HATCHERY PRODUCTION OF SHRIMP SEEDS

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HATCHERY PRODUCTION OF SHRIMP SEEDS

The pioneering efforts of Hudinaga in the successful spawning of *Penaeus japonicus* under controlled conditions and their subsequent rearing upto the juvenile stage have paved way for the large scale hatchery production of seed of penaeid prawns for aquaculture. There are two basic hatchery techniques for mass rearing of larvae of penaeid prawns - Japanese techniques and Galveston technique. These techniques have been appropriately modified to suit different geographical and climatic conditions and different species of prawns used for aquaculture. Thus many gradations between these two techniques have been noticed in different parts of the world. Sometimes combinations of these two techniques have also been used.

1 Japanese Technique

The well known Japanese system, otherwise known as community culture system or fertilized system or large tank hatchery system, involves spawning, hatching, larval and post larval rearing upto the fry stage in the same tank. By fertilizing the water phyto and zooplankton organisms which form the food of larvae are also raised along with the prawn larvae in the same tank. The hatchery tanks (cement concrete) are large and vary in size from 60-200 tons of water capacity and above. They may be rectangular or square having a depth of 1.5 to 2 m. They may be indoor in hatchery with transparent roof or outdoor depending on the weather conditions. Tanks are provided with good aeration systems and rotating agitators. Just before the larval rearing operations, tanks are cleaned, sun dried and filled 1/5 with fresh filtered sea water. Vigorous aeration is provided and the water is agitated slowly by rotating vanes attached to an electric motor.

Spawners are treated with 3 ppm potassium permanganate or any other specified chemicals in required strength and introduced into the tank in cage nets. (1 spawner per m^3 of tank capacity). After spawning, the spawners are removed along with the cage nets. The eggs hatch out into nauplii within 12-18 hrs depending on the water temperature. The tank is now fertilized with nitrates (KNO_3, 2 ppm) and phosphates ($KHPO_4$, 0.2 ppm) which helps the growth of naturally occuring diatoms on which the protozoea exclusively feed. The water is fertilized daily to maintain a good growth of diatoms (5000 to 20,000 cells/ml). By the time protozoea develops into mysis stage, a good population of zooplankton also develops in the tank. Thus an environment closely similar to sea is created. Anaerobic decay of the dead organisms is prevented by vigorously aerating the entire column of water. From mysis I to the post larva 4, fresh,

sediments-free, clean filtered sea water is pumped everyday until the water level is increased to the maximum tank capacity. Artemia nauplii or minced and washed clam meat or formulated feed of appropriate size are provided for post larval stages as supplementary feed. It is difficult to maintain the initial stocking density of nauplii constant throughout the run in this system. Generally the initial stocking is around 100 N/L. Postlarvae are reared upto PL 25-30 in the same tank within a period of 35-40 days, at the production rate of 5-25/L on an average so that a minimum of 10,00,000 PL 25-30 can be obtained from a larval rearing tank of 200 ton capacity in a single run. Modifications in the feeding pattern has been effected subsequently. In Taiwan, oyster larvae produced by artificial fertilization was used as food when phytoplankton failed to bloom. 'Bread-yeast' @ 2 gm/tonne/day is being used along with mixed diatom to feed protozoea and mysis stages in Philippines. Rotifier is cultured separately and fed at a concentration of 10-25/ml for mysis and early postlarval stages.

The maintenance cost and technical expertise required are low for this system of hatchery compared to the Galveston system. Using the same tank for rearing larvae through various stages upto the seed size and transferring the same to the farm are the notable advantages of this system. The disadvantages are the high initial cost of large tank construction, lack of control over the intensity of the phytoplankton and the frequent blooming of undesirable species of organisms such as dinoflagellates and Noctiluca, which leads to mass mortality of larvae. As the larvae do not hunt for food but filter the food particles within their reach in the medium, a good amount of food will remain unutilized when the density of larval population is less.

2 The Galveston System

This system is more sophisticated and it consists of few independent functional processes such as mass production and storage of pure algal culture, mass production of freshly hatched Artemia nauplii and larval rearing operations which involve higher technical skill. Culture of desirable species of food organisms and proper control over the water quality, as small containers are used, make this method more dependable.

Originally a fibreglass tank of 946 litre capacity was used for spawning and a 19 litre polyurethene carbuoy for rearing nauplii to post larvae. Phytoplankton feed in the larval tank is kept in suspension by aeration. Half the water in the carbuoy is replaced every day with fresh filtered seawater, which dilutes the metaboilite concentration. Using this system, a total of 133 postlarvae were obtained from 266 nauplii per litre (50%). Later, a modification to this system took place in which 1890 litre cylindrical polyethylene containers connected to a sea water re-circulation system were used with crushed oyster shell as filter bed for spawning and larval rearing. The re-circulation is stopped when pure cultures of diatoms or unicellular algae are added

to the tank water for feeding protozoea in order to maintain a concentration of 10,000-15,000 cells/ml. Freshly hatched Artemia nauplii are given at the rate of 3-5/ml of water for feeding the larvae from mysis stage onwards.

This system has been further improved by introducing cylindro-conical fibre glass tanks of 2 m^3 capacity for rearing larvae. The shape of the tank facilitates efficient dispersal of food items and larvae in the water column. This system has been adopted and modified in Tahiti (Philippines) and U.K. Algae in higher concentrations (30,000 - 1,00,000 cells/ml) are maintained separately and used for feeding protozoea larvae. Brachionus culture maintained separately is also fed at a concentration of 5-10 rotifers/ml of medium. From PL-1 onwards freshly hatched Artemia nauplii are fed at a density of 5 nos/ml in the medium. Nauplii are stocked at the rate of 100-200 nos/litre and reared upto PL-5 at a survival rate of 70% and are transferred to nursery tanks.

