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A BRIEF REVIEW OF MOLLUSCAN CULTURE IN THE WORLD

K. ALAGARSWAMI

The oysters, mussels, clams, cockles, scallops and abalones are the food molluscs which are produced through aquaculture in several parts of the world. Oysters are among the earliest invertebrates produced by aquaculture and oyster culture dates back to the Roman days of 100 B.C. In spite of its antiquity application of modern technologies for the production of molluscs has been relatively recent.

The world fish production through aquaculture is a little over 6 million tonnes. The molluscs alone account for about 1.05 million tonnes or 17.2% of total aquaculture production. Oysters and mussels form the two major groups accounting for about 56% and 31% of the total molluscs production respectively. Scallops, clams and cockles together contribute to the remaining 13%.

OYSTER CULTURE

Japan

The major species used in culture in Japan is Crassostrea gigas, the Pacific oyster. The technology employed is highly sophisticated compared to the practices followed in other countries, including the USA. The industry is concentrated in Miyagi, Hiroshima and Kumamoto prefectures. Five different methods are employed in oyster culture: Bottom sowing, stick, rack, long line and raft culture. The bottom sowing method is the simplest of all and the earliest to be practised in Hiroshima. However, the modern oyster culture depends on raft and long line culture methods, accounting for 64% and 11.6% of the total area used in oyster culture. These methods have the advantages of expanding the area of operation to the deeper waters, using entire water column for increasing production and also for

controlling the predators. The seed collection industry functions independent of oyster culture for the market. Although hatchery technology has been developed, for commercial production of seed hatcheries have not become popular. The seed of C. gigas is also exported to USA, Canada, France and other countries. The oyster spat are collected on shell strings using scallop shells or on plastic mesh collectors, called Netron. Oyster production in Japan stood at about 266,000 tonnes in 1968 after which there has been a decline due to pollution and other problems. The average yield under long line culture is as high as 26,000 kg meat weight/ha/annum which is the highest yield in the world.

U.S.A.

The culture industry is spread along both the coasts of USA. The American oyster, Crassostrea virginica is cultured on the Atlantic coast, and the Pacific oyster C. gigas along the Pacific coast. The latter was introduced from Japan and has established itself and is breeding successfully. About 60% of the oyster production comes from the natural stocks on the state-owned intertidal or subtidal beds which are harvested by licensed fishermen, and 40% of production comes from the privately owned or leased beds. The oyster industry is based entirely on on-bottom culture. Long-Island on the Atlantic coast and Washington on the Pacific coast are the most important oyster production centres, although it is practised at several other places. Even by this unsophisticated bottom culture method an average production of 5000 kg of meat/ha/year is obtained from the Atlanctic coast due to intensive management practices. The total oyster landings of USA stood at 326,000 tonnes (round weight) in 1972.

Major technological advances in oyster culture have been in the direction of artificial breeding production of seed and disease control. Commercial oyster hatcheries have been established both on the Atlantic and Pacific coasts and they are so versatile that they can produce seeds of oysters of different species, clams and abalones.

A completely closed cycle shellfish factory has been tested at the University of Delaware where the production through the whole life cycle of the oyster is controlled. Great strides have been made in the control of predators such as oyster drills and starfish and in understanding the causes of diseases and mass mortalities.

France

Two major species of oysters traditionally grown in France are the flat oyster Ostrea edulis and Portuguese oyster C. angulata. In the recent years C. gigas has been introduced. The Bay of Arcachon on the southwest part of France on the Atlantic coast and the Gulf of Morbihan on the southwestern part of Brittany are the most important regions for oyster culture in France. Collection of spat on lime coated, semicylindrical ceramic tiles which was introduced at Arcachon in 1857 is still being continued with little change. However, for the collection of seed of Portuguese oyster, shell bags have been found to be more efficient. The spat removed from the tiles are grown by on-bottom culture in oyster parks in the harbour and estuaries. The last one year of culture is done in small marshy ponds called "claires" for the fattening and greening of oysters. Production of oyster has fluctuated very highly in France due to large scale mortalities and disease problems. In 1975 the production was 71,000 tonnes. The average yield is 1000 kg meat weight for C. angulata and 250 kg for O. edulis per ha/year.

