

PRESENT STATUS OF PRAWN FARMING
IN THE PHILIPPINES

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Prawn culture in the Philippines is still mainly traditional. Except for the few who can secure hatchery-produced fry, almost all fishpond operators involved in prawn culture still depend on the wild catch to stock their ponds. Rearing techniques in ponds are generally based on culture methods used for milkfish.

This paper summarizes the usual practices and recent developments in prawn culture in the Philippines.

Seed Production and Larval Rearing

a. Broodstock Development

The successful spawning of cultured P. monodon after eyestalk ablation, stocked in pens under fully marine conditions for gonadal maturation, (Santiago, 1977) has been a significant development in the effort to overcome inadequate and unreliable supply of spawners. Before this, spawner supply mainly depended on the catch from the wild.

Gonadal development in P. monodon since then, has been further studied in more closely controlled environment. With a flow-through system in land-based ferro-cement tanks (Tolosa, 1978) using full-strength marine water, Primavera (1978) observed a minimum of one week and an average of three weeks from ablation to full gonadal maturation on P. monodon. A minimum period of 3 to 5 days for a subsequent spawning after the preceding one was also observed.

The percentage of the original stock which rematures decreases with subsequent rematurations.

The broodstock may be from ponds or from the wild. Desirable weights are 90 g for females and 50 g for males. Those obtained from ponds should be at least one year old (Primavera, 1978).

Since harvest of marketable sized prawns from ponds is 4-6 months from stocking, it would be necessary to provide for a broodstock pond where the marketable sized prawns may be stocked until these would be at least one year old and ready for ablation.

From the source, the prawns may be transported in continuously aerated plastic or canvas tanks. Acclimation should be done over a period of 1-3 days depending on the difference in water conditions of the source and that in the tank or in the pen.

Ablation should be done only when the prawns are hard-shelled. Only the females are ablated and it may either be the left or the right eye. At present, feeds for the broodstock mainly consist of mussel meat but studies are being done on the nutritional requirement and development of artificial diets (Primavera & Lim, 1978).

Fecundity of ablated P. monodon is less than that of the wild. Eggs from one ablated spawner number between 20,000 to 500,000 while eggs from one wild spawner ranged from 50,000 to 1,000,000.

There is no significant difference in the hatching rates of eggs from wild or ablated spawners. Hatching rates range from 0 to 98 percent with 40-50 percent as the average.

b. Small-scale Prawn Hatchery

Prawn hatchery systems developed earlier in other countries like Japan (Shigueno, 1972) and the United States (Cook & Murphy, 1966, Mock & Neal, 1974), have to be modified to suit our local environmental and economic conditions.

There are two general types of hatchery systems (Mock & Neal, 1974) used for the larval rearing of prawns. These are the fertilized and the unfertilized systems.

The fertilized system involves the production of natural feeds in the same tank used for larval rearing. The plankton bloom in the rearing tank is induced by adding fertilizers. The type of plankton bloom is influenced by the biological population in the seawater pumped into the rearing tanks, thus this system is highly site-specific. Larval rearing tanks range in size from 10 to 200 tons. The dependability and larval survival for this system are generally low. The stocking density is normally low at 30-50 larvae per liter with survival rates averaging about 20 percent from nauplius to postlarvae.

The unfertilized system is more sophisticated and involves the mass production of uni-algal cultures which have been found as effective feeds for the larvae, e.g., Skeletonema, Isochrysis, Chaetoceros, Tetraselmis, etc.

The unfertilized system has a higher efficiency but requires a higher initial investment cost and a higher production level for an economically viable operation. The efficiency of the fertilized system is lower but requires a lower investment cost and a lower production level for an economically viable operation.

For a small scale hatchery using the fertilized system, as the hatchery capacity increases and goes beyond a certain production level it would be cheaper to shift to the unfertilized system.

The Barangay sugpo hatchery project of the SEAFDEC Aquaculture Department, organized in January 1977, has the function of developing a small-scale compact hatchery system for P. monodon to serve as a model for fish farmers in adopting the prawn hatchery technology within their economic and technical capabilities. It would also serve as a training facility for interested parties.