This system has many advantages. Few spawners will suffice the larval requirement of the hatchery. It is easy to manage the water quality and the water requirement is less. Further, the water temperature can be controlled. Diseases can be checked and prevented by water management and antibiotic treatment. Food is not wasted and survival rate is high.

3 Hatchery systems developed in India

3.1 CMFRI Technology:

A low cost technology for hatchery production of prawn seed has been developed by the Central Marine Fisheries Research Institute (C.M.F.R.I.) and used successfully for the large-scale production of PL 15-20 of, *P.indicus, P.monodon, P.semisulcatus* and *P.canaliculatus*. Using this technology, CMFRI has established a hatchery (capacity: 1 million seeds per run) for MATSYAFED at Cannanore, Kerala.

Cost of production of PL 15-20 is made minimum, making use of the natural advantages of Indian coast, such as good sun light, ideal temperature, clean sea water of above 30% salinity, and native candidate species. It is established, all feeding larval stages could be reared successfully by feeding them exclusively with the diatom *Chaetoceros* spp. which are abundant along the Indian coastal waters. They are cultured in indoor fibreglass tanks in hatcheries with transparent roof facilities. Mysis III to PL 20 are fed with hen egg-prawn custard.

This technology can be put into operation after hatchery is constructed on a properly selected site. The following are important criteria to be considered for choosing a site for the hatchery.

1. The sea water should be of good quality and have a salinity of 28-34 ppt throughout the year. For this the site should be far away from river mouths so that the sea water is not

diluted by the freshwater discharge from the rivers. Flood water from the rivers also brings in a lot of silt and detritus adding to the turbidity of the water.

2. It should not be located near sources of thermal, sewage or industrial pollution.

3. The sea bottom near the site should be sandy or rocky, not muddy. The seashore should be flat or gently sloping.

4. Freshwater (either from tap or from wells) should be available at the site.

5. The area should be easily approachable by good roads and should be near a town with amenities for the hatchery staff to live in.

6. The site should be situated in the neighbourhood of prawn farms. The proximity to a fishing harbour would be advantageous so that obtaining adult prawns for the broodstock will be easier.

7. Areas subject to sea erosion or soil erosion should be avoided.

8. The area should not be affected by cyclones and floods.

9. Electricity supply should be available in the vicinity, from which connections could be taken to the hatchery without heavy expenditure.

The technology developed by CMFRI for Penaeus species is in fact a package of practices involving the following components: i) Brood stock management ii) Spawning iii) Larval rearing, iv) diatom culture and v) preparation of hen egg-prawn custard for feeding postlarvae.

Brood stock management: Spawners are either collected from the marine trawl net catches or from brood stock maintained in the hatchery. The females are also induced to mature under controlled conditions.

Induced maturation is effected by unilateral eyestalk ablation and providing congenial conditions for faster ovary development. Females of appropriate weight are collected from brood stock tanks from shrimp farms or from sea. Female shrimps brought are first acclimatised to hatchery conditions for 24-48 hours. Unilateral eye stalk ablation is done using electrocautery apparatus or by using red hot forceps. Only female shrimp is ablated. After ablation they are maintained in maturation pools for further development along with males of proper weight at a ratio of 1:1. Generally ten-ton tanks with biological filter are used as maturation pools. Depending on the species selected 20-50 animals can be maintained in a 10 ton tank. Inner side of the maturation tank is painted black using non toxic paints and is covered to prevent light for about 14 hours every day.

"Clear sea water conforming to the following hydrological parameters are conducive for maturation"

Parameter	Premissible range
Salinity	29-34 ppt
Temperature	27-29°C
pHI	8.0-8.2
Dissolved oxygen	4.0-5.5 ml/litre
Total ammonia	0.002-0.07 ppm
Nitrite	0.003-0.02 ppm
Light intensity during day time in the shed	500-3600 s lux

The pH of the sea water in the pool is maintained between 8.0 and 8.2 by addition of sodium carbonate (ca. 25 g/m^3 of water every day). The prawns are fed with fresh clam or mussel meat at the rate of 12.5-15.0% of prawn biomass per day in the evening. The unused food and faecal pellets are siphoned out in the morning. Under these conditions about 70% of the ablated females mature and spawn within 4-5 days after eyestalk ablation.

The water in the maturation pool is totally replaced before introducing a fresh batch of ablated females. Spent females can also be used for rematuration when fresh spawners are not readily available.

Spawning: Impregnated females with fully mature ovary* (fig.1) are transferred at a rate of one each to a 250 litre capacity spawning tank containing 200 litres of sea water of 30-34 ‰ salinity, filtered through 50 micron mesh. Spawner transfer is done in the evening. Disodium salt of EDTA is added to the water at the rate of 0.1 g/100 litres of water. The ideal temperature range is 27-30°C and pH 8.0-8.2 A mild aeration is provided and the tank is covered with black cloth to protect the spawner from strong light and to prevent it from escape. Spawning usually takes place between 8 pm. and 2 am. in the same day. Female, after spawning, is removed from the tank at 6 am. Continuous increased aeration is maintained in the tank. Depending on temperature, hatching takes place within 12-18 hrs and by afternoon all viable eggs hatch out to nauplii. After 5-6 hours, aeration is stopped and nauplii are allowed to congregate at the surface. Dead and unhatched eggs that sink to the bottom are siphoned out along with bottom sediments. Once again aeration is switched on and the water is mixed thoroughly and three, 100 ml samples are collected with beakers and the number of nauplii in the samples counted and the total number of nauplii estimated.