Other countries

The Republic of Korea produces about 73,000 tonnes using C. gigas under raft culture. In Australia the Sydney rock oyster C. commercialis is used in culture by the stick and tray methods and the production is around 10,000 tonnes. The slipper oyster C. eradelie is used in Philippines. In the recent years, Cuba and Venezuela have made substantial progress in the culture of mangrove oyster C. rhizophorae. In the Netherlands and Spain O. edulis is grown by

on-bottom culture method. Mexico produces 45,000 tonnes of oysters, Thailand about 23,000 tonnes, Taiwan about 14,000 tonnes, Canada about 5,000 tonnes and U.K. about 3,000 tonnes.

MUSSEL CULTURE

In terms of production potential, culture of mussel assumes more importance even over the oysters. The world production of mussels ranges between 300,000 and 400,000 tonnes and the large-scale operations are confined to the temperate waters of Europe. Spain with 160,000 tonnes leads in mussel production, followed by the Netherlands (100,000 tonnes), Italy (30,000 tonnes) and France (17,000 tonnes), Federal Republic of Germany, Korea, Chile, Yugoslavia, Philippines and New Zealand are the other countries where mussel culture is practised. Unlike in the case of oysters with several species, a single species of the blue mussel Mytilus edulis contributes nearly to the total world production of mussels. The mediterranean mussel M. galloprovincialis and the green mussel M.smaragdinus are the other two important species. The former is closely related to the blue mussel.

Spain

The Galician Bays of Spain are the most important mussel farming centres of Spain, mussels are grown in rafts, the construction of which has undergone several improvements and steel structures are used today. Mussel seed is collected both from the rocky intertidal areas and on ropes suspended specially for the purpose from the floating mussel parks. The seed collected from rocks are wrapped around thick ropes and secured by fine, large mesh rayon netting which disintegrates within 24 hours of being placed in sea water, by which time the young mussels have attached themselves to the ropes. Spat collected on ropes are left to grow. When the clumps of mussels become large, the peripheral layers are removed and put on new ropes. Harvest is done by cranes when the mussels reach 7.5 - 10.0 cm. The

rate of production is 300 tonnes meat/ha/year. Since mussels depend for their food on the first link of the food chain (phytoplankton and organic detritus) and plenty of food is available in the water column such high production rate is achieved.

Netherlands

Mussel farming in the Netherlands is more than a century old. The seed grounds are public beds and the Government permits collection of seed during short, well defined periods. The mussel farmers take the seed to their private plots and spread them. The half grown mussels are transferred to fattening grounds. Finally, after harvest, the mussels are kept in cleansing grounds before they are sold. The mussel industry has become highly mechanised. Seed collection and harvesting are done by mussel boats by dredging. Zeeland and Waddenzee are the two important mussel producing centres. The Dutch-style of mussel farming is a semi-culture operation depending on transplantation of seed from natural beds to better growing and fattening beds.

France

Mussel farming in France starts with the story of the Irish sailor Patrick Walton who in 1235 was shipwrecked in the Bay of Aiguillon and found good settlement of mussels on poles. Since then culture of mussels on rows of poles called the "Bouchots" has become the practice. Earlier seed was collected on poles planted in muddy areas but this has already been replaced to a large extent by collecting seeds on coco fibres stretched out horizontally. Planting poles has been mechanised to a certain extent and long tubes of nylon netting are used to attach mussels to the poles of bouchots. The north coast of Brittany is the chief mussel producing area. However, important seed collection centres are located in La Rochells in southern France. The mussel reaches the marketable size of 5 cm in about one year. Average production rate in bouchot culture is 2250 kg meat weight/ha/year.

