NACA/WP/83/7 August 1983

BRIEF NOTE ON THE STATE OF THE ART OF MACROBRACHIUM CULTURE IN THAILAND

BY

Mali Boonyaratpalin and Paiboon Vorasayan
DOF, Bangkok

NETWORK OF AQUACULTURE CENTRES IN ASIA
Bangkok, Thailand
September 1983

BRIEF NOTE ON THE STATE OF THE ART OF MACROBRACHIUM CULTURE IN THAILAND

by

Mali Boonyaratpalin and Paiboon Vorasayan

INTRODUCTION

The farming of the Giant Freshwater Prawn has expanded rapidly in Thailand in recent years. Production has increased from less than 3 tons/year in 1976 to an estimated output of more than 1,200 tons in 1982. This rapid growth was largely stimulated by the Chachoengsao Fisheries Station established in 1976 to solely promote culture of the prawn. Services of the station comprise the production and distribution of post-larvae, without cost to the farmers in 1976 –1978, along with training and extension programmes

on all phases of Macrobrachium culture. During the initial period of 1976–78, postlarvae were distributed to farmers free of charge. The assistance of UNDP/FAO in 1979–1980 has also contributed much to its rapid expansion. The station has increased its post larvae production from 5.6 million in 1979 to 15 million in 1982. The number of farms and acreage have also increased, from 306 farms with a total area of 300 ha in 1979 to 677 farms of 1,737 ha by 1982.

Thailand is still importing some Macrobrachium, about 700 tons/year chiefly from Burma, but at the present rate of growth, domestic demands will soon be met by local production. Current practices and the improvement made in the culture system in Thailand are reviewed below.

HATCHERY

1. Hatchery Management

Water: The hatchery operation in Thailand uses the "clearwater" technique and open system except for one farm which employs the recirculating system. Sources of saline water supply is dependent on location of the hatchery. If it is located near the coast, the seawater (~ 30 ppt) is drawn directly from the sea and treated with 50 ppm calcium hypochlorite or 50 ppm formalin and stored for 7 days before use. For hatchery located further inland saline water from salt pans is used. It has a salinity of 80–120 ppt, with less variation in quality. Most of the hatcheries use tap water or underground water as their source of freshwater. Water from either source has to be stored and aerated before use, to remove residual chlorine in tap water and to bring the temperature and dissolved oxygen of well-water to the optimum level. Water from river or canals also requires similar treatment as sea water.

Larval rearing tank: Two main different types of concrete tanks are used for larval rearing: one is circular conical bottomed, diameter of 1.3–6 m and the other is rectangular tank of size 1.5–2.0 × 8.0–10.0 m. The interior surface is coated with pure epoxy resin to provide a smooth surface which facilitates tank cleaning and reduces the crevices for bacterial and protozoan growth. The larvae tanks are outdoor with simple shading so as to receive sunlight in the morning and late afternoon. Only two farms in Thailand has indoor larval tanks.

Water storage tank: The open system hatcheries should have water tank with a total storage and mixing capacity of about 2 times the volume of its larval rearing tanks. The ratio of storage tank and mixing tank is 1:1 by volume. The ratio of salt water tank and fresh water tank is dependent on source of salt water. If sea water is used then 60% of the storage tank is for salt water because of the lower salinity (30 ppt). Unwanted organisms in the water are eradicated by treating it with calcium hypochlorite and stored for 7 days before use. If water from salt farm is used then only 20% of storage tanks is for salt water.

Hatching: Berried females are obtained from Macrobrachium farms in the central part of Thailand such as Chonburi, Nakornpratom, Aungtong and Suphanburi, during partial or total harvest. They are transported in plastic bags or in fibergrass tanks with aerated freshwater. The cost per female is ฿10. As they are usually sold for human consumption after the eggs have hatched, it is not a general practice to economize on the number of berried females utilized for the hatcheries. The practical stocking rate of berried female is 2–4 per cubic meter. Water salinity is maintained at 12 ppt. Healthy animal with large egg mass that are brown in colour are selected. After the eggs are hatched, usually within 2–3 days, the spent females are removed with a coarse mesh dip net. Since the larvae are of the same age (1–3 days), the incident of cannibalism will be reduced.