The guidelines on the design and operations of a small-scale hatchery system was already prepared and published as an Aquaculture Extension Manual of the Department. It is basically patterned after the unfertilized system but not as sophisticated. At the moment when there is still no comprehensive survey to pinpoint which areas in the country are suitable for the fertilized system and which areas are for unfertilized system, a model of a hatchery system based on the unfertilized system is deemed appropriate. The unfertilized system, being not dependent on the biological population of the seawater in a specific location, can be adopted in a wide range of environmental conditions. Algal stock cultures need not be maintained by small-scale operators as these can be obtained from the SEAFDEC Aquaculture Department's Phycology Laboratory at Tigbauan. After a period of hatchery operations when it will have been observed that a specific site is appropriate for the fertilized system, the Barangay hatchery system can be modified and may be operated as a fertilized system.

Barangay hatchery runs in Tigbauan using 2-ton conical-bottom tanks gave an average larval survival rate of about 30 percent from nauplii to P₅ with a normal initial stocking of 100,000 nauplii. The highest production of 70,000 P₅ in one tank with a survival rate of about 60 percent was obtained.

At the SEAFDEC substation in Batan, Aklan, hatchery runs gave a highest survival rate of more than 90 percent from nauplius to P₅ with an average of about 50 percent.

Barangay hatchery operations, developed mainly for P. monodon, were also found effective for the larval rearing of other penaeid species like P. japonicus, P. indicus, P. merguensis and M. ensis.

c. Natural Feed Production

Algal Culture

The bulk of the problem in hatchery operation is the production of natural feeds.

In the fertilized system, the larval feeds consist of a highly diverse plankton population in the rearing tank, predominantly diatoms such as Skeletonema, Chaetoceros, Nitzschia, Rhizosolenia, Thalassiosira, etc. The natural bloom in the rearing tank is induced by adding mainly potassium nitrate (1-2 ppm) and potassium phosphate (0.1-0.2 ppm).

In the unfertilized system, mass production of uni-algal cultures is conducted. The SEAFDEC Phycology Laboratory has already standardized the culture techniques for the mass propagation of Chaetoceros, Skeletonema, Tetraselmis and Isochrysis. Mass propagation involves a series of culture volumes from a one-liter dextrose bottle to 3-liter jar, 200-liter tank, 1-ton tank and finally to 40-ton rectangular concrete tank. While the 1-liter, 3-liter and 200-liter cultures are continuously lighted by fluorescent lamps the 1-ton and 40-ton cultures are located outdoors and depend on the sun as the light source.

For small-scale systems the maximum culture volume may only be up to 1 ton. The algal culture is concentrated and washed by the use of a fine sand filter before feeding into the rearing tank.

Even with uni-algal cultures, synchronizing natural feed production with larval rearing operation is sometimes met with difficulties, e.g. the expected bloom does not occur due to contamination.

The feeds for the zoea stage mainly consist of algae. At the mysis stage, the larvae feed on rotifers (Brachionus) or brine shrimp in addition to the algae. In the postlarval stage, the diet mainly consists of brine shrimp or blended mussel meat or shrimp meat.

Brachionus Culture

The culture technique for the mass production of Brachionus fed with Chlorella or Tetraselmis has already been standardized and is one important component of the hatchery operation. Brachionus culture is harvested by draining onto a fine (mesh no. 200) nylon net.

Brine Shrimp Culture

The nauplius of Artemia is the primary food of the mysis and the postlarvae in penaeid hatcheries and also of aquarium fishes. Brine shrimp is normally available in the form of cysts or eggs contained in cans which could remain viable for years. These cysts are collected in large quantities from their hypersaline environment, e.g. Salt Lake in Utah, or San Francisco Bay. When placed in ordinary seawater, the cysts hatch in about one day.

The biology of brine shrimp has been significantly studied (Sorgeloos, 1973; Nimura, 1967). At this stage basic research data are being applied into aquaculture systems for the mass production of this species.

