# RECENT DEVELOPMENT IN MOLLUSCAN AQUACULTURE IN INDIA

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Aquaculture has been in existence for centuries as a traditional practice in India mainly for freshwater finfishes and brackishwater shrimp production. Only in recent years emphasis was given to develop coastal aquaculture with focus on increased production and to generate more income and employment opportunities for the artisanal and small-scale coastal fishing communities. Foreign exchange earnings through aquaculture is yet another factor for increased interest towards aquaculture. Since eighties scientific shrimp farming commenced in the country with traditional, extensive, semi-intensive and intensive farming techniques. Experimental farming of mussels, pearl oysters and pearl production and clams were initiated by early seventies in the country by National Research Laboratories but these technologies are yet to be adopted by fishermen for large-scale production. Since marine fish production is stagnating or even reached an optimum level as is the case with several shrimp stocks further increase in the production is not envisaged in coming years in the currently exploited fishing zone.

Considering this there is increasing awareness in the country to produce more seafood through scientific aquaculture. In the present paper a brief review of global scenario and the recent developments in molluscan aquaculture in the country are given.

**Global scenario**

Global harvest of aquaculture has been increasing all through these years and out of the total world production of 8,580,700 t of molluscs, 3,500,719 t comes from aquaculture in 1992, contributed mainly by mussels, oysters, clams, scallops and others. Molluscs, produced by culture form 18.1% of the total world aquaculture production. Among molluscs, mussels top the production (31%) followed by oysters (27.2%), clams (21.9%) and scallops (15.7%). Asia contributed 76.1% of molluscan production by culture and China ranks first in aquaculture production with 1,597,467 t. Indonesia, Malaysia, Philippines, Singapore, South Korea, Srilanka, Taiwan and Thailand are the other Asian countries producing molluscs by culture.

Production of Marine pearls accounts for 78 t valued at 1042 million US$. Japanese are the first to develop pearl culture technique and Japan holds the monopoly in production of sea pearls. Apart from Japan, pearl culture is being done in Australia, China, Cook Island, India, Indonesia, Mexico, Myanmar, Philippines, United States and Vietnam. Pearl culture is rapidly emerging as a viable and suitable form of farming practice. Nations as small as Cook Island and as large as China are scrambling to take advantage of technological and Institutional changes which do not exist few years ago. China developed large scale production of pearls by 1970 and are doing both marine and freshwater pearl production by culture. In 1992 China exported pearls worth 2.78 million US$.

The world production of edible oysters is 1,067,403 t in 1992 of which 953,529 t (89.2%) is produced by culture. The important edible oyster producing countries by culture are Republic of Korea (235,326 t), China (123,008 t), France (120,581 t) and Japan (24,490 t). There is vast potential for oyster farming in tropical countries especially Malaysia, Philippines, Thailand and India.

The world production of mussel by aquaculture is 1,086,310 t forming 81% of the total mussel production of 1,337,551 t. China, Spain Netherland, Germany, France are the leading mussel producing countries. China produced 538,895 t mussels in 1992 by aquaculture, ranking first in mussel production followed by Spain (13,910 t).

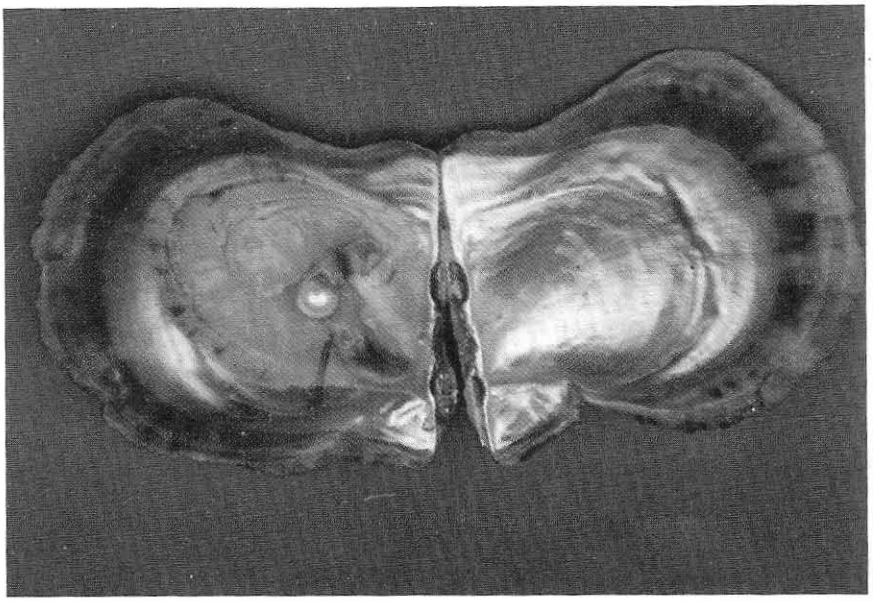
Clam production by aquaculture is 764,744 t which forms 45% of the total world clam production of 2,696,468 t and forms 15.7% of the total world molluscan production by culture. China, Republic of Korea and Malaysia are the leading clam producing countries by culture. Among gastropods, *Haliotis* spp and *Strombus* sp are produced by culture in the world.