2. Larval Rearing

Salinity: Larval rearing salinity is maintained at 12 ppt until metamorphosis, thereafter salinity is decreased to 6 ppt, 3 ppt and 0 ppt by using freshwater for water exchange at a rate of 50% per day.

Temperature: Thailand has the optimum water temperature for larvae growth, it takes 20–30 days to attain metamorphosis. This year we had an unusually cold winter, the water temperature drop to 18°C so the time taken to attain metamorphosis was longer. This affects hatcheries economics. Some farms plan to build a green house for next winter. Sudden changes in water temperature must be avoided as they can cause shock and mortality. An adequate stock of prepared water of 12 ppt salinity are maintained under the same environmental conditions as the larvae tanks at all times, and temperature are checked before pumping into the larval tank.

Dissolved oxygen: A good aeration system is necessary for larval rearing, to maintain dissolved oxygen level near saturation. Aeration must be continuous except for short periods during larvae observation or tank cleaning. Aeration system is a vital part of the hatchery, therefore, a spare blower and motor, in working order, should be available at all times.

Feeds and feeding: Live and artificial feeds are used in hatcheries throughout the country. The live feeds are brine shrimp nauplii. Most freshwater prawn larvae do not feed on the first 2 days but on the third to the seventh day, brine shrimp nauplii are fed twice a day, in the morning and in the evening, at a rate of 3–5 nauplii per milliliter of water. The artificial feeds are given at the day time, 5 times a day. The exact quantity of feed to be given at each time cannot be prescribed. It depends on the utilization of feed by the larvae and must be judged visually by the operator. from day eight till metamorphosis brine shrimp nauplii are given only once a day in the evening, to ensure the presence of food at all times.

Two different compositions of artificial feed are used in the rearing of freshwater prawn larvae in addition to the feeding of brine shrimp. The first artificial feed is widely used in all hatcheries except one. It is a mixture of green mussel and egg. This feed can be prepared by blending 0.5 kg of shelled green mussel and 4–5 whole eggs and cooking the

mixture in a steamer until it solidifies into a custard which is then screened to size. The second artificial feed is similarly prepared but the ingredients used are skipjack tuna, oyster source, agar, fish meal, and eggs.

Tank cleaning and water exchange: Between larval rearing cycles all the equipment and tanks are scrubbed and treated with 50 ppm formalin, or 50 ppm calcium hypochlorite, or 4 ppm $KMnO_4$ for one day. They are then flushed and dried in sunlight for a few days, then rinsed or flushed before reuse.

Daily exchange of water is essential in maintaining an optimum environment for larval growth. Before initiating the procedure the air supply is turned off to allow solid particles to settle. For circular conical tanks, water is made to revolve either clock-wise or counter clock-wise to allow the solid particle to settle on the bottom of the cone. The sediments are then siphoned off from the bottom of the tank. 50 percent of water volume is exchanged every day for the rectangular tank and 10% for the circular conical tank. Water exchange rate should be increased when poor water quality is suspected. This operation should be done after the last artificial feeding, so that no uneaten feed is left overnight in the tank. However, for workers convenience many farms do it in the morning, before feeding time.

3. Larval Growth and Production

Growth rate of larvae varies according to feeding, temperature, water quality, predator and health. In a healthy well-fed batch, which is maintained within the optimum temperature range, most of the larvae will metamorphosed into post larvae within 20–30 days. Once the majority has metamorphosed, the remaining larvae (the minority) are then transferred to the other tank to reduce density and minimize cannibalism. The metamorphosed post-larvaes are acclimatized to freshwater in the larvae tank and hold until required for grow out. Post-larvae production varies from 5–30 per litre. Estimated output of post-larvae from government and private hatcheries in Thailand in 1982, was 80 million.

4. Value of Post-larvae

Post-larvae from government hatcheries were originally distributed free within 1–2 weeks of metamorphosis, and it is this policy which has encouraged the rapid growth of macrobrachium farming in Thailand. Since 1979, a price of 25 *baht/100 has been imposed by the government hatcheries. The same age post-larvae sold by private hatcheries has been ฿30–35/100. Since the end of 1981, due to the over supply of post larvae, the price has decreased to ฿20–25/100. According to the farmer the cost of production varies from ฿5/100 to ฿15/100.

