Mariculture

&

Its Prospects

Prof. S.P. Trivedi

MARICULTURE

- Mariculture is an activity involving food production for human consumption. It is an activity in which aquatic organisms both plants and animals are cultured in a confined environment in the aquatic medium which may be completely marine or marine mixed to various degrees with freshwater in the brackishwater areas.

Prospects of Mariculture in India:

Our country, India is blessed with vast and varied marine resources. Our coast line extends up to 8,129 km. and we have an Exclusive Economic Zone (EEZ) of 2.02 sq Km. The Indian Ocean spreads over a total area of 51 sq. km. Our EEZ includes 0.86 million sq. km. in the east coast, 0.56 million sq. km. on the west coast and 0.60 million sq. km. around the Andaman and Nikobar Islands. In EEZ, besides having absolute rights, India has also acquired the responsibility of conservation, protection, development and optimal exploitation of living marine resources up to 200 nautical miles off the coastline. As far as production of fish is concerned, India ranks at number two in global fish production. Our total fish production in the year 2017-18 was recorded to the tune of 12.59 million metric tones (MMT) which includes 8.90 MMT from Inland sector and 3.69 MMT from marine sector. An average annual growth of 10.14% was achieved in fish production during 2017-18. Gujarat is currently the leading state in marine fish production (7.01 lakh tones) (*Handbook on Fisheries Statistics*, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, 2018).

India has abundant fishery resources with great potential for substantial progress. A total of 788 marine fish species landed along Indian coasts in 2017. India's marine fish production is up by 5.6% to touch a total marine production of 3.83 million tonnes in 2017. Indian oil sardine was the topmost contributor in marine fish resources with a landing of 3.37 lakh tonnes (8.8% of total landings) in 2017. However, a sharp fall of 54% was recorded in its production in the year 2018. Now the Indian mackerel with a contribution of 2.84 lakh tonnes towards the total landings (8.1%) became the topmost contributor in marine fish resources. The Bumper landings of red toothed trigger fish, *Odonus niger*, along the west coast since August 2018 is a major boost for marine sector. Among the nine maritime states Tamil Nadu is now the major contributor followed by Kerala, Gujarat and Karnataka. A marginal increase of 2% was recorded in Elasmobranch landings. The fishery landed in

2018-19 was dominated by clams (76.3%) followed by mussels (15.3%) and oysters (5.3%) (CMFRI Annual Reports, 2017-18 & 2018-19).

Fisheries sector provides livelihood to over 1.60 crore people. We possess more than 10% of global fish biodiversity. More than 5% of the agricultural GDP in India is contributed by Fisheries sector. Our EEZ is a potential source of marine fishery resources. In EEZ approximately 3.9 million tonnes of fishery resources are available which can be easily harvested. About 58% of these resources are available in 0-50 m depth, 35% in 50-200 m depth and 70% in depth beyond 200 m. Apart from this we have 530, 000 sq km area under continental self. There are 1,896 or more landing centers and around 4,000 fishing villages along the coasts of India.

Major contributors in marine fishery resources of India:

1. Molluscan fishery-that includes Oysters, Clams, Mussels, Scallops, Cephalopods, Gastropods, Pearl fishery and Chank fishery, etc.
2. Marine finfishes.
3. Marine ornamental fishes.
4. Marine crustaceans-that include marine shrimps, Lobsters, and crabs etc.
5. Marine seaweeds, and
6. Sea cucumbers etc.

Prominent farming/culture activities in Indian Mariculture Programme:

Fig. 1. An Oyster Farm

Site selection for Oysters

- Open seas free from strong waves
- High plankton production
- Moderate water current
- pH 7-8.5
- Low silt road
- Dissolved oxygen > 3.5ml/L
- Market for selling produce
- Avoid site prone to toxic algal bloom
- Away from pollution

Mussel Farming in India

- Mussel farming has a long history that dates back to the thirteenth century.
- The main producers of mussels are countries such as China, Netherlands, Korea, New Zealand, France, Spain, and Philippines.
- Approximately 17 species of edible mussels are cultured and harvested worldwide.

Fig. 2 Mussels

- It is one of the most popular mariculture operations in temperate countries.
- Mussel production from Asia also increased considerable during the last two decades, from 2.1 million tonnes in 1984 to 8.1 million tonnes in 2003
- Apart from being rich in proteins and vitamins, mussels have several medicinal properties.
- Green lipped mussel helps in maintaining mobility of joints.
- Mussels have anti-inflammatory, anti-histamine and other therapeutic properties.
- In India, 2 species of marine mussels *Perna viridis* and brown mussel *P. Indica*

- **Clam and Cockle Farming:**
- Edible infaunal bivalves are often called clams.
- A **cockle** is a small, edible, marine bivalve mollusc.
- In 2003, 3.7 million tonnes of clams were produced through mariculture.
- Asia has been the major producer of clams.
- A majority of clam species are present in India.
- Clams are eaten more in the coastal regions of India, especially in the Konkan, Kerala, Bengal and Karnataka r egions.
- Eg. *Archidae, Solenidae, Veneridae, Donacidae* etc.