**Molluscan aquaculture in India**

The prospects and potential of coastal aquaculture of molluscs in India was realised recently and concerted efforts were made from early seventies to develop suitable technologies for scientific farming which could be easily adopted by the coastal fishermen. Several research programmes were taken up by National Research Laboratories, Universities and Department of Fisheries of maritime states during the past 25 years for development of coastal aquaculture in the country. Considerable advances have been made in the culture of mussels, pearl oysters and pearl production, edible oysters and clams.

**Pearl Culture**

Out of the six species of pearl oysters available in India *Pinctada fucata* is the common Indian pearl oyster used for pearl production. The Central Marine Fisheries Research Institute (CMFRI) has achieved a breakthrough in the production of cultured pearls in 1973 and hatchery production of pearl oyster seed in 1982. The pearl production technology evolved in the country comprises of three phases viz. seed production in hatchery and wild, nursery rearing of the seed, mother oyster farming and culture of implanted oysters. Pearl oysters are farmed in rack, raft, longline or in onshore tank. Raft culture was done at Tuticorin, Vizhinjam and Calicut. Longline culture experiment was done successfully at Andakaranazhi near Sherthalai. On-shore tank culture experiments are being taken up at Tuticorin, Mandapam Camp and Visakhapatnam. Based on the technology developed by CMFRI, Kerala State Fisheries Department, Tamilnadu Pearls Ltd., Tamilnadu Fisheries Development Corporation and State Fisheries Departments of Gujarat and Lakshadweep have produced Pearls. The CMFRI is perfecting the technologies for land-based pearl culture and application of the bio-technology in this field. Researches on *in vitro* production of pearls have been initiated. The CMFRI regularly conducts national and international training courses of 4-6 weeks duration covering all aspects of saltwater pearl culture at its Tuticorin Research Centre. More than 100 persons from aboard and officials of Fisheries Departments of maritime states of India and respective of private firms have received pearl culture training at Tuticorin Research Centre of CMFRI and it continues to be the Centre for R&D activities for pearl culture.

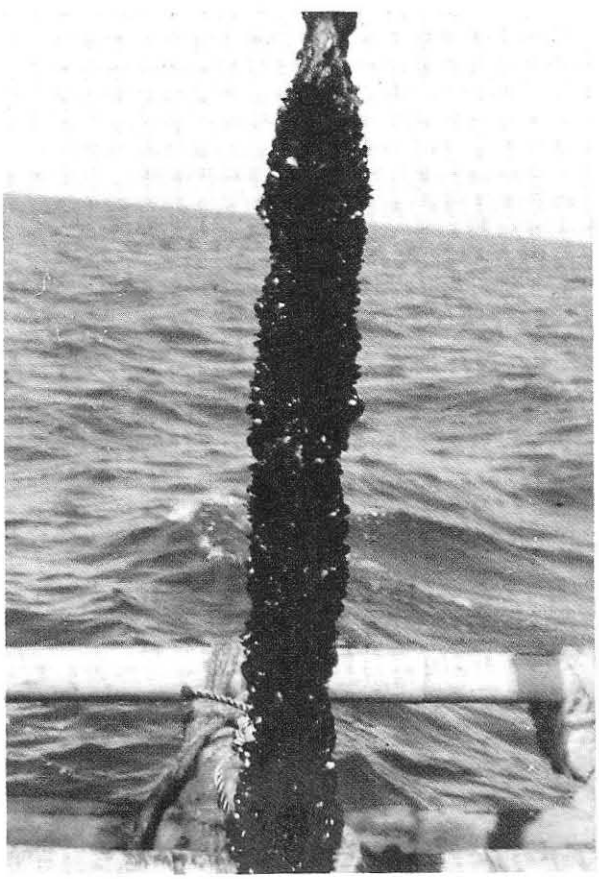


Pearl oyster with culture pearl *in situ*

Location testing for developing pearl culture along Kerala and Andhra coasts recently showed that pearl oysters grow much faster in these areas. Nucleated oysters grown at Kozhikode and Andakaranazhi in Kerala during November 1994 to May 1995 yielded good quality pearls. Scientists of the Central Institute of Freshwater Aquaculture have succeeded in pearl production in three species of freshwater mussels, *Lamellidens marginalis*, *L. corriannus* and *Parreyasia corrugata* for nucleated spherical pearls forms India in 1992.