5. Transporting Post-larvae

Post larvae are transported in plastic bags at the rate of 300–400/litre of water, inflated with oxygen and sealed tightly with rubber band. A 40 × 65 cm bag with 2.5–3.0 litres of

water will hold 1,000 post-larvae. A 50 × 75 cm bag with 5 litre of water will hold 2,000 post-larvae. These inflated bags can be used to transport post-larvae for up to 24 hours travelling time, if the temperature is low. Therefore, transportation are practiced in the evening or at night and post larvae are stocked at night or in the morning.

GROW-OUT OPERATION IN THAILAND

1. Pond Production of Prawn

Market demand and price are the major factors determining the success of any prawn grow-out operation. In 1980 the supply of Macrobrachium was far below the demand but today the gap is narrowing. While the total number of Macrobrachium grow-out farmers doubled between 1980 and 1982 increasing from 306 to 667, the cultivated area and total production increased fivefold during the same period from 300 ha to 1,600 ha and from 245 tons to over 1,200 tons respectively. Due to the rapid increase in production the market price has decreased as shown in Table 1.

* US$1.00 = ฿22.96

Table 1. Price of marketable prawns in Thailand

Prawn size	Prices (฿/kg)		
	Locally produced		Imported*
	1981	1983	1983
Large (4–7 tails/kg)	200	190	170–180
Medium (10–15 tails/kg)	180	160	120–130
Small (20–22 tails/kg)	160	140	70–80

* There is a steady flow of imported prawns packed in ice from Burma (1–2 tons/day)

2. Grow-out Areas and Water Management

Macrobrachium farms exist in 51 of 72 provinces in Thailand with the largest number located in the Central Plain particularly in the provinces of Nakorn Prathom, Suphanburi, Ayuthaya, Aungtong since these areas have a good water supply and are close to the large Bangkok market. Ponds vary from 1600 m^2 to 80,000 m^2 and are rectangular in shape. The water supply in these areas is mostly from irrigation canals. Water is obtained by pumping in most cases. In some farms the ponds are filled by gravity. In a few farms in Samut Prakarn and Chacheongsao the water is taken from wells. Well water has a high hardness and is low in dissolved oxygen. It is an expensive source of water supply and is therefore not economical for a large grow-out farm. It is however a good source for

hatcheries since it is predator and pollutant free. Normally water is changed every 10 to 15 days beginning 1.5 to 2 months after stocking. About half of the pond volume is changed at a time. Continuous flow-through is not usually practised but greater production (2.5 tons/ha/yr) has been achieved using this method. The water supply is not generally filtered other than by screen.

Only monoculture of Macrobrachium is practised in Thailand. Some farms stock 90 bighead or silver carp per hectare to reduce the population of phytoplankton and thereby the risk of oxygen depletion in the morning.

3. Stocking Rates

Most Thai prawn farmers stock their grow-out ponds at a rate of 20–25/m^2 and grow them for 2.5–3 months. This constitutes the nursery phase. Survival in a properly managed pond can be 70–80%. The prawns are harvested after the nursery phase and restocked at lower rates (3–5 tails/m^2). Harvesting begins 3 months later. Some farms that do not have sufficient ponds will by-pass the nursery phase, and stock instead with 7–10 days old post-larvae at a reduced rate of 5–10/m^2. Harvesting then begins after 5.5–6 months. Grow out ponds are normally stocked once per year and are harvested periodically (every 15–30 days once harvesting has begun). Only one farm, the largest in Thailand practices continuous restocking after periodic harvests. The number restocked is usually twice the number of prawns harvested.

