2. HATCHERIES ABROAD - AN OVERVIEW

The status of shrimp hatcheries and the methods adopted for their successful operation and production at the global level are described below:

a. Japan:

Shrimp culture began in 1963, when Dr. M. Fujinaga established shrimp farms in western Japan. About 157 farm were established in 1987. *P. japonicus* is the principal species. The Japanese technology followed rearing of larvae in large tanks of 100-400 cu.m. from nauplii to post-larval (PL) stages in the same tank. PL were transferred only after PL18-20 stages into nursery ponds at a stocking density of 130-150 pieces/sq.m. and reared till they reached 0.5 g juveniles from which they were transferred to rearing ponds of 1.5-2 ha. This technology followed the concept of rearing the shrimps utilising phytoplankton, which is grown in the same system to achieve good results in natural conditions (Arlo and James, *op. cit.*).

b. Indonesia:

The country has brackishwater farms of 1,80,000 ha. water spread area (Sukotjo, 1981). Fry of shrimps are available between September and November and between May and July. In 1979, the Government of Indonesia initiated a National Shrimp Development Programme to cater to the demand for shrimp seed. The Government encourages establishing hatcheries,
providing training programme and gives technical assistance on all the aspects of hatchery operation and designs. In Indonesia, majority of the hatcheries are of 'Backyard-type'. Most of the hatcheries in Indonesia are designed similar to that of the technology developed by Brackishwater Aquaculture Development Centre at Jepara (BADC). The small scale hatcheries in the entire country produces around 1-2 lakhs seeds/month. They do not have problems in marketing fry. The major constraints faced by some private hatcheries were lack of Artemia cysts, non-availability of brood stock, lack of skilled personnel, lack of knowledge on disease control and non-availability of power. These problems are being in the process of rectification to certain extent.

c. Thailand:

Research on shrimp started in Thailand since 1968. In 1970, experiments on spawning, developmental stages of larvae and feeding were completed. In 1972, the Government of Thailand established the 'Shrimp Culture Project' through Japanese Government to concentrate on mass production of marine seeds. Penaeus monodon and Penaeus merguiensis are the candidate species cultured in Thailand. The Galveston system hatchery was tried in 1977. The Japanese system was also tried. The Satul Fisheries Station has modified the system by combining the advantageous features of both the system to produce good results (Pinij, 1982). In the recent past, Thailand faced disease outbreak in intensive farming and thereby caused many hatcheries to shut down operation due to very less demand for seeds.
d. Malaysia:

The total area in Malaysia used for shrimp culture was estimated to be less than 600 ha. with estimated production of less than 500 tons/year (Ong, 1981). Most farms are located in Johore while, farms based on hatchery produced fry have recently been constructed in Kedah, Perak, Penang and Sahah. The shrimp hatcheries are located near the sea. Environmental control system for optimum rearing conditions are lacking and thus, hatchery operations are affected by adverse weather conditions especially during monsoon. The hatcheries established in Malaysia are mainly of backyard technology. The size of larviculture tanks in Malaysia ranges from 2 to 16cu.m. Round tanks with conical bottom similar to the tanks used in Tahiti have been set locally. Pre-filtered water was obtained in few localities on the west coast of peninsular Malaysia (Cansdale, 1979). Ling (1973) stated the general features affecting the shrimp hatchery in Malaysia like non-availability of brood stock, lack of good and inexpensive feed that can eliminate dependence on Artemia and lack of skilled manpower.

e. Philippines :

In Philippines, *Penaeus monodon* called ‘Sugpo’ has been recognised as one of the most economically important shell-fish commodities and also popular in South East Asian countries (Portfirieo, 1981). Based on the demand and high price for *P. monodon*, entrepreneurs have ventured into monoculture of this species. However, the quantity of fry caught from the wild was inadequate. Therefore, an artificial mass producing unit in controlled
enclosure was envisaged. The Japanese and Galveston methods were tried in Philippines for rearing **P. monodon** at Mindanao State University Marine Fisheries Research Laboratory in Naawan, Misamis Oriental Province in 1973 and later at South East Asian Fisheries Development Corporation Aquaculture Department (SEAFDEC AQD) in Tigbauan, Iloilo, Philippines. In 1978, a modified Japanese system was established. The SEAFDEC AQD further developed new systems in which cost effective hatcheries were established using a combination of techniques. In the recent past, SEAFDEC developed consultancy services to cater the demand of seeds for Asian countries with successful results. In 1983, around 60 private and public hatcheries producing 500 million post larvae were established. In Philippines, political turmoil, reluctance to invest capital, threats in land reforms retarded the effect of shrimp culture expansion to certain extent (Arlo and James, *op. cit.*).

f. Taiwan:

Around 3000 farms exist in Taiwan with a culture area of 16,400 ha. (Arlo and James, *op. cit.*). In 1987, around 2000 hatcheries were recorded. **P. monodon** and **P. japonicus** are cultured as the main species. The shift from semi-intensive to intensive culture system in farms from 1977 to 1987 increased the number of hatcheries from 150 to 2000. Initially, plastic tanks were used for all culture. In 1968, concrete tanks were constructed and a refined hatchery was established in TungKang Marine Laboratory of Taiwan Fisheries Research Institute which serves as a model for commercial hatcheries. The ‘ladder-type’ system utilising the advantage of slope of ground and different level in tanks for sequential larval and post larval stages was
established. High intensive system practices began between 1990 and 1992 in which high pollution and disease outbreak were recorded. Since 1990, the production slowly declined due to this factor.

g. Mexico:

