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TECHNOLOGY OF CLAMS AND COCKLES. CULTURE

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Cultivable species

Good number of clams are at present cultivated in a number of countries. It may be seen that clam/cockle culture is extensively (Table 1) practised in Japan, Korea, Taiwan, Malaysia and Thailand. True cockles belonging to the genus Cardium are not commercially cultured but the blood clam Anadara granosa which is referred to as cockle in the south-east Asian countries is extensively cultured. In our country, apart from the 4 species given in the table, Katelysia opima and Vellorita cyprinoides var cochinensis have the potential for farming.

Induced spawning and hatchery production of seed

The procedure is popularly known as the Milford method (Bardach et al., 1972) and is the same as followed for oysters. In short the adult clams are held at 10°C and are conditioned for spawning by slowly raising the temperature to about 18°C. For 2-4 weeks the temperature is maintained at this level depending upon the time of the year. Then it is raised to 25°C which induces spawning. The larvae are reared in the hatchery supplied with sterilised water. Algal cultures of Monochrysis lutheri and Isochrysis galbana are given as feed. When the larvae are ready to settle they are transferred to larger settling tanks for rearing the spat. By this method the quahog, Mercenaria mercenaria was spawned in the U.S. and the seed raised. A great advantage of this method is that the clams can be induced to spawn at any time of the year which would ensure continuous seed supply.

Seed collection

The size of the seed collected from the wild varies even for the same species at a given locality depending upon the time of collection. In Taiwan (Chen, 1976) where there is a practice of

nursery rearing of seed, seed measuring 0.5 mm length onwards are collected. Otherwise for most of the commercial species 5-25 mm seed are collected. The equipments required are a spade, rack or any implement suitable to dig the top layer of substratum. In mud flats, for Anadara seed, a small hand net with nylon mesh netting is scooped in the mud or operated from a boat. Propulsion on mud flats may be on a wooden plank with one foot pushing through the mud while kneeling on the plank with the other leg. Sieves are used to separate the seed. Hand picking is a common practice for slightly larger seed. Also a container like a bamboo basket, wooden box, trough etc., is carried to hold the seed collected. Seed collection is usually done at low tide.

Nursery rearing of seed

In Taiwan tiny seeds (about 0.5 mm in length) of Meretrix lusoria are gathered from sandy flats in tidal areas by sieving the substratum (Chen, 1976). They are stocked in milk fish ponds at 30 to 50 million per hectare. Bamboo sticks are planted to serve as markers. If the productivity in the pond is poor fertilisers like night soil, hog manure, chicken droppings, rice bran etc., are applied. Predators are removed periodically. After about 6 months nursery rearing they are harvested (survival 50-60%) and sold for stocking in clam farms. Similar nursery management of the seed clams of A. granosa is in vogue in Taiwan (Chen, 1976) where they are reared for a few months in mud flat enclosures (area 0.1 to 0.3 ha) made of nylon netting supported by bamboo sticks.

Site selection

The clam farms are located in estuaries, bays and other sheltered areas close to the shore having tidal influence. About 1-2 h exposure at each low tide has the obvious advantage of managing the farm with ease. Too long an exposure results in poor growth due to reduced feeding and may cause mortality due to desiccation. Farms

located farther in sub-tidal area have the disadvantage when predators are to be eradicated. Clams are rarely grown in ponds. In Taiwan (Chen, 1976) Meretrix lusoria is grown in ponds formerly used for milkfish and also in the outlet and inlet canals of milk fish ponds. The type of substratum preferred varies with species cultured. For example Meretrix sp., thrives well on sandy bottom while Anadara granosa prefers mud flats containing upto 90% silt. Also the range of salinity tolerated differs. Few species tolerate prolonged low saline conditions which are generally prevalent in areas subjected to heavy rains or fresh water drain from the land. Clam farms should be located in areas where there is little wave action. Areas prone to frequent changes of contour and liable to pollution should be avoided. It is also desirable that the clam seed is available close to the farm site.

Equipment

Very little equipment is required for clam farming. Bamboo sticks are planted to indicate the farm area. The movements of the clams are limited and fencing is not necessary. However synthetic fibre nets are sometimes erected as in Taiwan (1976) and U.S.A. (Bardach et al., 1972) to prevent their escape with the water current and/or to keep the predators (crabs and fish) away. A watchman's shed and a bamboo raft or a boat for transplanting, harvesting and inspection are required depending on the size and location of the farm.