4. Feeds

The major feeds used in rearing prawns in Thailand are broiler starter pellets, home made pellets and the commercial prawn pellets. The small farmer with a pond area of less than 3.2 ha usually prefers to use broiler starter (฿6/kg) as food for the first 2 months of the growing period. Afterwards a home-made feed is used consisting of 50% cooked broken rice, 25% rice bran, and 25% fish meal. This feed costs ฿5/kg to make and is used throughout the rearing period. Most of the big farms in the Central Plain have been using a commercial prawn pellet (฿10–11/kg) for the first two months and a prepared home-made pellet for the rest of the rearing period. However recently they have found that the quality of the commercial pellet was not as good as the home-made pellet in spite of its higher price. Therefore home-made pellet has now been adopted by most of the larger farmers for the entire grow-out period.

There are several different home-made pellet formulations as shown in Table 2.

Table 2. Composition of three home-made prawn diets

	Formula		
	(%)	(%)	(%)
Trash fish*	-	52	72

Fish meal	30	10.5	-
Shrimp meal	20	-	3.6
Soya-bean meal	-	10.5	5.5
Broken rice	-	10.5	5.5
Rice bran	30	15.6	3.6
Epilepil	-	-	1.1
Broiler starter	-	-	5.5
Starch	10	-	-
Gaurgum	2	-	-
Fish oil	3–4	-	-
Vitamin	4–5	0.3	1.8
Mineral	-	0.6	-
Feed cost (฿/kg)	8–10	7.4	9.2

* Trash fish is the only ingredient used on a wet weight basis.

5. Feed Preparation

Prawn pellets must be of the sinking types with good water stability because prawns are bottom feeders. They feed slowly by holding a pellet in their claws and eating it bite by bite until the whole pellet is gone. In Thailand, two methods are used to make stable pellet. One method is to use an extruder and to adjust the feed composition and processing condition so that the starch is gelatinized but the pellet is still dense enough to sink. The other way is by using binders which have proved effective such as basfin, Guargum, banana, mung bean bran and trash fish.

6. Feeding Rate and Frequency

Feed is normally presented twice per day. The amount of feed is determined by the size of the pond, the number and age of prawns, the water or bottom soil conditions and the weather conditions. The recommended daily feeding rate for a one rai* pond, stocked with 8,000–10,000 post-larvae, with good water, bottom soil and weather conditions are given in Table 3.

Table 3. Daily feeding rate as recommended by the Department of Fisheries of Thailand.

Months after stocking (month)	Amount of feed (kg/day)	Remark
0 – 1	0.5	

1 – 2	1	
2 – 3	1.5 – 2	Amount of feed varies due to differences in genetic, survival rate and water e exchange rates
3 – 4	2 – 4	
4 – 5	3 – 5	
5 – 6	5	
6 – 7	3 – 3	Population size decreases due to periodic harvesting
7 – 8	1 – 3	

* One rai = 1,600 m^2

The amount of feed given per rai per day can be either increased if food given disappear within a day or decreased if there is food leftover. Periodic checking is necessary since leftover feed can create many problems.

7. Growth and Production

Usually a pond-reared prawn reaches marketable size within 5.5–9.5 months after stocking in small ponds of less than 20 rai in size, and 5.5–12.5 months in large ponds of 25–50 rai each. The yield per rai varies from farm to farm, the critical factors that account for the yearly differences in yields are: health of post-larvae, water quality, disease, feed quality, experience of the prawn farmer and predation. Annual yield per rai varies from 120–250 kg (750–1,560 kg/ha).

Table 4. Size, number and output of freshwater prawn farms in Thailand, in 1979 and 1982

	1979	1982
Size of pond (rai)	1 – 10	1 – 50
Size of farm (rai)	1 – 400	1 – 400
Number of hatcheries	44	80
Number of farms	306	667
Total area (rai)	1,878	10,857
Annual output of post-larvae from Chachoengsao Fisheries Station (million)	5.6	14.6

Annual post-larvae required (million)	19	110
Price of post-larvae (฿/100)	25 – 35	20 – 25

PROBLEMS IN MACROBRACHIUM CULTURE

Hatchery production varies from crop to crop, depending on weather, the availability of berried females, water quality, disease and fluorescent protozoa in the water. Some of these problems require further research.