Italy

In Italy, mussel farming is done by the hanging culture method. In the sheltered areas where mussel farming is practised the bottom is predominantly soft and muddy. The mussel parks comprise networks of poles connected with horizontal ropes. From these ropes strings of mussels are suspended. A special type of rope is stretched around the parks to collect the seed. The important areas of mussel farming are Chioggia-Venezia-Trieste, the region of Taranto, the Gulf of La Spezia, the area of Napoli and also the regions of Olbia and Varano. The Italian mussel production is around 30,000 tonnes.

Philippines

The Philippines is one of the very few countries in the tropical region which has developed mussel farming. The green mussel M. smaragdinus is farmed in the sub-tidal area of Bacoor Bay near Manila. Bamboo poles are erected in muddy areas and seed mussels settle on the poles and grow until marketable size. Divers are engaged both for staking the bamboo poles and for harvesting the mussels. It takes about 6 months for the mussels to reach the marketable size of 4 - 6 cm.

Other countries

Mussel culture is also done in Federal Republic of Germany (annual production about 14,000 tonnes), Republic of Korea (5,600 tonnes), Chile (1,300 tonnes), Yugoslavia (300 tonnes), New Zealand (200 tonnes) and Singapore.

CLAM AND COCKLE CULTURE

Culture of clams is next only to that of oysters in antiquity. Clam culture is widely practised in Japan and other countries of Asia and also the United States. The principle of clam culture remains still one of transplantation of seed from slow-growing beds to fast-growing beds.

Japan

Although about nine species of clams are cultured in Japan, the "Asari" clam Tapes japonica forms the most important species. The beds are prepared by ploughing the foreshore area with tractor to loosen the soil and to eliminate weeds. Clam culture is restricted to waters less than 25 cm deep at low tide. The bed is left undisturbed for a week and seed clams (T. japonica) of 1.5 cm size collected from the breeding areas are sown by hand at the initial stocking density of 1 - 4 litres/m^2. The clam grows to the marketable size of 4.0 cm or more in 22 months. Hand tools or simple dredges are used for harvesting.

Malaysia

The culture of blood clam or "Cockle", Anadara granosa, is one of the important avocations in coastal aquaculture in Malaysia. About 2000 ha of estuarine mud flats in the states of Perak and Selang are used in cockle culture. The spat density in reproductive beds is as high as 10,000 seed/m^2 or more. Seed of 4 - 10 mm (4 months old) size are collected using a fine mesh wire scoop and stocked in otherwise barren beds at an initial density of 1000 - 2000/m^2. The clams are grown for a period of 8 - 9 months when they reach the minimum legal size of 31 mm. Harvest is done with a wide mesh wire scoop. The average rate of production is 20.7 tonnes/ha/annum. The total annual production is about 28,000 tonnes (1975).

Other countries in Asia

Clam culture is also practised on a smaller scales in Taiwan, Republic of Korea, Thailand and Philippines. In Taiwan, the hard clam Meretrix meretrix, and the blood clam, Anadara granosa are cultured in about 1829 ha of area in western and northern coasts of Taiwan. The production is about 15,000 tonnes per annum. In the Republic of Korea, clams cultured are Meretrix lusoria, Venerupis japonica and Anadara bisenensis. The annual production is about 25,000 tonnes. The "cockle"

A. granosa is cultured in Thailand in about 625 ha in the estuaries of Mae Klong and Petchburi rivers. The duration of culture is about 8 - 12 months.

U.S.A.

Culture of the quahog, Mercenaria mercenaria is important along the Atlantic Coast of the United States of America, particularly in New England and Long Island Sound. The same primitive method of bottom culture as for oysters is used in clam culture. Seed clams of 3 - 12 mm size are scattered in the shallo water area and allowed to grow to marketable size (50 - 63.5 mm) which requires 5 - 8 years. Hatcheries are available for commercial production of clam seed. Hatchery seed planted in Florida reach marketable size in 2 years time. The soft-neck clam Mya arenaria is second in importance and culture of this clam is concentrated in Maine. The market size is reached in about 3 - 4 years.