The life cycle of Artemia is about 2-3 weeks in ordinary seawater (32-36 ppt), at a temperature range of 27°-32°C. Subjecting them to salinity stress by increasing from 32 to about 60 ppt, gravid females give off their eggs (Villacarlos, 1975).

Experiments on feeding for brine shrimp at SEAFDEC showed that Chlorella (Villacarlos and Villegas, 1976) and fine rice bran (less than 60 microns in diameter) (Bernardino & Laviña, 1978) are each effective feeds for mass rearing in tanks.

The first successful mass rearing of brine shrimp in the Philippines, using earthen ponds (de los Santos, 1978, personal communication), is now capable of producing 500-1000 grams of cysts per hectare per day.

Screening of Artemia strains for local culture is going on at SEAFDEC.

d. Artificial Feed Formulation

The use of artificial diets in the larval rearing of prawns in the Philippines is not as common as it is in Japan, the United States, Taiwan and Panama. Most of these feeds are manufactured by companies which also own the hatcheries; these feeds are for their own use. These artificial feeds, after having been finely ground and passed through Mesh No. 60, may be given starting at the mysis stage.

For the postlarval stages of P. monodon, Lim (1978) developed different artificial diets containing different protein sources such as casein, shrimp meal, squid meal and Spirulina. Results showed that squid meal and shrimp meal are good protein sources for P. monodon postlarvae.

Much has to be done regarding nutritional requirements of the different larval and postlarval stages of the prawn and the eventual development of artificial diets.

Development of micro-capsulated artificial diets for the larval stages is being done in Japan and Europe. Efforts on these are mostly experimental at the experimental stage.

e. Diseases

Diseases in prawn hatcheries are mainly caused by infections from fungus, bacterial and protozoans. Iagenidium or Sirolopidium can cause mass mortality at all larval and postlarval stages. Some bacterial infections have been observed to be associated with the collapse of diatoms in the larval rearing tank (Villaluz, et al., 1976) causing reddening and discoloration of body tissues of mysis and post-larvae.

The most effective method of controlling these diseases is to eliminate the possible sources of infection. Chlorination of water after fertilization and neutralization 12 hours later with sodium thiosulfate is helpful (Cook, 1976).

Disinfection of spawners before these are placed in spawning tanks using formalin (50 ppm) or furanace (3 ppm) is a standard practice in Barangay hatchery operations. The spawning debris should be removed and the eggs may be treated with malachite green (5 ppm). In transferring nauplii from the hatching tank to the larval rearing tank, unhatched eggs should be settled first and scooping of the nauplii should be done with care not to scour the sediments. Gacutan (1978) also pointed out Treflan (0.1 ppm) and 2, 4-D (0.01 ppm) to be suitable for disinfection of spawners.

f. Rearing in Nursery Ponds

Harvest in the hatchery is done at P₅. From the hatchery the postlarvae are transported to the nursery ponds using continuously aerated transport tanks (for hundreds of thousand P₅) or in oxygenated plastic bags contained in styrofoam boxes (for 10,000 to 20,000 P₅ per bag). Transport should be done in the early morning or late afternoon or on such time that after acclimation at the pond site, stocking could be done when the sun is not so bright (earlier than 0900 hrs or later than 1700 hrs).

The period of acclimation varies depending on the difference in water conditions in the pond and in the container. Normally, three hours is sufficient.

Pond culture of prawns in the Philippines is basically an adaptation of the culture system for milkfish. Since prawn and milkfish have entirely different biological requirements, an attempt to intensify prawn culture would require modifications of existing milkfish culture systems or development of systems more appropriate for prawns.

Apud (1977) has developed an effective nursery pond system for prawns. The important features of the system are:

1. a daily replenishment of about 10 percent of the pond water volume
2. water depth of 50-75 cm
3. sand filtration of water flowing through the nursery pond
4. introduction of water to the ponds by sprinkling through perforated pipes, increasing dissolved oxygen in the water
5. diamond-shape ponds with the two acute corners positioned along the prevailing wind directions
6. a horizontal gravel and sand filter box through which water from the pond is drained and is located on one of the two acute corners
7. diagonal trench canal extending along the two acute corners

Pond areas ranging from 500 to 1,500 sq m per compartment are practical and easily manageable.