*fully mature every is dark green in colour, occupies major portion on the dorsal side of the animal along its entire length. It has a lateral expansion in the first abdominal segment.

Larval rearing: 2 to 5 ton capacity cylindroconical tanks are used for rearing larvae upto PL 3-5. Fibreglass or cement tanks with an inner coating of non toxic epoxy paint are used. The tanks are cleaned with bleaching powder, washed with freshwater, and sun dried for 24 hours. They are again washed with filtered sea water and then set for larval rearing. Tank is half filled with sea water, filtered through 50 micron mesh. Continuous good aeration is provided throughout the rearing period. Counted nauplii are transferred to the larval rearing tank at a stocking density of 75-100 /litre. During stocking the temperature difference of water in the spawning and larval rearing tank should not be more than $1^{o}C$. Desired temperature for larval growing is $28^{o}C$-$30^{o}C$. After 36 hrs of hatching, the nauplii will be in its 5th or 6th stage depending on the temperature of the medium. During this time 100 litres of mixed algal culture dominated by *Chaetoceros* sp. or *Skeletonema* sp. is added into the larval rearing tank.* Concentration of the algal cell in the medium must not be below 20,000 cells/ml. The diatoms thus added will ensure the availability of food with in the easy reach of first protozoea. From first protozoeal stage onwards 150-200 litres of algal culture is added and the water level is made up to the maximum by adding filtered sea water. From 4th day onwards daily 1/4th to 1/3rd water is replenished. Filter bags suitably meshed are used while siphoning out water to prevent escape of larvae. If the algal culture used is dominated with *Chaetoceros* species, no supplementary feed is required until third mysis stage. Otherwise supplementary feeding with particulate feed or hen egg-prawn custard may be given from first mysis stage onwards. Usually it is provided from third mysis stage onwards. The quantity of algal diet is reduced from first postlarval stage. Larvae are reared upto PL 3-5 in the same tanks and then transferred to nursery tanks for further rearing.

From 2nd protozoea onwards, bottom sediments of the tank are removed daily. Aeration is stopped to allow larvae to surface before siphoning out the water or removing the bottom sediments.Clear seawater conforming to the following hydrological parameters are conducive for larval rearing:

Salinity	-	29-34 ppt
Temperature	-	26-0-32.5^{o}C
pH	-	8.0-8.5
Dissolved oxygen	-	3.0-8.0 ml/litre
Light intensity in the hatchery during the time	-	20000 to 125000 lux
Total ammonia	-	< 0.1 ppm
Nitrite	-	< 0.05 ppm

*Protozoea Feed on a variety of daitoms such as Skeletonema Costatum, Chaetoceros sp Thalassiosira sp etc. But it was found that larvae upto last mysis stage could be reared exclusively on Chaetoceros sp.

Few guidelines to the management of larval rearing tanks are given in table No.2. But it must be noted that careful attention to water quality and condition of larvae, the volume of water exchanged and the amount of feed given should be judiciously varied to meet the exigencies of the situation

Table 2: Management of larval rearing pools

Day	State		Seawater removed (litres)	Algal culture added (litres)	Egg prawn custard (g)	Seawater addition (litres)	Total vol.of water made upto (litres)
1	N	2	-	-	-	1000	1000
2	N	5	-	100	-	-	1100
3	PZ	1	-	150-200	-	700-750	2000
4	PZ	2	500	150-250	-	250-350	2000
5	PZ	3	500	150-250	-	250-350	2000
6	M	1	500	150-250	-	250-350	2000
7	M	2	500	150-250	-	250-350	2000
8	M	3	500	150-250	80-100*	250-350	2000
9	PL	1	750	100-150	80-100	600-650	2000
10	PL	2	750	100-150	100-125	600-650	2000
11	PL	3	750	100-150	100-125	600-650	2000
12	PL	4	750	100-150	100-125	600-650	2000
13	PL	5	750	100-150	100-125	600-650	2000

* The daily ration of egg custard may be split into 4 to 6 equal doses and fed at suitable intervals.

Diatom culture initiation and maintenance: For initiating the algal culture, fresh unpolluted sea water (30-34 ppt salinity) is filtered through a 50 micron mesh bolting cloth and kept in 1000 litre capacity, white fibre-glass tanks placed under the transparent shed. The sea water is fertilized as below:

Sodium nitrate	..	12 ppm
Potassium orthophosphate	..	3 ppm
Sodium silicate	..	6 ppm
EDTA di-sodium salt	..	6 ppm

Sodium silicate has to be completely dissolved in freshwater. Other chemicals can dissolved in freshwater/seawater, and mixed thoroughly in the sea water of the algal culture tan

Two air-stones connected to the aeration grid are kept in each tank. The intensity of sunl in the shed can vary from 20000 to 120000 lux during day time and the temperature of the cul medium from 28°C-35°C. Under these conditions the diatom cells present in the sea wa multiply rapidly and give rise to a golden-brown bloom of diatoms in 24-48 hrs. Although ma species of diatoms may be originally present in the sea water, under the above tempera conditions, *Chaetoceros* spp. become the dominant diatom forming 75-90 % of the cells in culture. Other diatoms like *Thalassiosira, Skeletonema* and *Nitzschia* may also be present in les densities. A culture containing a concentration of 3-4 lakh cells/ml is preferred for feeding. T culture is used for feeding the prawn larvae and also as an inoculum for developing batch cultu on succeeding days. Algal cultures are thus started everyday using the previous day's culture inoculum (at the rate of 30-55 litres per m^3 of filtered seawater and fertilized as above). It att feeding concentration within 16-20 hrs after inoculation. On cloudy days, daitom multiplicat will be delayed, hence the quantum of inoculum can be increased.