Experimentally the quahog has been grown in sewage tanks at Poole Harbour. Work on clam genetics and cross-breeding has made some progress.

SCALLOP CULTURE

Japan leads in scallop culture, with the species of deep-sea scallop, Patinopecten yessoensis. The scallops are grown in sandwichtype frame nets and wire boxes under raft culture. The annual production is about 62,600 tonnes. In U.S.A. the bay-scallop Argopecten irradians is cultured on a very small scale.

ABALONES

At least eight species of the gastropod abalone occur in the Japanese waters. However, success has been achieved in rearing of Haliotis discus, the most important species. Hatchery technology is used for production of abalone seed. When they are 1.5 - 2.0 cm they are sold to fisheries co-operative societies. Growing abalone to

commercial size under controlled conditions is too expensive and hence natural beds are stocked with the hatchery-raised seed. The recapture rate is about 10% of the seed in 2 - 3 years when the abalones reach 12 cm or more. Experimentally full hanging culture of abalone is done at the Oyster Research Institute, Kesennuma.

California has an important natural fishery for abalones, next only to that of Japan. Culture of the red abalone Haliotis rufescens is done in the Morro Bay area where a hatchery also functions.

CEPHALOPODS

Culture of octopus, squid and cuttlefish is still in the initial stage of development. Japan has taken a lead in this for the culture of squid Sepioteuthis lessoniana and cuttlefishes Euprymna, Sepia and Sepiella. Both egg capsules and young ones collected from nature are reared in tanks. Starting with an initial weight of 4 grams, the squid attains 500 to 700 grams in about 5 months which is the marketable size. Larvae are fed with live Mysis and the grown ups are supplied with shrimp and fish meat. The Republic of Korea has taken up culture of the octopus Polypus vulgaris. In the U.S.A., the squid Sepioteuthis sepioidea is cultured for research purposes and not commercially. From egg to maturity the squid takes about 5 months to grow.

GENERAL REMARKS

From the above review it emerges that molluscan culture is practised in many parts of the world. It is done on an extensive scale in the temperate and sub-tropical regions, particularly along the Atlantic coast of U.S.A. and in Japan for oysters and clams, and in Europe for oysters and mussels. In the tropics, South-east Asia has a culture industry predominantly based on clams and oysters.

The concentration of molluscan culture industry, as stated, is in the temperate region. Highly evolved techniques of hatchery production of seed, improved and intensive farming practices, predator control etc, are employed in these areas. The major problem is one of slow growth of the organisms and it takes between two and six years for the harvest. On the other hand in the tropical waters the techniques employed are of a primitive nature. But the advantage is the fast growth of the organisms and the culture duration is hardly from 6 to 12 months. There are immense possibilities of increasing production of molluscs in the tropical region by bringing in additional areas and adoption of improved technologies. However, there is a social problem of enlarging the consumption of cultured molluscs by the people and the economic problem of realising remunerative prices.

Perhaps India has one of the highest potentials for production of molluscs in this region having a variety of species exploited at subsistence level. Adopting simple farming practices developed in the recent years it would be possible to increase production. The mussel gives one of the highest production rates in raft culture and the duration is hardly 5 months. The oysters reach marketable size in about one year's time and the average yield is good for the raft culture. The natural beds of clams along the west coast of India and in some parts of the east coast are rich and by simple transplantation method it would be possible to increase production.

Both inUSA and Japan industrial and domestic pollution, frequent occurrence of mass mortalities, recreational demand etc., act against the interest of molluscan culture and any substantial increase in production would become possible only through employment of high-cost advanced technologies. The developing countries, particularly those in the tropical belt, have very good prospects for the production of molluscs for meeting the protein and energy requirements of their people and also to meet the demands of the developed countries.