The nursery pond is prepared and fertilized in a similar manner as for milkfish although the benefits of fertilization for prawn culture are indirect (Cook, 1976). Fertilizers induce phytoplankton bloom upon which various microorganisms feed; prawns feed on the microorganisms.

Without supplementary feeding, nursery ponds may be stocked at densities ranging from 50 to 100 P₅ per sq m. With supplementary feeding (trash fish, mussel meat, or formulated feeds) stocking densities may be as high as 150 P₅ per sq m.

Optimum water salinity is 20-25 ppt. Survival rates from P₅ to P₃₅ range from 40 to 80 percent with an average of about 60 percent.

The use of raceways as nurseries is practical in areas where electric power needed to drive a blower or compressor is dependable. Feeding for this system is mainly introduced.

When juveniles or P₃₅, about 1-2 gm sizes are harvested, the filter tray at the draining end of the pond is removed. The box which holds the filter tray in place also serves as a collecting pool. A bagnet fitted to the monk gate at the discharge end collects juveniles that have escaped from the collecting box. Juveniles inside the box are scooped and transferred into pails or tank containing enough water. Those left in the pond bottom or in the diagonal trench canal are flushed into the collecting box.

g. Transport of juveniles

Juveniles may be transported by either using a continuously aerated transport tank (cylindrical and lying on its side with an opening at the top) or oxygenated plastic bags.

A continuously aerated tank was used in transporting P₂₅ from SEAFDEC's Leganes ponds to its Freshwater Fisheries Station in Binangonan, Rizal. For a stocking density of 500,000 per ton of water, the mortality rate was about 20 percent. The tank was transported by ship and the total time of transport and handling from Leganes to Binangonan was about 30 hours.

When transporting with the use of oxygenated plastic bags, the juveniles are transferred into a tank containing water which should at least be sand-filtered. The water temperature is then reduced gradually to about 20°C using frozen sea water. The juveniles are then packed in plastic bags containing 8-10 liters of water and inflated with about 16 liters of oxygen. The bags are placed singly or doubly in styrofoam boxes, each box provided with an ice pack firmly placed on top of the plastic bag.

Yap, et al., (1978) established the range of transport mortality rates for juveniles (P₂₂) transported in oxygenated plastic bags, at different packing densities for a period of 12 hours of transport and handling. Five density levels were 1,000, 2,000, 3,000, 4,000 and 5,000 juveniles per bag. A pack of 300 g of ice was used in each box. It was found that prawns of 40 mg size can be packed as high as 3,000 per bag. Packing densities above 3,000 per bag containing 8 liters of sea water and 16 liters of oxygen can be used only for short transport periods.

Culture in Grow-out Ponds

a. Layout and Construction

Pond culture of prawns is still in great need of basic standards of pond layout and construction. There have been significant results from basic researches during the last decade which can be made as the basis for the development of an aquaculture system for prawns.

Pond Layout

In extensive systems where prawns mainly subsist on natural feeds propagated by fertilization of ponds, Santiago, et al, (1974) observed that growth rate of P. monodon decreased after about two months of culture in ponds. This observation is confirmed by some fishfarmers who have tried mono-culture of prawns.

It would probably be desirable to develop a progressive method of culture wherein the stock may be transferred from one pond to another depending on the size of the stock. The lay-out of ponds can thus be arranged to enable a series of transfer from nursery pond (NP), to the transition pond (TP) and finally to the rearing pond (RP). The ponds should be adjacent to enable the prawns to move with the water during transfer.

For intensive systems, it would be sufficient to have nursery ponds (NP) and rearing ponds (RP). Since feeding would mainly consist of feed introduced into the pond, a flow-through system would be advisable to maintain water quality in the ponds.