Predation is perhaps the greatest problem for freshwater prawn farming. Predation occurs mainly through canivorous fish, crabs, birds and humans. Freshwater prawn farms are more prone to human predation than many fish farms because of the high value of prawn and the relative ease to catch them. This type of predation can be minimized by good public relations and management. Dogs and reliable watchmen also help. Snakehead or murrel, the most troublesome predators can be kept out by the use of fine net fences around the ponds and by screens placed at the inlet. Crabs can be removed by sinking jars (traps) in the pond banks. Birds predation is minimized by food poisoning and shooting.

In the dry season water supply is either low with less dissolved oxygen or polluted with pesticides which result in slower growth and greater susceptibility to diseases. This should be controlled by reducing feeding rates and by good management. Multidisciplinary and system-oriented research to increase production and reduce losses should be conducted for the development of packaged technology for Macrobrachium culture.

LITERATURE CITED

Boonyaratpalin, M. and M.B. New. 1980. Evaluation of diets for Macrobrachium rosenbergii reared in concrete ponds. IFS Provisional Report. 9: 185 – 200.

Brohmanonda, P. and S. Sahavacharin. 1970. Results of experimental culture of giant freshwater prawn larvae (Macrobrachium rosengergii) at Songkhla Marine Fisheries Station. Songkhla Marine Fisheries Station, Division of Research and Investigations, Department of Fisheries. 30 pp.

Chalorkpunrut, P. 1982. Studies on growth and survival of the post larvae of freshwater prawn, Macrobrachium rosenbergii (De Man stocked at different levels and fed with two types of pellet. Bangkok: M.S. Thesis (Fisheries), Kasetsart University. 82 pp.

Danayadon, Y. 1977. Experiments on cement pond culture of giant freshwater prawn, Macrobrachium rosenbergii with mixed feeds. Annual Report. Songkhla Fisheries Station. 49 – 59.

Menasveta, P. 1980. Effect of ozone treatment on the survival of prawn larvae reared in a closed recirculating water system. Thai Fisheries Gazette. 33(6): 677 – 683.

New, M.B.; M. Boonyaratpalin and P. Vorasayan. 1980. An assessment of performance of Macrobrachium rosenbergii fed simple non-vitam supplemented diets. Joint Department of Fisheries and UNDP/FAO Programme for the Expansion of Freshwater prawn farming in Thailand, Bangpakong, Chacheongsao. 16: 26 pp.

Petcharatmannee, T. and T. Thadtananun. 1977. Experimental on feeding of 3–10 days giant freshwater prawn larvae (Macrobrachium rosenbergii) by using 3 kinds of zooplankton. Annual Report. Songkhla Fisheries Station. p. 150 – 156.

Singholka, S.; M.B. New and P. Vorasayan. 1980. The status of Macrobrachium farming in Thailand. Joint Department of Fisheries and UNDP/FAO Programme for the Expansion of Freshwater prawn farming in Thailand, Bangpakong, Chacheongsao 11: 20.

Sukwon, S.; S. Tansuwan and K. Kulkaew. 1983. Giant freshwater prawn (Macrobrachium rosenbergii de Man) culture in the pen farming Aquaculture Development Project, Department of Fisheries, Bangkok. 15 pp.

Thadtananum, T. and S. Maneewong. 1977. Experiment on culturing of 10–45 days old giant freshwater prawn (Macrobrachium rosenbergii) larvae by using different kind of food. Annual Report. Songkhla Fisheries Station. p. 157 – 165.

Tunsutaphanich, A. and P. Pangpiree. 1981. Demonstrate of Macrobrachium larvae production. Chacheongsao Fisheries Station. 20 pp.

Tunsutapanich, A. 1980. Mixed culture of giant prawn and Chinese carps. Thai Fisheries Gazette. 33(5): 546 – 561.

Tunsutapanich, A. 1981. Macrobrachium breeding in mixed salt waters. Thai Fisheries Gazette. 34(1): 43 – 56.

Vongsomnuk, S.: P. Panichsuk and Y. Danayadol. 1978. Experimental Culture of the giant freshwater prawn, Macrobrachium rosenbergii de Man in a nylon wet exclosure. Annual Report. Songkhla Fisheries Station. 140 – 144.

Wetchagarun, K. and P. Urironk. 1980. Economic analysis of giant prawn farming in Thailand. Thai Fisheries Gazette. 3(5): 571 – 586.