Problems in Culturing Black Tiger Shrimp (*Penaeus monodon*) the Semi-Intensive Way:

An Indian Experience

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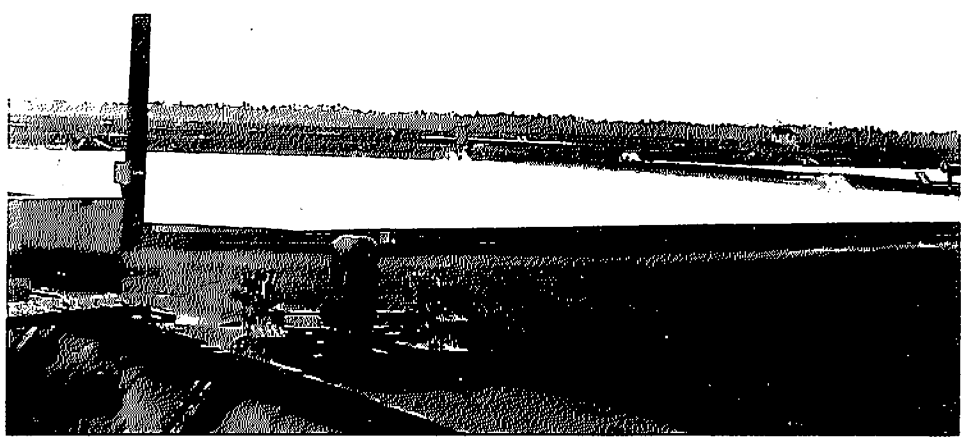
Shrimp farming is picking up fast in India. India has a potential brackishwater culture area of 1.2 million ha. From 50,000 ha formerly under traditional culture, it increased to 80,000 ha by 1993. Shrimps are cultured in the traditional and extensive way over very large areas in Kerala, Karnataka, Goa, Maha-rashtra, Orissa and West Bengal, but scientific farming has taken root only in Andhra Pradesh and Tamil Nadu. The black tiger shrimp *(Penaeus monodon)* is in high demand for overseas markets and is the dominant cultured species. This paper details some of the problems encountered in culturing this organism the semi-intensive way.



*A semi-intensive black tiger shrimp(*Penaeus monodon*) farm in South India, with a paddle-wheel aerator in the foreground. (Photo by S. Rajagopal)*

Problems Due to Aquatic Macrophytes

Blooms caused by brown algae *(Phaeocystis pouchetii)* were encountered during periods of low salinity (12-18 ppt). High nutrient levels [nitrate (NO_3), 1.30 mg/l; phosphate (PO_4), 0.12 mg/l and silicate (SiO_3), 21.13mg/l] in water of low salinity facilitated such blooms and the water became golden brown in color. Such blooms led to anoxic conditions, with shrimps swimming laterally and also rapidly at the surface. This also led to lack of appetite among the shrimps and the algae clogged their gills. Application of lime in divided doses (100 kg/ha, two hours after the 6 a.m. feeding for three consecutive days) and 30% daily water exchange in the evening hours until the disappearance of brown color, were effective. Continuous running of aerators and draining of surface water were also helpful. Subsequent application of organic and inorganic fertilizers [30 kg/ha of cow dung, 30 kg/ha of urea and 3 kg/ha of super (mono) phosphate] ensured desirable transparency levels (35-40 cm).

Blooms of green algae *(Enteromorpha intestinalis)* were also encountered. As chemicals are to be avoided in culture operations, the algal mats were removed manually every other day.

Invasions by Molluscs, Jellyfish and Frogs

The majority (80%) of shrimp farms, in particular almost all the virgin ponds, had problems when at high salinities (30-35 ppt), eggs and larvae of an opisthobranch mollusc (*Aplysia oculifera*) that entered in enormous numbers (120-200/ml) through the source water (pump-fed water filtered through a 40-mesh net), grew rapidly and became adults in two months. As many as 1,000-1,500 organisms were encountered in a 1-ha pond. The high levels of organic matter at the pond bottom appeared to provide a good environment for them and they were capable of completing their entire life cycle in the ponds. They started reproducing during the summer months (April to June). Under pond conditions, they spawned up to five times within 45 days. They were recorded in ponds having clay soils and sandy-clay soils. They also thrived in lower salinities down to 5-10 ppt. Even though they appeared not to prey on the cultured shrimps, they caused a lot of concern to the shrimp farmers as they competed with shrimps for space, food and dissolved oxygen (DO). Manual removal (handpicking) was the most effective way of eradication. Further lowering of the salinity, to less than 5 ppt, was also effective.

In shrimp farms where seawater was pumped in directly, the early life history stages of marine hydromedusae *(Phialidium* sp.*)* also entered and grew rapidly. Another hydromedusan (not identified) entered ponds through the water source, grew rapidly and attained a diameter of 15-20 cm over a period of 90 days of culture. Hydromedusae developed mature gonads in these confined systems but we did not observe planula or hydroid stages.

They withstood admirably salinities of up to 5-10 ppt, recorded during the monsoon months. Their survival was 100% at 10 ppt and reduced to 50% at 5 ppt. When *Phialidium* sp. were present in large numbers, they covered the entire surface of the pond reducing primary production and DO levels. Scooping them out with a net is one way of elimination. Draining of surface water was also effective. Application of hydrated lime (135 kg/ha daily for three days) and inorganic fertilizers (urea and superphosphate) helped too.