During prolonged cloudy conditions, maintenance of mixed culture becomes diffic Therefore it is advisable to have a separate, small, diatom culture unit on the hatchery w air-conditioning and artificial lighting to ensure a steady supply of diatom.

Preparation of egg-prawn custard: Yolk and albumen of hen's egg and prawn meat small prawns are mixed well in a mixie at the ratio of 1:5 and cooked for 10 minutes in a pressu cooker and kept in refrigerator. A solid block of this custard, after thawing can be made ir suitable particle by passing through proper sieves. Custard should not be stored more than 3 day

At Azhicode prawn hatchery of Kerala State, penaeid prawn larvae are fed with prawn m suspension. 6 to 60 ton outdoor pools or concrete tanks of 75 to 100 cm ht are used for larv rearing. Cleaned and sun dried tanks are filled to 1/5th of its capacity with filtered seawater. W spawners either *P.indicus* or *P.monodon* are introduced into the tank at the rate of o spawner/ton of water. Spawner is removed after spawning, and water level is raised to 1/2 a aeration continued.

Prawn meat suspension made out of juvenile *M.dobsoni* or squilla meat is fed to the larv Mysis and Acetes are also used for making suspension. The approximate weights of meat feed different larval stages are given below.

		M.dobsoni	*Squilla*
Protozoea I for	1000 larvae/day	0.5 g	1.0 g
Protozoea II & III	-do-	0.75 g	1 .5 g
Mysis I	- do-	1.0 g	1.75 g
Mysis II	-do-	1.25 g	1.75 g
Mysis III	-do-	1.5 g	2.00 g
PL I	-do-	2.00 g	3.00 g

From mysis I stage onwards 1/3rd tank water is exchanged daily. Depending on the phytoplankton bloom developed in the larval rearing tanks water exchange is regulated. The larval rearing tanks are generally stocked with 100-250 nauplii/1. They are reared upto postlarva 10 in the same tank at the survival rate of 75%.

5 Larval diseases:

Most serious diseases affecting the larval stages are caused by fungi (*Legenidium, Fusarium*) bacteria (Vibrio), filamentous bacteria (*Leucothrix*) and protozoans (*Zoothamnium, Vorticella*).

Several antimycotic compounds and antibiotics are available for the treatment of fungal and bacterial diseases. Clotrimazole, crystal violet, malachite green, trifluralin etc. are some of the chemotherapeutic agents employed for the control of fungi. These chemicals should be used with great care as they themselves are toxic to the larvae if it exceeds certain limit. The best method of control of fungal disease is by disinfecting the spawners which are the potential source of infection, even through they do not show any visible sign of infection. Antibiotics such as streptomycin, gallimycin, penicillin etc. are used to prevent and treat bacterial disease in larval rearing tanks.

Treating infected larvae is very difficult and often expensive. The best remedy by far, is to prevent the diseases. To achieve this, the spawning tanks should preferably be separated from the larval rearing tanks, spawners should be disinfected, and good quality filtered or purified seawater should be provided in adequate quantity.

6 Nursery rearing:

Postlarvae of penaeid prawns at PL 3-5 are very fragile and are sensitive to changed water conditions and fall easy prey to predators. When stocked in the grow out ponds, initial mortality will be high due to handling, transportation and acclimatisation stress. Stress factors in ponds are

unavoidable. Hence inclusion of a nursery phase in shrimp culture to enable the farmer to have hardy shrimp seeds for stocking.

In the Japanese system, since larvae are stocked in low densities in large tanks, the same can be used continuously for further rearing of postlarvae to PL 15 or above - an ideal age for stocking in farms.

In small cylindro-conical tanks, larvae can be reared upto PL 3-5 when they turn benthic in habit or swim around the sides of the tank leading to over crowding, which increases mortality due to cannibalism. To avoid this PL 3 to 5 are transferred to large nursery tanks which offer enough surface area for good growth. Thus in this system nursery rearing becomes a necessity. When grown in nursery upto PL 15 or more and stocked in ponds farmer can be sure of the size of the stock and determine the right feeding regime.

Nursery rearing can be done in cement tanks, earthen ponds and in net cages (hapas) in deeper ponds.

Cement tanks: Large outdoor rectangular tanks of 1 m depth provided with good aeration can be used for nursery rearing. They are cleaned, dried and filled with filtered sea water of suitable salinity. Pure culture of diatom is then added to maintain water quality and reducing water transparency. Stocking density depends on the species and efficiency of water management. Postlarvae of *Penaeus indicus* can be stocked at a density of 7500 to 10,000 nos/m^3 and *Penaeus monodon* 3500 to 5000 nos/m^3. Because of its habit of clinging to the walls and bottom the surface area of the tank may be increased using additional substrates. Nylon screen can be placed length wise in the tank. About 40-50% water should be exchanged daily. Chopped mussel meat or pelletized feed are given. Early stages can be fed with adult Artemia. Raceway systems and flow through systems are also used to improve the water quality and survival rate. In higher stocking rates water quality is maintained by increasing water exchange (300 % or more) and providing strong aeration. PL 15 and above can be harvested and stocked in the grow out ponds.

Liao developed a 'ladder system hatchery' to increase the survival of larvae. This consists of 4 inter connected hatchery tanks on slopping grounds-algal culture tank (1-2 tons) - larval rearing tanks (1-2 ton capacity) where larvae are reared upto third protozoea stage 10-15 ton tanks to rear Mysis to PL 5 stages and 15-25 ton tanks to rear PL5 - PL 20 and above - All tanks are built one below the other on a slopping ground to facilitate transfer of larvae directly without much handling.