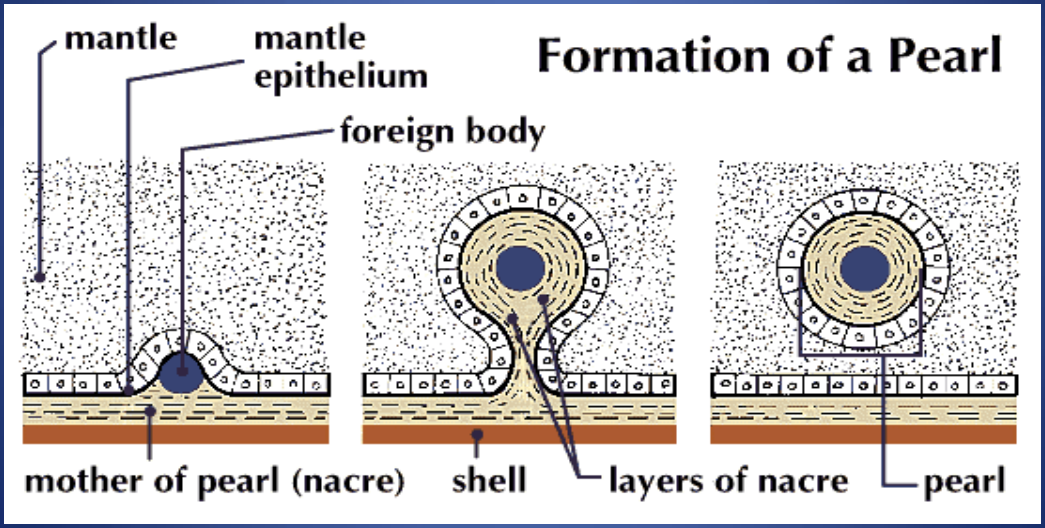
Fig 3. Paphia malabarica

Fig. 4 Villorita cyprinoides

- Relaying of clams:
- The method of clam culture is termed relaying or semiculture.
- It protects the resource from depletion.
- The clam pickers collect clams from lakes and stock them for harvesting later.
- It allows clams to grow to their full potential and gives them opportunity to utilize their full reproductive potential before being fished.
- Annually, about 800 tonnes of relayed clam is harvested.

- **Marine Pearl Farming**
- Pearls are jewels and are produced by the pearl oyster.
- It is a hard object produced within the soft tissue (specifically the mantle) of a living shelled mollusc.
- Just like the shell of a clam, a pearl is composed of calcium carbonate in minute crystalline form, which has been deposited in concentric layers.
- The species of pearl oysters found in India are *Pinctada maxima, P. fucata* and *P. margaritifera*

Nucleus/nuclei can be implanted along with a piece of mantle tissue as graft into the gonads oysters which results in formation of cultured pearls



The oysters are harvested after the formation of required size of pearls

- Value added pearls:
- The Central Marine fisheries Research Institute, Cochin developed the technology for cultured marine pearl production.
- Mabe pearls are dome shaped pearls and are produced by placing a hemisphere or miniature image against the side of oyster shell interior.

Fig. 5 Mabe pearls

- Akoya:
- These were originally produced in Japan and are perfectly round in shape and have the highest lustre.

- Baroque pearls:
- This is not round and is irregular in shape.
- These can occur naturally or are cultivated.
- More affordable.

- Keshi pearls:
- These are very tiny, round, natural pearls under 2mm in size.
- These are extremely rare.

- **Gastropod Farming**
- Commercial farming of gastropod started only after 1960.
- In 2003, 75.25% of the global production was from Asia and 10 species of abalones are cultured nowadays.
- India has not yet started farming abalones and other commercially important gastropods.

- Abalone farming:
- Abalones have soft meat and are capable of good quality rainbow colour pearls.
- Have high market demand.
- These are herbivorous, and the grow out systems are specific to this.
- In India, the technique for induced breeding and larval rearing of *Haliotis varia* has been developed.
- Preliminary success has been achieved in pearl implantation and tissue culture.

2. Marine Finfish Culture

- Marine finsfish culture originated only in the last century.
- The first marine finfish to be successfully cultured is the Japanese yellowtail, *Seriola quinqueradiata.*
- About 20 marine species are commercially cultured.
- The biggest challenge it faces is the high capital investment.

- Marine finfish farming in India:
- In India, culture has been tried either in monoculture or integrated systems.
- Pen and cage finfish culture has been tried.
- Success has been achieved in the broodstock development and spawning of greasy grouper *Epinephlis tauvina, Latis calcarifer* and *M. cephalus*.

3. Marine Ornamental Fish Farming

- Marine ornamentals are fishes, corals and invertebrates.
- Indonesia and Philippines supply more than half of the global marine ornamentals.
- US is the major importer.
- More than 98% marine ornamentals are collected from the wild which leads to stock depletion and reduces species diversity.
- The demand is exceeding the supply.

- However for home aquarium, freshwater fish types are narrowed down to some main groups and a brief description about themis given below.
- ***Livebearears***: Most of these fish types belong to the group cyprinodonts (tooted carps). These types of fish give birth to young fish babies differing with most of the other fish which lay eggs. Among these guppies, mollies, sword-tails and platies.
- ***Anabantoids:*** Siamese fighter (betta) and gourami are the most popular in this group. These have labyrinth organ which allows them to take oxygen directly form the air.