During the monsoon months, the frog *Rana hexadactyla* also entered the ponds in large numbers; as many as 800-1,000 frogs in a single pond. They competed with shrimps for space, food and DO. They withstood salinities of up to 15 ppt and then left when salinities rose further. Cast netting was quite useful in their elimination.

Predators

Predatory fishes (e.g., *Lates calcarifer* and *Triacanthus* sp.) and crabs (e.g., *Scylla serrata* and *Portunus pelagicus*) were encountered very commonly in all the farms and they posed serious threats to the survival of the cultured shrimps (survival was reduced by 20-60%). Enough care at the preparatory stage (proper drying of the ponds and application of tea seed cake) and proper filtration of water is helpful in keeping all of these organisms at bay, except *S. serrata*. During the culture period, periodic fishing with cast nets (once in seven days) greatly reduced the predators. *S. serrata* still caused quite a lot of problems. It entered the pond from the natural environments by ascending the bunds and, once inside, evaded capture by burrowing. Its entry can be prevented by erecting fences but evolving a suitable method for capturing it from the pond is badly needed.

Fouling Organisms and Other Problems

Fouling organisms like polychaetes (*Sabellaria* sp.), barnacles (*Balanus amphitrite*) and oysters (*Crassostrea madrasensis*) gave trouble by settling on different structures. They entered into the pond though the water source (pump-fed) as eggs or larvae. Their attachment to the outlet shutters (sluice gates) prevented normal operations for exchange of water. They also attached to paddle-wheel aerators, floating structures, feeding trays and submersible wires, impeding their functions and utility. Fouling organisms were removed periodically (every week) by scrubbing.

Black anoxic soil formation, with production of hydrogen sulfide (H_2S), was a serious problem encountered in almost all the farms. Light penetration to the pond bottom enhanced the production of algal-detrital felts ('lab lab') which developed to cover the entire bottom. When the transparency in the ponds reached the desired level (30-40 cm) through addition of organic and inorganic fertilizers, the growth and survival of 'lab lab' were affected. The dead and decaying mats of 'lab lab' started floating to the surface and sides of the pond. These were also driven to corners by wind action. Settling of these mats led to formation of black anoxic soil, with a smell of H_2S, and the water became milky white.

Direct application of organic fertilizers and chicken manure led to black soil formation and caused mortality among the shrimps (5-6% loss daily). This problem was overcome by applying cow dung in gunny bags. The cow dung nutrients, exuding from the bags, were readily utilized without impairing water quality.

The use of wet clams (*Meretrix meretrix*, *M. casta* and *Katelysia opima*, collected from estuaries and backwaters) as feed also led to black soil formation. The uneaten portions settled to the bottom and decayed. Under these circumstances, the shrimps showed low feed acceptance (feeding down by 30%) and stunted growth (daily growth rate down by 60%). Black soil formation also led to soft shell formation in shrimps and to outbreaks of vibriosis. When this happened, clams were not given as feed until conditions improved.

The elimination of black soil is difficult once it has occurred in a pond during culture. Addition of lime (200 kg/ha daily for five days) helped to restore the soil and the organisms to health. Rapid water exchange (up to 50% daily for three consecutive days) also helped to reduce H_2S level in the water column. During such measures, the water depth was maintained at 1.2 m and all available aerators (four per pond) were operated continuously. After five days, the water depth was reduced to 50 cm and black soil from the sides and corners removed manually. Hydrated lime (350 kg/ha) was then broadcast (60% on the exposed sides and corners and the remainder to the water column). The water depth was then restored to 1.2 m. The aerators were kept running while lowering the water level and also during the lime application. During draining, the aerators were positioned facing the outlet. This was quite effective in removing black soil from the pond bottom (deeper parts). Charcoal bags (each containing 10 kg of activated charcoal) suspended in various parts of the pond also helped in gas absorption. With the restoration of water quality, the incidence of vibriosis declined (15%). Shrimps recommenced feeding and newly moulted shrimps became sturdy and normal.

During heavy rainfall and also during windy days, water turbidity caused some anxious moments. It was kept under check by the application of lime (hydrated lime, 75 kg/ha daily for three days). The suspended materials adhered to the fine particles of lime and settled down. As a consequence, the transparency increased and was brought to desired levels by the application of organic and inorganic fertilizers.

Future Directions

Scientific shrimp farming is catching up fast in Tamil Nadu. In the Vellar-Coleroon estuarine complex situated on the southern side of South Arcot Vallalar and northern part of Quaid-e-Milleth districts, many shrimp farms have sprung up in the past two years. The production rate in this area varies from 2.5 to 4 t/ha/crop. This success has generated a lot of interest among entrepreneurs who are entering into this field in a big way. The problems involved in the semi-intensive culture of shrimps described in the paper and the need for solutions will affect other farmers. The information given here may help farmers to overcome such problems. In this vital sector, nobody should work in isolation and there should be exchange of technical know-how and experiences. This paper is an attempt in this direction.

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