Dike Construction

Before the construction of dikes, design criteria (Denila, 1976) should include:

1. tidal fluctuations
2. observations of flood waters
3. weather conditions
4. availability of local labor
5. type of soil
6. water source

The decision on whether to use tidal fluctuation or pumping to supply water into the ponds is greatly influenced by the economics of construction and the dependability of electric power. The desirable effective depth of water in the pond is 1 m.

Water Distribution System

It is desirable to have separate intake and discharge canals. This would minimize the spread of disease from one pond to another. This would also enable better exchange of water unlike in a one-canal system where water at the far end is not likely to be flushed out unless the pond is completely drained. With this system, a flow-through condition may be employed which is essential for intensive culture.

Water Control Gates

Design of gates should consider the following:

1. water requirement in the ponds per unit of time and the amount to be drained per unit of time
2. a provision for water to be taken in and discharged from the bottom
3. the bottom should allow complete drainage of water from the pond
4. provision for screens to serve both as a predator control and to prevent escape of prawns from the pond
5. provision for installing a net for harvesting
6. when using boards, these should be interchangeable

b. Liming and fertilization

Pond soil should have a pH of at least 6.5. Acidic soils normally result in lower growth rate. Liming may be used to reduce or eliminate soil acidity. The amount of lime to be applied into an acidic pond depends on the pH. For pond conditioning in acidic ponds, Primavera and Apud (1977) recommend a lime dosage of 1,000-2,000 kg/ha.

Since the composition of soil and sea water varies with location, the desired fertilizer dosage for different ponds would also vary. It is suggested that every pond operator develop a fertilization method appropriate for his own ponds. Soil and water analysis should be made to determine the amount of nitrogen and phosphorus that should be added. With a certain starting dose, the rate of application may be increased or decreased while the corresponding type of phytoplankton bloom is observed. The optimum level of fertilization could be established after a number of trials.

Diatoms in prawn ponds is more desirable than other types of algae (Cook, 1976). A bloom of diatoms in ponds is characterized by a yellowish brown color while other types give a bright green color. The nitrogen to phosphorus ratio of 30:1 has been found most suitable for diatoms.

It has been a common practise among fishfarmers to use both organic and inorganic fertilizers.

c. Pests and Predator Control

Fish, crabs and birds are the main predators in prawn ponds.

The entry into the pond of unwanted fish may be prevented by the use of screens installed in the gates. However, those which are able to gain entry may be eliminated with the use of Saponin applied at the rates of 10-25 ppm (Cook, 1976). This effects the fish but not the prawn. Rotenone is also effective in eliminating fish predators but care must be taken when using it because the difference in lethal limit for fish and prawns is small. Thorough drying of ponds during pond preparation is effective in eliminating unwanted fish.

Crabs are one of the causes of leakage in dikes. Traps may be used to catch them.

Birds can eat a significant portion of the cultured prawns. They may be driven away by bird-scaring devices (Cook, 1976). Stumps extending beyond the water level in ponds may encourage flocking of birds as these stumps provide resting places. These stumps should be removed.

Snails compete for the natural food. These may be eliminated by applying commercial nicotine at 12-15 kg/ha or tobacco waste at 200-400 kg (Primavera and Apud, 1977) during pond preparation.

d. Natural Food in Ponds

The natural feeds growing in ponds consist of lablab, lumut, phytoplankton and benthic animals.

Lablab is mainly composed of benthic blue-green algae and diatoms. Many other forms of plants and animals are associated with it. Lablab grows well at a salinity level of about 20 ppt.

Lumut is composed of filamentous green-algae. Other organisms associated with it contribute to its nutritive value.

Phytoplanktons are microscopic plants which float in the water. Other organisms eat phytoplanktons; prawns feed on these other organisms.

Benthic organisms are those which remain at the bottom of the ponds and feed on detritus or settled decomposing substances.

e. Nutrition and Feed Formulation

In extensive traditional ponds, feeding is mainly supplementary to the natural productivity of ponds. The common feeds that are given are rice bran, mussel meat, trash fish, corn or carabao skin, toads and snails.