**Mussels**

Two species of marine mussels, the green mussel *Perna viridis* and the brown mussel *P. indica* are suitable for coastal aquaculture in India. From 1991 onwards attempts for culturing mussels have been initiated and with suitable modifications, the CMFRI started mussel culture by raft culture method and the technology for large scale mussel farming was evolved at Calicut and Vizhinjam. Later raft culture experiments were carried our with success at Karwar, Goa and Ratnagiri along west coast and at Tuticorin, Madras and Kakinada along east coast and also at Andaman coast. Experiments done in lagoons and backwaters in Madras by pole culture method and by submerged rafts off Kovalam, Madras also gave encouraging results. The National Institute of Oceanography, Goa; Konkan Krishi Vidyapeeth, Ratnagiri; The Central Agricultural Research Institute, Port Blair and Department of Fisheries, Kerala have carried out various experiments and pilot projects during the last 20 years to demonstrate the possibilities of coastal aquaculture along Indian coasts. The high productivity, the presence of huge quantities of unexploited seed in natural bed, high rate of yield in a short period when cultured and pollution free water are some of the favourable factors for large-scale farming of mussels in Indian waters. Recent researches reveal that longline method of mussel farming in shallow waters of 10-15 m depth can withstand monsoon conditions and experimental farming has already been taken up at Andakaranazhi near Sherthalai and Adimalaithura near Vizhinjam. The basic technologies for seed production of *P. viridus* and *P. indica* were devel-

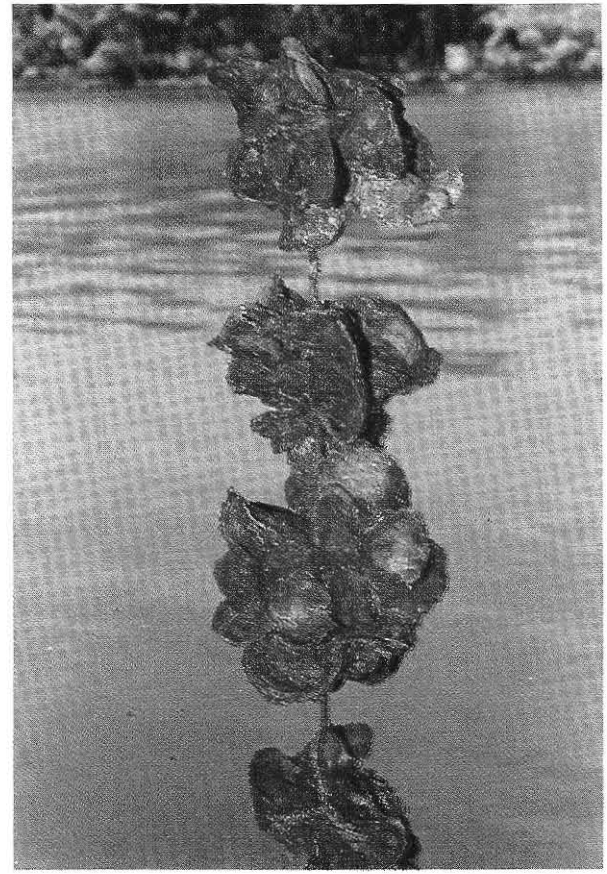


Mussel cultured by floating raft method

oped by CMFRI, but large-scale spat production in hatcheries has not been yet tried. The CMFRI has initiated a project at Calicut for large-scale hatchery production of green mussel spat with funding from Department of Biotechnology. The CMFRI organises short-term training programme for mussel culture to prospective mussel farmers.

**Edible oyster**

Among the four species of edible oysters from Indian coasts *Crassostrea madrasensis* is formed widely distributed along east and west coast of India. James Hornell made preliminary attempts to culture edible oysters in the erstwhile Madras Presidency in 1910. Since early 70s the CMFRI has been conducting researches on various aspects of oyster biology and culture. During the past two decades, a package of technology for oyster farming including hatchery production of seed has been developed at the Tuticorin Research Centre of CMFRI. The studies carried out since 1970, have resulted in developing simple methods of oysters farming and related aspects suitable for Indian conditions. Location testing experiments done by the Institute indicate that various backwaters in Karnataka, Kerala, Tamilnadu and



Edible oyster cultured by rack and ren method at Andakaranazhi

Andhra Pradesh are suitable for oyster farming. The technology transfer programme of the Institute at Dalavapuram, Ashtamudi lake in Kerala from 1993 was a success and from 1995 October onwards, local fishermen started establishing small-scale oyster farms in and round the Ashtamudi lake for commercial production. Location testing experiments were also carried out at Munambam near Cochin, Korapuzha near Calicut, Dharmadam near Cannanore in Kerala and at Mangalore and Karwar in Karnataka during 1993-95 period. The CMFRI is now operating a pilot scale semi-commercial project on oyster culture at Tuticorin in collaboration with the National Bank for Agriculture and Rural Development and the farm grown oysters are marketed by the Integrated Fisheries Project, Cochin. In India, rack and tray method, rack and ren method, stake method and raft method of culture of oysters were tried and the second method was found to be most suitable in shallow waters having 1.5 to 2.5 m depth.

