CLAM CULTURE

K.A. NARASIMHAM *

Central Marine Fisheries Research Institute, Cochin - 682014.

Introduction

The word 'clam' is popularly used while referring to the members of several bivalve families which burrow into the substratum with the help of usually well developed foot. A few clam species are also known to attach to hard substrates with byssus threads. Clams are the most widely distributed and abundant among all the exploited bivalve resources of India. The clams form subsistence fisheries all along the Indian coast. They occur in shallow coastal waters and are usually hand picked at low tides. Also hand-operated dredges are used from plank - built non- powered craft. On global basis, the production of clams by aquaculture was estimated at 901, 374 tonnes in 1993, forming 21.8% of the total mollusc production by farming.

In India, the Central Marine Fisheries Research Institute (CMFRI) developed packages of clam farming technologies for several species. However, clam farming on scientific lines is yet to take off in the country.

Clam Resources

The cultivable clam species belong to the families *Arcidae*, *Veneridae*, *Corbiculidae* and *Tridacnidae*. The surveys conducted at important production centres showed that an estimated 45,000 t of clams are landed annually. The black clam *Villorita cyprinoides* accounts for 64%, venerid clams *Katelysia opima*, *Paphia malabarica*, *Meretrix meretrix* and *M.casta* 30.9% and the blood clam *Anadara granosa* 4.4% of the catches. Of all the maritime states, Kerala leads in clam production accounting for 72.5% followed by Karnataka 12.5%. Studies conducted in India on the ecology and biology of various clam species reveal that

a) They show wide fluctuations in abundance both in time and space resulting in highly productive clam beds becoming barred and new beds appearing

b) the nature of the substratum, particularly the particle size is important in limiting the distribution

c) they feed on phytoplankton and detritus by filtering the water, attain first maturity at the age of 3-4 months and the meat forms from 8 to 23% of the total weight, depending upon the species and is usually high before spawning and

d) they are recruited to the fishery when 5-6 months old and majority of the clams are harvested before they are one year old.

Clam Farming

In clam farming, seeds are generally collected from the natural grounds and trans-

Present Address : Kakinada Research Centre of CMFRI, Kakinada - 533004

planted in suitable areas for growing them to market. This practice of relaying the seeds on the ground in sheltered water bodies and growing them to marketable size is simple to adopt, involving little farm maintenance work.

Seed collection from wild

In the commercial cultivation of clams in other countries, seed requirements are mostly met by collections from the natural beds and supplemented to a smaller extent from the hatcheries. A hand-operated scoop net or a dredge having 2-5 mm meshbag is used for seed collection. A spade or showel is also used for scrapping the top layer of the substratum and the sediment is sieved.

Hatchery production of seed

The hatchery technology for the large scale production of the seed of *A.granosa*, *P. malabarica*, *M.meretrix* and *M.casta* has been developed by the CMFRI. About 30 adult clams are used as brood stock. They are conditioned in unfiltered seawater of about 25-30 ppt. held at 22-24°C and fed intensively with mixed microalgae reared in outdoor tanks. After about 3 weeks of conditioning, the clams attain full gonad development and are subjected to thermal stimulation by slowly raising the water temperature to about 32 °C. If spawning does not occur they are transferred back to 22-24°C seawater and the process is repeated every two hours. Spawning can also be induced by placing the clams in the buffer solution of 9.0 pH for 1-2 hours and later transferred to normal seawater. Several years of studies in the hatchery showed that once the clams are ripe they readily spawn, to smaller disturbances such as change of water, addition of live microalgal food and transfer from the spawning chamber to the conditioning room. On several occasions no special techniques were found necessary.

The fertilised eggs settle at the bottom and are reared in FRP tanks. After a series of cell divisions they develop into veliger larvae, which are also called straight hinge larvae or 'D' shape larvae. The unicellular microalga, *Isochrysis galbana* is given as food to the larvae from day 2. In the clam hatchery, biological filtration of the seawater which allows the nannoplankters and smaller algae, measuring upto 10 microns was found to be beneficial since supplementary feed is available to the larvae and spat. After passing through the umbo and pediveliger stages the larvae settle on the tank bottom as spat in 7-10 days depending upon the species. The larvae are reared at a density of 5 larvae/ml of seawater. Spat settlement at 20-30% of the initial stock of veliger larvae is considered as satisfactory. The freshly set spat measure about 300μ and in the next 4-6 weeks reach 2-5 mm length. The spat are fed with mixed microalagae. For nursery rearing these spat are transferred to 40x40x10 cm cages, covered with fine velon screen mesh and for additional protection against damage by crabs and fishes, a 10m mesh nylon fish net is stitched over the cages. These cages are suspended from racks in shallow calm waters. They are periodically cleaned to remove silt, predators and foulers. Recently nursery rearing

of the hatchery produced seeds of *P. malabarica* (2-3 mm length) in 25x25 mm nylon bags of 1-2 mm mesh and stocked at a density of 1000/bag and suspended from a rack in the Tuticorin bay gave highly encouraging results. In about 6 weeks the spat attain 10-15 mm length and are ready for planting on the grow-out grounds.