Apud (1978) conducted a study on the monoculture of P. monodon using a flow-through water management scheme with supplementary feeding at various stocking densities in ponds. Over a period of 3.5 months, with stocking densities of 2.5, 5.0, 10 and 20 juveniles (0.45 g) per sq m, the average weight at harvest was least (7.24 gm) at 20 per sq m density. It consistently increased with decrease in stocking density. Total production per hectare increased consistently with increase in stocking density; 583.84 and 1264.43 kg at 2.5 and 20 per sq m density, respectively.

Mangalik and Lim (1978) studied the effect of various lipid sources on the growth and survival rates of P. monodon juveniles in a controlled environment. Results of the study indicated that beef tallow is a good lipid source for P. monodon when based on growth rates. However, based on feed conversion values and survival rates, fish oil is better utilized by shrimp than beef tallow. Pork lard, coconut oil and corn oil are not good lipid sources for P. monodon.

f. Monoculture/Polyculture

In the Philippines, the bulk of pond-harvested prawns is cultured with milkfish. Only a few are involved in monoculture of prawns. Among fishpond operators in Iloilo Province who were involved in SEAFDEC's Cooperators' Program, 77 percent had dual culture of sugpo and milkfish while only 23 percent had monoculture (SEAFDEC, 1977). The percentage of those involved in monoculture for Iloilo is most likely to be the highest among all regions in the country due to the presence of the SEAFDEC hatchery in Iloilo which could provide large quantities of fry at a given time.

By comparing the economics of the two culture systems, the returns from monoculture is significantly higher than that from polyculture with milkfish. (Apud, personal communication, 1978).

Economics of Mono- and Poly-Culture

	Monoculture	Polyculture with Milkfish
Stock requirement/ha/yr (2 operations/yr)		
a) <u>P. monodon</u> juveniles (40,000 and 10,000 at ₱0.35)	14,000.00	3,500.00
b) Milkfish fingerlings (6,000 at ₱0.30)		1,800.00
Total Production Cost*	36,000.00	16,500.00
Gross Income:		
a) $\frac{40,000 \times 60\%}{20 \text{ pcs/kg}} \times \text{₱}40.00/\text{kg}$	48,000.00	
b) $\frac{10,000 \times 60\%}{20 \text{ pcs/kg}} \times \text{₱}40.00/\text{kg}$		12,000.00
$\frac{6,000 \times 90\%}{3 \text{ pcs/kg}} \times \text{₱}5.00/\text{kg}$		9,000.00
Net Income	12,000.00	4,500.00

*Does not include land acquisition cost

The development of an intensive monoculture system depends on the dependable supply of fry from hatcheries and the development of suitable formulated diets.

g. Stocking rates

For polyculture systems with milkfish, stocking per hectare of 5,000-10,000 for prawns and 500-1,000 for milkfish is recommended by Primavera and Apud (1977). At higher stocking densities of prawn, supplementary feeds are introduced.

For monoculture systems, stocking densities for prawn range from 5,000 to 30,000 per hectare for extensive systems and 100,000 to 200,000 for intensive systems.

h. Parasites and diseases

Since the prevailing method of prawn culture at the moment is still the extensive one, few cases of disease from ponds have been reported. Among those observed is "black gill" disease. This can be caused by fungus, bacteria or detritus.

Another condition observed is the papery exoskeletons and soft flesh of prawns. This may be caused by poor nutrition and poor pond conditions.

Some shrimp diseases observed in other countries are muscle necrosis (Rigdon and Baxter, 1970), cotton shrimp (Sinderman, 1974), Virio (Shigueno, 1974), white shell disease and viral disease.

In the control of diseases, it would be worthwhile to consider the environmental conditions and nutrition of the infected stock. Mere addition of chemicals is not sufficient.

i. Harvesting

After a rearing period of 4 to 6 months in ponds with 10-25 ppt salinity, the size of the stock may range from 30 to 60 grams each (Primavera and Apud, 1977). Growth is slower at higher salinities.

Harvesting may be done partially or totally. Partial harvesting may be done with nets, or traps. If nets are used, it would be effective to attract the prawns and getting them to concentrate in a certain area by introducing food or, if harvest is done at night, by the use of lights.