Earthen ponds: 500-2000 m^2 earthen ponds are used generally as a nursery to rear PL 3-5 to PL 15-25. The earthen nursery ponds have to be dried tilled, limed and fertilized. After fertilisation and filling of water, enough time may be given for the development of lab-lab in the

ponds. When lab-lab is developed, stock the ponds with PL 3-5 at the rate of 100-200 PL/m^2. Formulated pelletized feed or chopped mussel meat at the rate of 20-25% of biomass is provided daily as supplementary feed. When natural productivity of the pond is less, supplementary feed is increased suitably. Depending on the pond conditions, 10-40% pond water is exchanged daily. If the water source is tidal flow, water is let in through a properly designed sluice gate, provided with nylon screen of suitable mesh size to prevent entry of predators and escape of postlarvae. Screens should be checked regularly for any damage and cleaned periodically to remove biofouling. In these nurseries, postlarvae 3-5 are reared for 20-25 days.

Nursery cages: Cages made of synthetic netting of small mesh size (0.5 mm) are used for nursery rearing of PL 3-5.

The cages can be of floating or fixed type. Floating cages are normally supported by frames and floating buoys made of bamboo. The cages can be stationary and held in position by bamboo/wooden poles. They can be fixed in calm water in bays, lagoons or even inside grow out ponds. Biofouling of the cages is a problem and it must be cleaned properly. 1000-2000 PL 3-5/m3 can be stocked in the cages. They are fed with mussel meat/prawn-egg custard or pelletized feed at the rate of 15-20 % of the total biomass/day. PL 3-5 are reared in these cage for 15-20 days.

7 Economics of hatchery:

The facilities and economics of a hatchery with a production capacity of 23 million seed per annum are as follows (See fig 4 for layout of the hatchery)

Hatchery shed: The main hatchery shed occupies an area of 26 x 19 m area. It has a central, raised platform which is used for the regular culture of diatoms as well as for keeping spawners. Glazed roofing sheets are provided over this raised platform to facilitate proper lighting for the development of diatoms. The elevation helps to transfer the nauplii from spawning tanks to larval rearing tanks and diatom culture to larval rearing tanks by gravity flow.

Spawning tanks: Cylindroconical fiberglass tanks of 200 litre capacity are used as spawning tanks (Fig.2 a). The inner surface of these tank is black in colour. Tanks are provided with three fibreglass coated iron legs. The conical bottom has a central drain fitted with a polypropylene ball valve. There are 20 such spawning tanks in the hatchery.

Diatom culture tanks: There are six oval tanks with 1,200 litre capacity and are smooth and white in colour on the inner surface (Fig.2 b).

Larval rearing tanks: These are fibreglass cylindroconical tanks of 2,000 litre capacity (Fig.3 a). The conical bottom has a short central drain pipe fitted with a polypropylene ball value. These tanks are mounted on wooden platforms and are placed on either side of the raised central platform. Ten tanks are required for the hatchery. Larvae from these tanks could be directly transferred to nursery tanks by connecting a hose to the exit valve of these tanks.

Nursery tanks: Twenty cement rectangular tanks of 10 ton capacity (5.3 x 2 x 1 m) are provided. Facilities are provided to transfer the post larvae from larval rearing tanks to these nursery tanks directly.

Broodstock tanks/larval rearing tanks: Two tanks of 100 ton capacity (10 x 10 x 1 m) and 8 tanks of 25 ton capacity (5 x 5 x 1 m) are constructed as one unit. 100 ton capacity tanks are used as brood stock tank while the other 25 ton capacity are used for rearing larvae upto PL 15-20. These tanks are also provided with glazed roofing sheets.

Maturation tank: One circular FRP tank of 10 ton capacity is used for this purpose (Fig.3 b). Inner surface of the tank is black in colour and is housed in a corner of the laboratory cum office complex.

Pump house: A pump house with 2 nos. of 3 HP. diesel pump sets to pump water directly from sea is provided.

Filtering unit: A filtering unit is provided to filter the sea water. The filtered water is stored in a sump. The sump has two compartments, each having a capacity to store 50 tons of sea water. From the sump, the sea water is pumped to an overhead tank constructed over the generator and machine room complex.

Air blower room: Two twin-lobe air blowers of 7.5 HP. are installed in this room. PVC distribution lines are provided from the blowers to all tanks in the hatchery so that a continuous air supply is assured.

Generator room: A generator of 30 KVA capacity is provided and the same is housed in a separate room. This ensures continuous electricity to the hatchery complex when normal supply fails.

Details regarding the hatchery operation using 2 ton capacity cylindroconical larval rearing tanks and 10 ton capacity nursery is given under the heading CMFRI technology production details for the same is given below:

PRODUCTION DETAILS OF THE HATCHERY USING 2 TON TANKS AND 10 TON NURSERIES

1.	No.of maturation tank in the hatchery	:	1
2.	No.of spawners kept in the spawning tank	:	30
3.	No.of animals spawned	:	20
4.	Average No.of nauplii/spawner	:	75,000
5.	Total No.of nauplii obtained	:	15,00,000
6.	No.of larval rearing tanks	:	10
7.	No.of nauplii stocked in a larval rearing tank (2 ton capacity)	:	1,50,000
8.	No.of nursery tank	:	20
9.	Percentage survival of nauplii to PL XX	:	40%
10.	Production of PL XX per hatchery run (30 days)	:	12,00,000
11.	No.of runs in an year	:	8
12.	Total No.of PL XX produced in an year	:	96,00,000