Selection of site.

Clams are cultured on the bottom in protected coastal waters such as backwaters, bays, creeks and estuaries. The occurrence of natural clam population in the vicinity generally indicates the suitability of the site for clam farming. About 1-2 hours tidal exposure at low tide is desirable as it helps in the management of the farm, particularly to remove the predators. Prolonged exposure of the clam farm during the tidal cycle results in poor growth due to reduced feeding and in summer there may be mortality due to desiccation.

The type of substratum preferred by the species varies. For example, *M.casta* thrives well on sandy bottom, while *A.granosa* prefers mud flats with greater proportion of silt and clay. Salinity tolerance limits of the species varies. *V.cyprinoides* prefers near freshwater conditions which are generally prevalent in areas subjected to heavy rains and freshwater drain from the land. Clam farms are located in areas where there is little wave action. Also strong water currents dislodge the clams from the burrows. Areas prone to frequent changes of the contour and vulnerable to pollution are avoided.

Farming in open coastal waters

The ground is levelled and cleared of predators such as boring gastropods, starfishes, crabs and skates. Bamboo poles are placed on the boundary of the farm as markers. The movements of the clams are limited and hence in many cases fencing is not necessary. Synthetic fibre net pens are erected in the U.S.A. to hold the clams within the farm against strong water currents and also to keep the predators away. In the Kakinada bay, split bamboo screens of 0.3m height interlaced with hemp twine proved effective in confining the clams inside the farm. At high tide, seeds measuring 10-25 mm in length are taken in a boat and planted in the farm, taking care for even dispersal as far as possible. Uneven distribution is set right during the next low tide. After seeding the farm, 10 mm synthetic netting is laid on the bottom and is held in stretched position by stakes; this net cover offers protection against predations and strong water currents. The stocking density varies with the species cultured and the size of the seed. In the case of *A. granosa* in Malaysia, 1000 to 2000/m^2 are stocked and are thinned more than once to achieve a final density of 300 seed of 20-25mm/m^2 which is considered as optimum. Except for the watch and ward and eradication of predators, no other maintenance work is involved during the grow-out phase. The clams are harvested after 5-6 months either by hand-picking or by a hand operated dredge.

In the blood clam, *A.granosa* culture in the Kakinada bay, seed clams of 5.53 to

7.08 g (length 21.8-25.1 mm) stocked at 140-175/m² have attained 25.5 to 32.9 g (39.2 to 42.7 mm) at harvest in 5-6 months. The retrieval was 83.4 to 88.6% when pen enclosures are used and 41.5% without pen. Production rates of about 40t/ha/5.5 months were obtained when pen culture was practised and 21t/ha/6 months when pen was not used. Thus both retrieval and production rates have come down by about 50% in blood clam culture if pen was not used. Field studies in blood clam culture showed that in pen culture, at a stocking density of 300/m², production of 70t/ha is possible.

In the Mulky estuary in Karnataka, in experimental culture, *M.meretrix* has grown from 23.6 to 37.5 mm in 4 months and the survival rate was 75.5%. In the Vellar estuary *M.casta* has grown from 7.3 to 40.6 mm in one year.

In the Ashtamudi lake and at Munambam, *P. malabarica* has been successfully cultured by the CMFRI by utilising the hatchery raised seed. Seed clams of 10.7 - 12.4 mm length have grown to 30.4 -34.6 mm (7.8 -9.5 g) in 3.5 to 5.5 months. The production worked out to 14.3 to 59.3t/ha with retrieval at 7 to 17.6%.

Farming in coastal ponds

Clams are also cultured in coastal ponds. In Taiwan after the set back in shrimp culture due to diseases, several shrimp culture ponds are used for farming the clam *Meretrix lusoria*. In Thailand *A.granosa* is grown along with the shrimp in the shrimp culture ponds. The clam seeds are planted in the central elevated areas of the shrimp ponds and are harvested after 5-6 months along with the shrimp. In India *P.malabarica* and *A.granosa* offer opportunities for integrating clam farming with shrimp culture. Apart from generating additional income, clams purify the water by reducing the sediment load.