Total harvest may be done with the use of bagnet in sluice gate, partial draining of water or with a trap in the outlet canal.

With the bagnet in the sluice gate, harvest is done by draining the pond and catching the prawns as they move with the outflowing water.

By partially draining the water the prawns move to the deeper canals. These are then caught by dragging a net along the canal or with the use of scoop nets.

Traps may be installed in the water outlet canal. As the pond is drained, the prawns moving with the outflowing water are caught in the traps.

Sugpo culture in cages in freshwater

Successful grow-out culture of P. monodon in freshwater using cages was achieved at the SEAFDEC Freshwater Fisheries Station in Laguna de Bay.

Juveniles (1 gram size) from the SEAFDEC ponds in Leganes which were earlier stocked as postlarvae from the Tigbauan hatchery were transported to the Freshwater Fisheries Station in Laguna de Bay. After acclimation for a period of about three days these were stocked in cages and placed in the lake. Supplementary formulated feed was given.

Post-harvest handling, processing and marketing

After harvest, dirt and debris are removed. The prawns are placed in baskets or any suitable container with crushed ice poured on top of the prawns. A container of 15-20 kilos capacity is convenient for handling and transporting (Tan, n.d.). Handling should be done carefully as bruised prawns deteriorate fast. For local markets, the prawns may be brought to the market in this condition. It is important that before the product finally reaches the consumers, it should be kept at a low temperature.

If the prawns are to be exported, further processing is necessary. From the ponds, the iced prawns are brought to the processing plant. The heads are then removed to help cut down on transport cost and minimize deterioration in transit. The head contains about 75% of bacteria on prawns (Legaspi, 1975). The prawns are then washed with cold water and sorted as to size. Prawns of same sizes are placed in 2 kg capacity trays (Tan, n.d.). These trays holding the headless prawns are subjected to quick freezing at -30 to 40°C for one hour.

The trays are then removed and chilled water is poured over the prawns to a level that all are impersed. The trays are again quick-frozen for another hour. The headless prawns are finally encased in small blocks of ice which are removed from trays by immersing in ordinary tap water. The blocks are then placed individually inside plastic bags and packed in bigger boxes (cartons), each box containing 10 blocks.

The boxes are sealed and stored at -15 to 20°C. These are shipped with the use of a refrigerating unit.

Economics of prawn culture

Assumptions:

- a. 30% of ablated females will spawn
- b. each spawner has 200,000 eggs
- c. hatching rate of eggs is 50%
- d. survival rate in the hatchery is 30%
- e. each hatchery tank is stocked with 100,000 nauplii
- f. stocking density in nursery ponds is 100 postlarvae per sq m
- g. survival rate in nursery ponds is 50%
- h. stocking density in grow-out ponds is 10 juveniles per sq m
- i. survival rate in grow-out ponds is 70%
- j. at the time of harvest, size of stock is 50 grams each or 20 pieces in 1 kg
- k. the price of prawn is ₱40.00 per kg

Economics of an Integrated Prawn Project

	Area Requirement	Initial Investment	No. of runs or crops/yr	Operating Expenses	Seed/Stock Requirement	Production	Income P.A.
Broodstock	2 4-m dia. tanks (50 sq m)	₱ 280,000	9	₱ 90,000	800 broodstock/ year 400 males; 400 females	120 spawners/yr 14 spawners/run	
Hatchery	10 2-ton tanks (250 sq m)		12		120 spawners/yr 24 M eggs/yr 12 M naup/yr 1 M naup/run	3.6 P ₅ /yr 300,000 P ₅ /run	
Nursery	20 600 sq m ponds	336,000	6	60,000	3.6 M P ₅ /yr	1.8 M P ₃₅ /yr	
Grow-out (Lemo.)	30 5,000 sq m ponds	1,500,000	2	400,000	1.8 M P ₃₅ /yr	1.26 M pcs/yr 63,000 kg/yr	₱2.52 M at ₱40/kg
		<u>₱2,116,000</u>		<u>₱550,000</u>			

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