When 25 ton tanks are used for seed production, nauplii to PL XX can be reared in the same tank. But these tanks can be used only when 24 spawners are available at the same time whereas the hatchery can be continuously operated when 2 ton tanks are used for seed production. For one run to be carried out using 2 ton tanks and nurseries 30 spawners are required under the present set up. After spawning, these animals may be maintained for 2-3 days in the broodstock tank. They can then be introduced into rematuration tanks after unilateral eyestalk ablation and provided with suitable conditions for speedy ovarian

PRODUCTION DETAILS OF THE HATCHERY USING 25 TON TANKS

1.	No.of spawners kept for spawning	:	24
2.	No.of females spawned	:	17
3.	No.of nauplii per spawner	:	75,000
4.	Total No.of nauplii stocked in a 25 ton tanks at the rate of 50 nos/m^3	:	12,50,000
5.	Total No.of nauplii for 17 spawners	:	12,75,000
6.	Average percentage survival from nauplii to PL XX	:	33.33
7.	Production of PL XX/run/tank		4,17,000
8.	Total No.of PL XX from one tank in an year (4 runs/year)	:	16,68,000
9.	No.of 25 ton out door tanks	:	8
10.	Total annual production from 8 tanks in 4 runs	:	1,33,44,000

ECONOMICS OF HATCHERY PRODUCTION OF PENAEID SEEDS

			Rs.
A. Initial investment:			
i)	Land with compound wall (3000 sq.m. area)	:	2,00,000
ii)	Hatchery shed, with transparent roofing, nursery tanks, office building, water filtering and storage facilities, fresh water, sea water, electrical and aeration facilities	:	21,00,000
iii)	Brood stock tanks, outdoor larval rearing facilities with roofing	:	5,00,000
iv)	Major equipments	:	4,00,000
v)	Fibreglass items		2,00,000
vi)	Laboratory equipments	:	1,94,000
			35,94,000

B. Operating cost	..	2,55,000
C. Fixed costs:		
Interest on initial investment @ 18%	..	6,46,920
Depreciation	..	2,67,150
Salary	..	1,56,000
		10,70,070
D. Total Cost (B + C)	..	13,25,070
E. Annual production		
i) From small units comprising 2 ton tanks and nurseries	..	96,00,000
ii) From medium units of 25 ton tanks	..	133,20,000
		2, 29,20,000
F . Annual revenue @ Rs. 100 per 1000 seeds.	..	22,92,000
G . Annual Net Profit (F-D)	..	9,66,930

REPAYMENTS DETAILS

Total loan outstanding

Initial capital investment	..	35,94,000
First year salary	..	1,56,000
First year operating cost	..	2,55,000
Total	..	**40,05,000**
Gross profit before interest and depreciation	..	18,81,000

Assuming that the total amount of money initially required for capital investment, operating cost and salary for first year is taken as loan from the bank at 18% interest a repayment schedule is given below:

Year	Principal outstanding	Interest @ 18%	Annual repayment	Gross annual profit	Annual Net balance
1	40,05,000	7,20,900	10,00,000	18,81,000	1,60,000
2	30,00,000	5,40,900	10,00,000	18,81,000	3,40,100
3	20,05,000	3,60,900	10,00,000	18,81,000	5,20,100
4	10,05,000	1,80,900	10,05,000	18,81,000	6,95,100

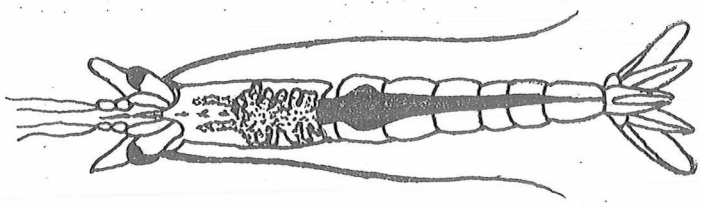
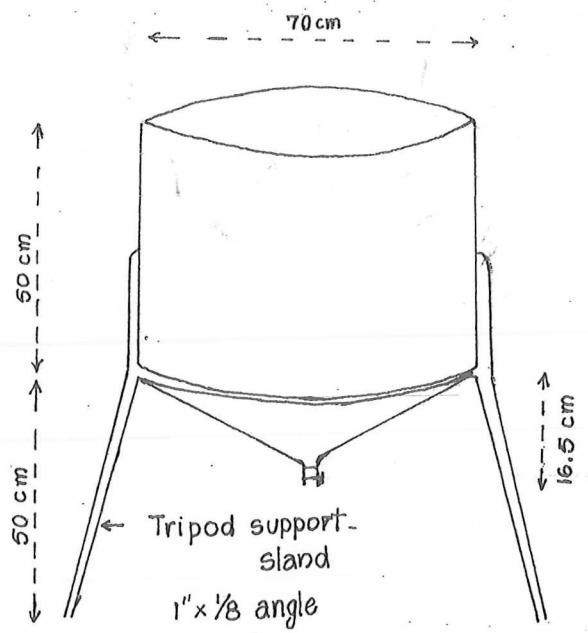
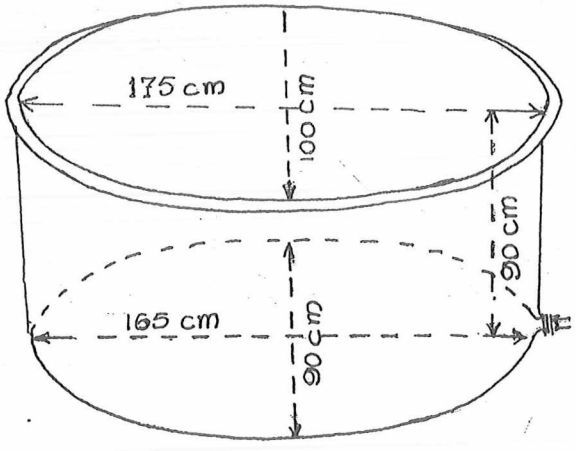


Fig. 1 Ovary of a fully mature penaeid prawn



a.

