultured shrimps. It usually grows to 30 grams in 4 months of culture.

There are three other closely related species: the banana shrimp *P. merguensis*, the Indian white shrimp *P. indicus*, and *Metapenaeus ensis*. Together, they are the second most commonly cultured species in Thailand. These species do not grow big in ponds. The fry and juveniles are locally and seasonally very abundant. Some experiments on intensive banana shrimp culture have shown low survival rate and slow growth. In contrast, studies on the culture of the other two species are limited. The three species are produced in traditional and semi-intensive farms.

In 1979, over 3,300 shrimp farms with a total area of 24,675 hectares were operated. With government support, shrimp farming slowly evolved into a

major agro-industry producing 100,000 tons in 1989 (Table 1). Tiger shrimp production contributed 58,000 tons in 1988 or 76%. It is projected that total shrimp production by 1995 could reach 180,000 tons.

Table 1. Coastal shrimp culture in Thailand, 1979-1989

Year	Number of form	Area (hectares)	Production (tons)
1979	3,378	24,675	7,064
1980	3,572	26,038	8,063
1981	3,657	27,449	10,728
1982	3,943	30,972	10,090
1983	4,327	35,537	11,550
1984	4,519	36,792	13,007
1985	4,939	40,769	15,841
1986	5,534	45,367	17,885
1987	7,264	52,148	25,000
1988	10,347	77,680	75,000
1989	10,347	78,209	100,000

Hatchery Techniques

Seed production techniques for *Penaeus* spp. was developed 15 years ago. The biologists were trained in Japan. There are two types of hatchery techniques. The big tank hatchery that was originally developed in Japan, and the small-tank hatchery that originated from Galveston, Texas, O.S. A. Both systems have their advantages and disadvantages, depending on environmental requirement, availability of spawners, etc. Current practice uses combined features of hatchery systems.

Hatchery Operation

Spawners are collected by fishermen from coastal waters. Spawner of tiger shrimp can be collected in the wild year-round from the east and west coast of Thailand. Eyestalk ablation and hormone injection have been successfully applied for spawner maturation in captivity.

- Some 2,000 shrimp hatcheries are operated in Thailand. These include both big hatchery and backyard hatchery (small hatchery). About 80% are backyard hatcheries. The estimated production of tiger shrimp fry in 1989 was approximately 121,000 million fry which can meet the demand of the shrimp industry in the country.

SEA BASS AND GROUPER CULTURE

History

Marine fish culture in Thailand has been practiced in ponds and cages. Sea bass can be cultured in a pond and cage while grouper is cultured only in cage because of salinity and other requirements of the species,

From the fisheries census of 1985, about 1,579 families are engaged in marine fish culture using some 600 hectares and 18,000 cages. About 87% of marine fish culture is in southern Thailand. The 1988 production of sea bass was 2,034 tons which was more than the combined production of grouper and other species (Table 2).

Table 2. Production of estuarine fish farming in Thailand 1982-1988

Year	Sea bass (tons)	Grouper (tons)
1982	145.0	-
1983	1,059.0	-
1984	473.0	176.0
1985	512.0	117.0
1986	764.0	161.0
1987	1,158.0	343.0
1988	2,034.1	357.0

Sexually mature sea bass are found in the river mouths and lagoons where the salinity and water depth range is 30-32 parts per thousand and 10-15 meters, respectively. Newly-hatched larvae (15-20 days old or 0.4-7.0 centimeters) are distributed along the coastline in estuaries while the 1-centimeter size larvae are found in freshwater bodies. Groupers cultured in Thailand are estuarine (*Epinephelus malabaricus* and *E. salmoides*). These are usually distributed in coastal and marine waters, especially along coral reefs. Grouper is a protogynous hermaphrodite; it matures as a female but transforms into a male when it grows bigger and older.

Site Selection for Cage Culture

The criteria for selecting a suitable site for cage culture of sea bass and grouper are the following:

1. Salinity range: 10-32 parts per thousand for sea bass and 20-32 parts per thousand for grouper.
2. Water depth: over 2 meters at lowest low tide. This is due to the usual size of the culture cage, which is 5 x 5 x 2 meters.

3. Current and waves: protected from strong winds, waves, and current. Ideal areas would be protected bays, sheltered coves, and similar protected waters.

4. Water quality: relatively free from domestic, industrial, and agricultural pollution.

5. Water circulation: enough water circulation to improve water quality and prevent waste materials to accumulate under the net cage.

Culture Techniques

There are two types of cages used in sea bass culture.

Floating Net Cages. The net-cages are hung on GI pipe, wooden, or bamboo frames. The cage is kept afloat by styrofoam drum, plastic carboy, or bamboo. The most convenient dimension for a cage is 5 x 5 x 2 meters. The cage unit is stabilized with concrete weights at each corner.