Giant clams

In the tropical Indo-Pacific, several countries have embarked upon mariculture of giant clams of the family *Tridacnidae*. These are high value species and listed as endangered. They occur in the Andaman & Nicobar and Lakshadweep group of islands with vast potential for the development of mariculture in these islands. Development of giant clam mariculture is of particular interest because *Tridacna* sp are autotrophic, requiring no artificial feeding, ocean grow-out phase is simple and the hatchery technology has already been developed elsewhere.

Depuration

Clams like other filter feeding bivalves, accumulate pathogenic organisms in their body. By depuration the bacterial load is brought down to permissible levels. The faecal matter, sand and silt particles are also removed from the alimentary canal. They are placed in cleaning tanks under a flow of filtered seawater. About 10-20% of the seawater is continuously replaced. The process is continued for 12 hours, the

water in the tank is drained and the clams are cleaned by a strong jet of water to remove the accumulated debris. They are further held in filtered seawater for 12 hours and washed again.

Products

In several countries clams are eaten raw or steamed. The clam meat is frozen as blocks or individually quick frozen, canned or smoked. Clam juice, clam stripes, clam streaks, stuffed clams, clam pickle and chowder are the other products of clam. In recent times clam meat is increasingly used as shrimp feed.

Byproducts

The clam shell is used in the manufacture of cement, calcium carbide, sand-lime bricks and lime. The shells of several clams are used for making curios.

Marketing

Shucked clam meat fetches Rs. 20-35/kg in the local market depending upon the size and species. The export of clam meat to the overseas markets has increased from 371t in 1989 to 900t in 1993. In terms of value, almost fivefold increase has ben recorded from Rs.63.02 lakhs in 1989 to Rs.292.25 lakhs in 1993. *Paphia malabarica* is the prime species in the export trade from the country.

Economics :
Blood clam culture

The economics of the on-bottom blood clam (*A.granosa*) culture in an area of 1 hectare at the stocking density of 300/m^2 is given below. After the culture period of six months a production of 70 tonnes can be obtained. The shell fetches a revenue of Rs. 1000 per tonne. The suitable period for culture is October-March. There is no capital expenditure. The cost of seed is based on supply from the hatchery since availability in the clam beds is scarce. Salinity range preferred is 15-30 ppt. This species can be cultured in east coast estuaries and bays where the substratum is soft and predominantly made of silt and clay.

A.	**Operational cost**	**Rs.**
1.	Casuarina poles	1,000
2.	Pen enclosure	2,000
3.	Seed @ Rs.55/1000	1,65,000
4.	Boat hiring	2,000
5.	Labour	2,000

6.	Harvesting, depuration & shucking of meat	10,000
7.	Contingencies	2,000
8.	Lease rent	10,000
9.	Watch and ward for 6 months	6,000
	Total	2,00,000
B.	**Cost of production**	2,00,000
C.	**Income**	
	Shell-on weight of harvested clams 70 t	
	Wet meat weight 10 t	
	Shell weight 52 t	
	Sale of 10 t meat @ Rs. 25,000/ t	2,50,000
	Sale of 52 t shell @ Rs. 1,000/ t	52,000
	Total	3,02,000
D.	**Profit**	
	(Rs. 3.02,000 - Rs. 2,00,000)	1,02,000
	Net profit on investment works out to 51.0%	

Black clam culture

The black clam *Villorita cyprinoides* is most suitable to culture in the upper reaches of the estuaries and backwaters of Kerala and Karnataka States. Peak spawning is during June-August, and seed clams of 15-20 mm occur from August onwards. Under favourable conditions seed density of 8000 - 12000 nos/m^2 is common in the Vembanad Lake. The seeds occurring in the natural grounds are adequate to support moderate level clam farming operations. Preferred salinity range is 2-10 ppt and single crop of 6 months duration can be raised during September-March. Studies indicated that pen enclosure is not necessary. the retrieval is 70% and at harvest the clams attain 25 g shellon weight.

A.	**Operational cost**	**Rs.**
1.	Casuarina poles	1,000
2.	Seed @ Rs. 10/1000	75,000
3.	Boat hiring	3,000

4.	Labour	3,000
5.	Harvesting, depuration & shucking of meat	20,000
6.	Watch and ward	9,000
7.	Lease rent	10,000
8.	Contingencies	2,000
	Total	1,23,000
B.	**Cost of production**	1,23,000
C.	**Income**	
	Shell-on weight of harvested clams 130 t	
	Wet meat weight 13 t	
	Shell weight 100 t	
	Sale of 13 t meat @ Rs. 10,000/t	1,30,000
	Sale of 100 t shell @ Rs. 600/t	60,000
	Total	1,90,000
D.	**Profit**	
	(Rs. 1,90,000 - Rs. 1,23,000)	67,000

Net profit on investment works out to 54.5%