Fig. 2
a. Spawning tank
b. diatom culture tank



b.

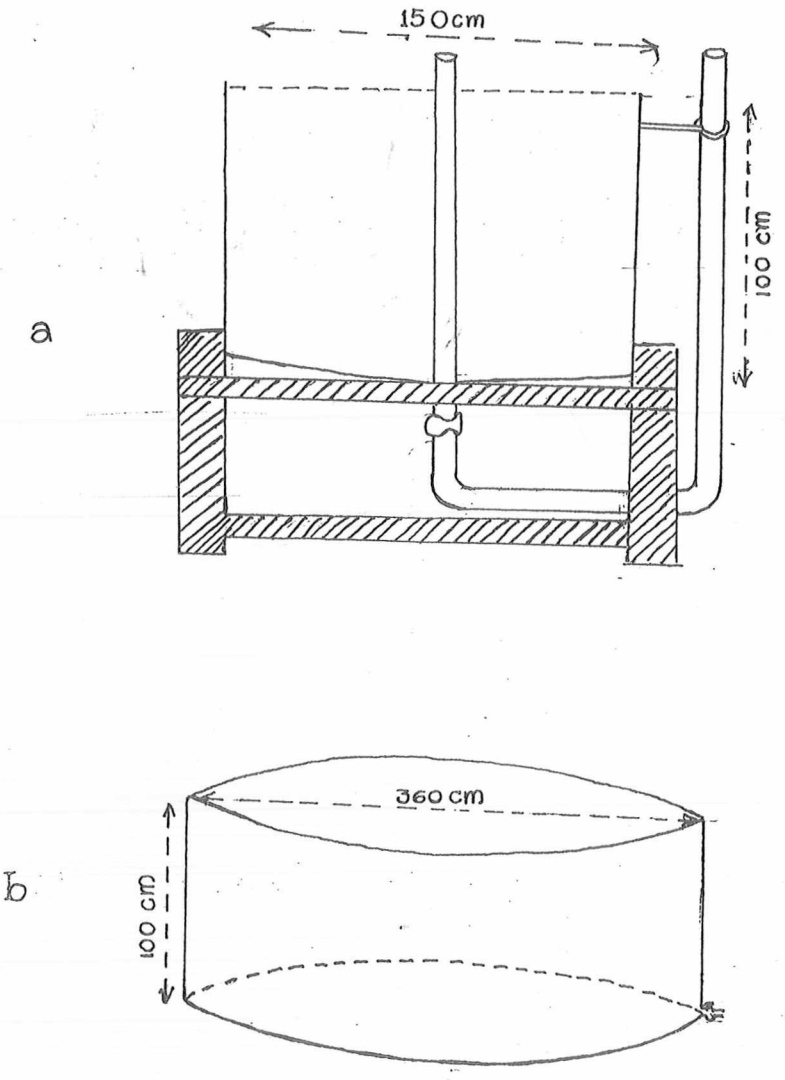


Fig. 3 a. Larval rearing tank
b. Maturation tank