Farming the clams for market

The ground should be levelled and cleared of predators. The clam farm is generally stocked at high tide. The seed may be sown from boats, taking care to get even dispersal. Any irregularity observed in the distribution is set right at the next low tide. The stocking density varies generally depending upon seed availability and the species cultured. In the case of A. granosa, in Malaysia it may reach 1000 to 2000/m^2 and this may be thinned more than once to

achieve a final density of 300 to 600/m^2 (Bardach et al., 1972). The duration of the culture depends upon the species and the country where grown. M. mercenaria when grown in northern waters of U.S.A. takes 5-8 years to reach marketable size and the same species when cultured in Florida could be marketed in 2 years (Bardach et al., 1972). Similarly A. granosa is cultured for 1-2 years in Taiwan, 8-9 months in Malaysia and at Kakinada it was harvested after 5 months culture (Narasimham, 1980).

Farm management and harvesting

The natural enemies of the clams are the boring gastropods, starfishes, crabs, skates and wild ducks. Therefore a close watch for predators is remunerative. The farm needs very little maintenance job. In clam culture fertilisers and feeds are not used. Care should be taken to prevent poaching. Harvesting is usually done by hand. Some of the implements used in seed collection are employed in harvesting. A dredge may also be used. The yield by clam culture varies widely in different countries, being invariably low in temperate countries. For example the production of A. granosa is less than a tonne/ha/year in Taiwan, 20.7 tonnes/ha/year in Malaysia and at Kakinada a very high production of 385.3 kg/100m^2/5 months was obtained at a stocking density of 140/m^2 (Narasimham 1980). In Malaysia usually clams are stocked, 300 to 600/m^2.

Economics

Data on cost benefit studies are available for a few clams. In Malaysia a 16 ha Anadara farm showed a gross profit of 6333 to 7600 US dollars (Fisheries Division, 1972) and in Thailand a 1.6 ha farm gave a net return of 1478 US dollars (Sribhibhadh, 1972). In Korea the net income from a 50 ha hard clam farm was estimated at 6870 million wons.

Clam culture prospects in India

On bottom clam culture is fairly simple. Experimental culture on the 'on bottom culture' of various clam species being undertaken at the Central Marine Fisheries Research Institute indicates that the clams grow very fast and reach marketable size in 5-6 months and their production per unit area is very high. As is the case with other edible molluscs, clam culture offers immense scope for coastal aquaculture.

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Table 1. Important species of clams and cockles cultured

Scientific name	Popular name	Family	Country where cultivated	Extent of development	Area under cultivation	Reference
Meretrix meretrix	Hard clam	Veneridae	Taiwan	Extensive	--	Ling (1972)
	Great clam	"	India	Experimental	--	
		"	Korea	Extensive	3396 ha	Office of Fisheries (1972)
		"	Japan	Extensive		Ling (1972)
		"	Taiwan	Extensive	3799 ha	Chen (1976)
M. casta	Backwater Clam	"	India	Experimental	--	
M. casta var ovum		"	India	Experimental	--	
Venerupis semidecussata		"	Japan	Extensive	--	Ling (1972)
V. decussata	Little neck clam	"	Portugal	Moderate	--	Korringa (1976)
V. japanica	Short necked clam	"	Korea	Extensive	888 ha	Office of Fisheries (1972)
Tapes japanica		"	Japan	Extensive	--	Bardarch et al (1972)
Mercenaria mercenaria	Hard clam, quahog	"	U.S.A.	Limited extent	--	Iverson (1976)
Anadara granosa	Cockle, blood clam	Arcidae	Malaysia	Extensive	2000 ha	Fisheries Division (1972)
		"	Thailand	Extensive	625 ha	Sribhibhadh (1972)
		"	Vietnam	Moderate		Ling (1972)
		"	Taiwan	Moderate	200 ha	Chen (1976)
		"	Philippines			Bardach et al (1972)
		"	India	Experimental	--	
A. broughtoni		"	Japan	Moderate	--	Ling (1972)
A. ganosa bisenensis		"	Japan	Moderate	--	Ling (1972)