- ***Corydoras***: They are peaceful, hardy, small, active and easy to keep.
- ***Arowanas***: They are also called dragonfish and are aggressive in nature. They suck in air into their swim-bladder and can breathe it.
- ***Loaches***: Belong to the family of catfishes are bottom living scavengers. Very docile, shy, active and are very easy to keep. Eg.Clown loaches, kuhli loaches, zebra loaches etc. They accept all types of food.
- ***Catfish:***They are hardy, bottom living scavengers cleaning the bottom of the freshwater aquarium.

- ***Carp family***: Consists of very popular freshwater aquarium types like goldfish, fan tail, oranda, moor, ranchu, pearl scale, koi, danios, barbs etc.
- ***Cichlids***: Many high value species like angelfish, oscar, discus come under this group and these have originated from Africa and America.
- ***Characins***: Tetras, hatchetfish, pencilfish, silver dollar, headstander come under this group. They comprise carnivores, herbivores and omnivores.

Fig. 6 Koi

Fig. 7 Angelfish

4. Farming of Marine Crustaceans

- Shrimps, crabs and lobsters are 3 major group of crustaceans.
- In 2003, about 2.1 million tonnes of crustaceans were produced from marine and brackish water environments.
- The global production of crsutaceans is 4.5 lakh tonnes and that in Asia is 3.1 lakh tonnes.

- Marine shrimp
- The major production of shrimp is from the brackish water environment and in Asia, nearly 8 countries are farming shrimp.
- Myanmar is the major producer.
- In India, Andhra Pradesh and Gujrat have some sea based farms for *P. mondon* family

Fig. 8 *Penaeus monodon,* commonly known as the giant tiger prawn or Asian tiger shrimp, is a marine crustacean that is widely reared for food.

- Lobster:
- It is a promising candidate for close-cycle culture and controlled aquaculture as it has high market demand, low wild catches and increasing prices.
- Philippines and Singapore are the two Asian countries producing farmed lobsters and are 21 and 11 tonnes respectively.
- *P.homarus* and *P. Ornatus* are main species having high export value

Fig. 9 *Panulirus homarus* is a species of spiny lobster that lives along the coasts of the Indian and Pacific Oceans.

- Crab farming
- The global production of crabs has been estimated 1.8 lakh tonnes and Asia is a major producer.
- In India, *Scylla serrata* and *S. tranquebarica* are highly valued crabs.
- Viable technologies have been developed for fattening.

Fig. 9.
Crabs are decapod crustaceans of the infraorder Brachyura, which typically have a very short projecting "tail", usually entirely hidden under the thorax.

5. Seaweed Farming

- Seaweeds are the natural source of phycocolloids such as agar-agar, algin and carrageenan.
- These are rich in vitamins, minerals, proteins, essential amino acids and low fat content.
- Globally seaweed production has been 12.48 million tonnes in 2003 with Asia contributing 99.9%.

Fig. 10. Agar agar

Fig. 11. Algin

Fig 12. Carrageenan

- Seaweed farming in India:
- *Gracilaria edulis* has been identified as the species suitable for farming.
- It is done by vegetative propagation using fragments from mother plants or by reproductive method using diffrent kinds of spores such as zoospores, tetraspores, carpospores etc.
- It gives high profit and fast returns.

6. Sea Cucumber Farming

- Sea cucumber is a highly valued marine product and is used in many dishes in South Asia.
- It has high medicinal property and is used for treating weakness, impotence, constipation etc.
- Technology for breeding and sea production of *Holothuria scabra* has been developed.
- Efforts are on to identify and solve the major technical, environmental and legal issues related to mariculture development in India.

Acknowledgements :

Contributors of following Resource materials/References/Websites are gratefully acknowledged for their direct/indirect help taken in preparation of aforementioned e-contents.

Resources/References

- Handbook of Fisheries and Aquaculture. Indian Council of Agricultural Research New Delhi.
- http://www.fao.org/docrep/field/003/AC583E/AC583E00.htm
- Kapetsky, J.M., Aguilar-Manjarrez, J. & Jenness, J. 2013. A global assessment of potential for offshore mariculture development from a spatial perspective. FAO Fisheries and Aquaculture Technical Paper No. 549. Rome, FAO. 181 pp.
- http://www.waterencyclopedia.com/La-Mi/Mariculture.html#ixzz4csbd7G6o
- Avault, James W., Jr. *Fundamentals of Aquaculture.* Baton Rouge, LA: AVA Publishing, 1996.
- Stickney, Robert R. *Principles of Aquaculture.* New York: John Wiley & Sons, 1994.
- http://indianpearlcompany.weebly.com/pearl-farming-india.htm
- http://www.ornamental-fishes.com/2009/12/freshwater-aquarium-fish-types.html
- CMFRI (Central Marine Fisheries Institute) Annual Report, 2017-18.
- CMFRI (Central Marine Fisheries Institute) Annual Report, 2018-19.