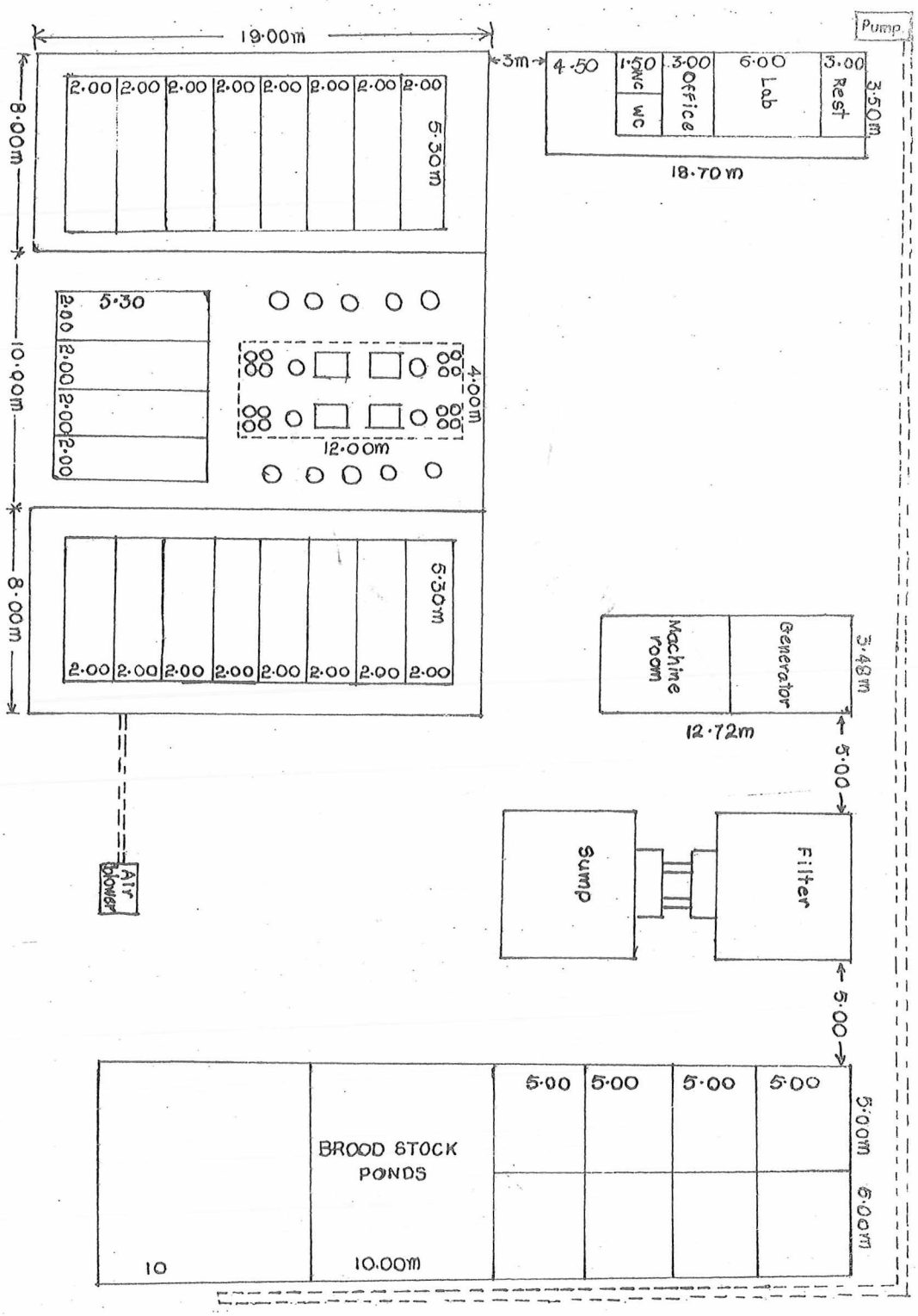
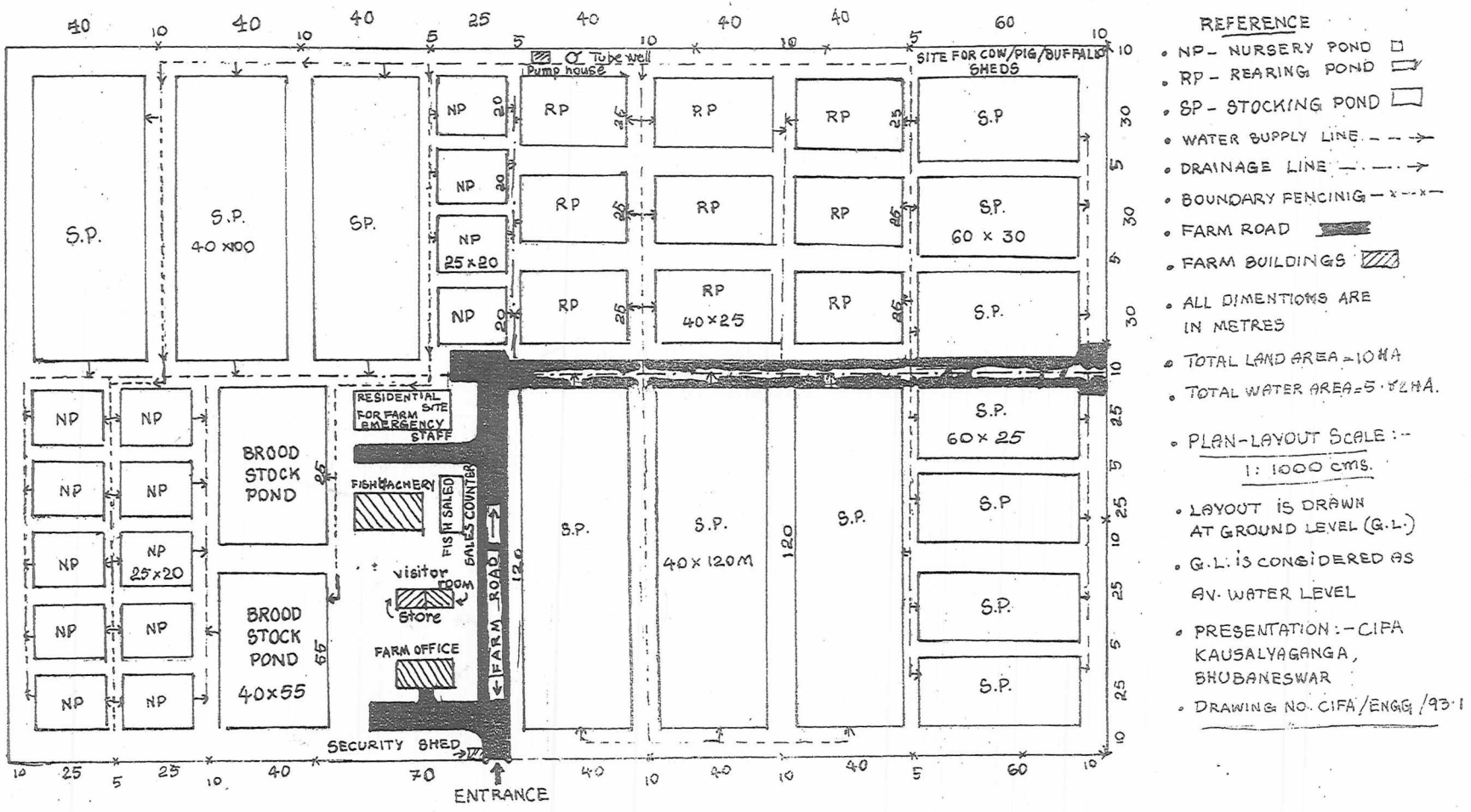


Fig. 4 Lay out of a prawn hatchery



TYPICAL LAY-OUT PLAN OF A 10 Ha FRESHWATER FISH FARM