Stationary Net Cages. This is fastened to wooden poles at its four corners. Stationary cages are usually set in shallow bays where the tidal fluctuation is low. The size is the same as the floating net cages.

Nursery

Sea Bass. Sea bass fry and fingerlings are reared in concrete tanks up to 2.5 centimeters size. They are then transferred to nylon net cages for rearing until they reach 25 centimeters in 2-3 months.

The most convenient cage design is a rectangular cage made of synthetic netting attached to wooden, GI pipe, or bamboo frames. It is either: 1) kept afloat by styrofoam or plastic carboy or 2) stationary by fastening to wooden or bamboo poles at each corner. The size of cage varies from 0.9 x 2 meters to 1.0 x 2.0 meters and a depth of 1.0 meter. The mesh size of the nylon net is 1.0 millimeter. After a month of nursing, fingerlings are transferred to net cages with mesh size of 0.5 centimeters.

The stocking density is about 1,000 fingerlings per cage. Grading of fingerlings is once a week during the nursery period, stocked separately for each size group. This minimizes cannibalism. Fingerlings of 2.5-5.0 centimeters are fed ground trash fish at 8-10% of body weight daily or 4-5 times a day.

The net cage is checked daily to ensure that it is not damaged by crabs or clogged with fouling organisms. It is cleaned every other day by soft brushing to maintain water circulation in the cage.

The survival rate during the nursery period is 50-80%, depending on amount and quality of feed, water conditions, and the experience of the fish farmers.

Grouper. Grouper fry are collected from the wild for culture in net cage. Grouper fry 7.5-10-centimeters long are usually collected by fish traps set in coastal waters near mangrove areas. Fry collection is done year-round but abundant from May to December.

The fish farmers collect grouper fry or buy from collectors. Before stocking, the fry are dipped in formalin solution at a concentration of 100-250 parts per million for 1 hour.

The fry are stocked in nursery cages similar to that for sea bass. Stocking is done separately for each size group since they also have cannibalistic behavior. Initially, ground trash fish is fed 3-4 times a day. Feeding is done slowly and ad libitum. The grouper fry get used to manual feeding after one week of stocking. Then, feeding is done two times a day, in the morning and afternoon. The fry are stocked in nursery cages for about 15-30 days before transferring to grow-out cages.

Grow-out

Sea Bass. Sea bass are reared from juvenile to marketable size for another 5-20 months. The marketable sizes are between 700-900 grams and 2,000-3,000 grams. The 700-900-gram fish is preferred by the local market.

Stocking density for grow-out culture varies from 13 to 300 per cubic meter depending on water conditions of the culture site. Floating cages can hold more fish than stationary cages. They are usually set in sites with better water conditions such as deeper and cleaner water, smaller salinity fluctuation, and faster circulation.

Trash fish is the main feed, and should be fresh and clean. It consists of sardines and other small marine fishes. The fish are fed slowly and feeding is stopped when the fish no longer come up to the surface.

Food conversion rates (FCR) of sea bass in Thailand range from 4.0 to 10.0:1. FCR also depends on the quality and quantity of trash fish. Normally, sea bass can grow at an average of 1 kilogram per year. Survival rates during grow-out culture are 80-95% in normal culture conditions.

The cages are checked once or twice a month to ensure they are not damaged. Nets are cleaned or changed every month. Net changes allow the farmer to check on the number and health of fish.

Cover nets are used to prevent fish from jumping out and to protect the fish from predators.

Grouper. The fish are reared in cages for 10-18 months to marketable size requirement of 700-900 grams and 1,200-1,400 grams. The fish are mostly exported live by air to Hong Kong and Taiwan. Stocking density for grow-out varies from 12 to 100 per cubic meter, depending on water conditions of the culture site.

Trash fish is also the main feed for grouper culture in Thailand. Based on experiment, grouper can be fed artificial diets easier than sea bass. Feeding and cage maintenance is the same as in sea bass culture. Food conversion rates of grouper vary with stocking density ranging from 6.0 to 7.5.

Feed is the major constraint to sea bass and grouper culture. At present, trash fish is the only food used in the first two months of culture at a feeding rate of 10% of body weight, after which feeding rate is reduced to about 5% of body

weight. Since trash fish is insufficient and expensive, studies on artificial diets have been conducted, and their use for sea bass and grouper culture is still at the experimental stage.

Diseases and Prevention

Diseases may result in significant losses. Diagnosis and treatment of diseases have not been established. Common practice are preventive measures. This include provision of fresh and high-quality feed, appropriate stocking density, and suitable water quality at the culture site.

Numerous diseases of sea bass and grouper have been reported in Thailand. The causative agents of these diseases are parasitic organisms, bacteria, viruses, malnutrition, and environmental stresses.

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