Short neck clam, *Paphia malabarica* contributing bulk of clam meat export from India

## Clams

A wealth of information is available on distribution, abundance, growth, condition index, reproduction and spawning of Indian clams. The CMFRI has developed viable technology for the production of seed and nursery rearing of *Anadara granosa, M. meretrix, M. casta, P. malabarica* and *V. cyprinoides*. On-bottom culture experiments of clams have been done at Kakinada day for *Anadara granosa* and at Mulky estuary and Vellar estuary for *M. casta*. Commercial production of clam by culture has not yet started in India. The CMFRI, through a research project sponsored by the marine Products Development Authority has initiated sea-ranching of hatchery produced seed of *P. malabarica* at Ashtamudi from 1992 for the replenishment of exploited stock with considerable success. Giant clams have emerged as a potential mariculture resource in recent years in the tropical Indo-Pacific. The technology for mass culture of giant clams is now quite well understood and commercial groups have started operations in Australia, the Marshall Islands and the Philippines. Giant clams are represented in India by *Tridacna maxima, T. crocea, T. squamosa* and *Hippopus hippopus*. These species are available in Andaman and Nicobar Islands and Lakshadweep in good quantities. Giant clam culture possibilities in India are bright. Other commercially important edible clams which offer scope for culture in India are *Katelysia opima, K. marmorata, P. laterisulca, Gafrarium tumidum, Mactra violacea, Mesodesma qlabratum, Tellina sp, Anadara rhombea, Donax cuneata, D. faba* and *D. incarnatus*.

## Gastropods

Edible and ornamental gastropods are fished, processed and few are exported from India. The most important species are topshell *Trochus niloticus*, turban shell *Turbo marmoratus*, sacred chank *Xancus pyrum*, whelks *Babylonia zeylanica, B. spirata, Chicorea virqinecus, Pleuroplaca trapezium*, a variety of cowries and spider shell *Lambis lambis*. Few studies were done in India on breeding, larval rearing and sea ranching of *T. niloticus, Xancus pyrum, B. zeylanica, C. vigincus* and *P. trapezium. Haliotis* sp and *Strombus* spp which are available in Indian waters can also be cultured for commercial production.

## Cephalopods

Squids and cuttlefishes are in good demand in recent years due to their contribution to the export trade in India. The CMFRI has conducted experiments on hatching eggs of *Sepia pharaonis* and *Sepioteuthis lessoniana* col-

lected from the wild and rearing the hatchlings to adult by providing live food organisms as feed. The eggs of *Loligo duvauceli* were hatched in the laboratory and reared for 5 days. All these studies were done to develop mariculture technologies for cephalopods in India.

**Remarks**

Molluscan aquaculture is a recent development in India. The research works of Central Marine Fisheries Research Institute and various other national laboratories of the country for the last two decades have evolved the technology for culture of commercially important molluscs such as pearl oysters, mussels, edible oysters, clams, gastropods and cephalopods. Though the possibilities of large-scale farming of molluscs are quite bright, there is lack of awareness among the entrepreneurs, planners, financial institutions and developmental agencies about the benefit of molluscan aquaculture. Lack of knowledge of the market potential, improved post-harvest technologies and quality control, lack of experienced technical personals, extension work, demand in the local market, shortage of seed availability and inadequacy of finance from financial agencies are the major constraints in developing large-scale commercial molluscan aquaculture in India.

Though national research laboratories have demonstrated the possibilities of molluscan aquaculture through various experiments in different parts of the country, large scale commercial production is yet to commence. A long term planning with research thrust on seed production, transfer of farming technologies, pollution and disease problem, water quality management, genetics, post harvest technology, marketing and upgradation of farming technologies is necessary to give impetus for large-scale molluscan aquaculture.

A sustainable development of molluscan aquaculture without environmental damage and social disruption, can augment production in our country. It is also suggested that just like Korea, Hong Kong, Indonesia and China molluscan farming can fill in the losses caused by the disease problem in shrimp culture. As the global harvest of aquaculture has been increasing all through these years, the contribution by molluscs is also rising significantly and in India there is tremendous potential for developing the mollusc culture both for providing nutritious seafood for local consumption and also for increasing the foreign exchange earnings by export.