The relative cold oceanwater during prime production month of January to April makes hatchery process difficult. Broodstock is selected from gulf of California and Pacific Ocean. Adult females are kept for 3-4 months in maturation section to aid continuous reproduction development. In Elcamaron Dorado, in southern Sonora, a hatchery was started with large maturation facility and 16 larval tanks with production of 15 million PL/month. The total yearly production was 131 million PL with 10.9 million/month on an average. In 1993, around 54 million PL and 210 million nauplii were sold. Due to operational difficulties, large hatcheries were unable to operate at design capacities (Arlo and James, op. cit.).

h. Kuwait:

Development of intensive culture system is being conducted in Kuwait in arid lands (Kneale et al., 1981). Commercial scale hatchery and culture production of *Penaeus semisulcatus* and *P. japonicus* showed spurt in 1981, due to the decline in commercial shrimp catches in Arabian gulf (Mathews, 1981). Promising approach in the arid land (Farmer, 1979; Mahler et al., 1974) had been worked out for intensive aquaculture. Pilot scale experiments have been developed since 1983. Hatchery production of
**P. semisulcatus** at Mariculture and Fisheries Department was started in 1971 with a production of 25 million PL during single spawning season (Farmer, op. cit.). Raceway system for larval culture was adopted for recycling and water exchange. Polyethylene green house enclosure was erected to prevent excess heat. Rearing trials with **P. merguiensis** was conducted in ‘Shigueno’ tanks which is based on high water exchange and aeration rates with double bottom sub-filtration system (Shigueno, 1975). Mass culture of **P. semisulcatus** at densities upto 200 PL10/litre in three cycles was carried out with a survival rate of 15-46%

i. China:

China has rich species diversity. It has more than 100 species, of which, 40 species are commercially utilised (Arlo and James, op. cit.). Shrimp culture in China began more than 300 years ago under the term ‘Port culture’, stocked in extensive culture bays or ponds with tidal waters. The semi-intensive culture initiated the surge in hatchery establishment. The Chinese concept followed similar to that of the Japanese and Galveston technology. Broodstock is procured from the wild and reared in the hatchery. Partial spawners with a fecundity ranging between 4 and 5 lakhs are only considered. Of all the species, **P. chinensis** is mainly reared. In this species, the nauplius takes 3-4 days to transform to zoea. Separate larval and post-larval culture tanks were constructed. Around 500-600 hatcheries were recorded between 1985 and 1989. The status of increase in the hatcheries after 1989 was found to be on the low scale due to competitive marketing, less demand for seeds and pollution caused due to intensive culture practices (as cited in Arlo and James, op. cit.).
j. Vietnam:

It has a coastline of 3200 Km. Shrimp culture in Vietnam relies on wild seeds for stocking ponds. In north Vietnam, culture is practiced by using tidal waters. Arlo and James (op. cit.) established the first trial with artificial propagation of Penaeid shrimps during 1971-74. *Penaeus pencillatus* and *P. merguiensis* are used as the candidate species. FAO helped in establishing hatchery in central Vietnam at Qui Nhon on *P. merguiensis*. The first mass production of tiger shrimp was carried out during 1984-85 in Nha Trang area. Thirteen hatcheries were built in late 1988 and increased upto 36 numbers in 1989. Most of these hatcheries were of 'Backyard' or small scale type. The annual production ranged from 1 to 5 million PL per hatchery and increased from 20 million in 1988 to 40 million in 1989 (Arlo and James, op. cit.). Breeders are collected from the wild especially from Central Vietnam which is popular for *P. monodon* spawners. Most hatcheries do not maintain non-gravid breeders. However, hatchery near Da Nang of Vatech’s stock breeders and re-spawned ones, several times.

Larviculture techniques are ‘Pot Pourri’ of Galveston, Japanese, SEAFDEC-Philippines and other techniques, adopted to local conditions. *Larvae* are cultured in 2-6 cu.m. capacity tanks while, M/s Vatech’s hatchery has 30 cu.m capacity. Phytoplankton is cultured outdoor in 500 litre concrete cylinders. In Quinhon, FAO based hatchery, *Acetes* sp. is used as larval feed. Larviculture proved very much profitable for small scale hatcheries due to less requirement of labourers.
k. Australia:

Shrimp farming was conducted from late 1970's especially on 'Feed Lot' culture of *Metapenaeus macleayi*. Construction of shrimp hatcheries in mid 1980's near Darwin, Innsfail and Yamba allowed for reliable stocking of ponds. There are eight major Penaeid hatcheries operating in Australia. The hatcheries adopt Taiwanese or western system with parabolic tanks, high larval densities and artificial feeds. Cyclone in tropical areas, varied water temperature, site availability and cost inhibiting future growth of the hatchery, were noted. The Australian hatcheries were troubled by Baculo virus due to inappropriate hatchery procedures. An intensive phase of research and development has been initiated to improve production efficiency and thereby compete with South East Asian Countries (Arlo and James, *op. cit.*).

l. United States of America:

The large market for shrimp in the US led to technological breakthrough and improvements in shrimp reproduction, larviculture, nutrition and latest techniques. The main candidate species popularly cultured is the Mexican shrimp, *Penaeus vannamei*. High labour, land cost and availability poses a constraint to develop farming. Cost effective PL production from hatcheries with the best technology like NMS Galveston, Texas has provided shrimp farmers control over the grow out. Modification of Galveston method is used to raise all hatchery produced PL in America. The breakthrough in captive maturation and spawning during mid 1970's has set U.S. shrimp hatcheries a great control over pond raised broodstock from their own farms for
sustainable seed production. M/s Amorient Aqua farm in Hawaii and M/s Laguna Madre Shrimp farm in Texas use broodstock in captivity for 5-8 generations. The first U.S. project to stock hatchery reared PL was built in Florida during late 1960's and 1970's. Constraints like high labour cost, high economical status and cost for inputs in the hatchery had led developments in a slow pace (Arlo and James, op.cit.).