SALT WATER 'FISH' FARMING

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Farming the waters for raising suitable varieties of fish, oysters etc. has been in practice since ancient times. Historical records show that oyster farming was practised by the Japanese as early as 2000 B. C. and by the Romans about 100 B. C. [1]. In Java, laws to protect milkfish farms from poaching were established as early as 1400 A. D. However salt water fish farming has not attained significant status over the centuries.

Glut or scarcity has often been recorded in the supply of marine fish because of natural fluctuations in the abundance of fish. One of the principal advantages of fish farming is that it stabilises the fish supply. According to FAO estimates the present annual world production of marine and fresh water fish, by farming techniques amounts to 4 million tonnes which includes one million tonne of shell fish. A short review will show the importance and potential of the salt water 'fish' farming in many parts of the world.

In the Po delta of Italy, along the Adriatic coast, eels and mullets are farmed in fenced ponds — the system being known as 'valli' culture. Mullets are farmed in Hawaii, India and several regions along the mediterranean sea. In north western Spain, mussels and oysters are farmed on a large scale. Arcachon and Anse de l' Aiguillon regions of France are world renowned centres for oyster culture. Oysters are farmed in the United States on a commercial scale. Intensive mussel culture is practised in the Waddensea by the Dutch. In Korea, oyster, cockle and sea mussel cultures are being undertaken in a big way. Milk fish farming in Indonesia and Philippines is a time old occupation. The Indonesian saltwater fish ponds are known as 'tambaks' and it is popularly believed that the tambak industry came to be established under the influence of the Hindu rule of the Islands.[2] Cultivation of 'sugpo', the tiger prawn in Philippines singly or in combination with milkfish is a profitable occupation. Shrimps, crabs, lobsters, oysters, fishes, seaweeds and cuttle fishes are cultivated in Japan.

Some traditional systems of salt water fish culture have been in vogue in India since long time. The Bhasa — badha fisheries of the estuaries of the Sunderbans in Bengal is a typical example. Low lying areas near

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estuaries and tidal rivers are embanked for this purpose and juvenile fishes and prawns are allowed entry and growth for one season before they are captured. The fishes thus cultivated include mullets (*Mugil* spp.), milk fish (*Chanos chanos*), grunter (*Pristipoma hasta*), thread fins (*Polynemus indicus*), cock-up (*Lates calcarifer*), tarpon (*Megalops cyprinoides*), tiger prawn (*Penaeus semisulcatus*) etc. Paddy field prawn fisheries of Kerala is another type of salt water fish culture practised in India. Here again the single crop paddy fields near estuaries are made use of. Young penaeid prawns are allowed to enter the fallow fields at a particular time of the year and left to grow for a short season and then harvested.

As early as 1911 James Hornell suggested the development of salt water fish farming in Madras Presidency, which led to the establishment of a marine fish farm near Tuticorin. This farm was closed down later. A marine fish farm is now being developed near the Adyar estuary in Madras.

Two commercially run salt water fish farms in the country are situated in Kerala. They are the Narakkal fish farm at Cochin and the Ayiramthengu farm adjoining the shallow Kayamkulam backwaters. These farms are stocked with mainly milkfish, mullets and pearl-spot. Yield from these farms is reported to be of the order of 1,000 kg. per hectare. Cultivable brackish water areas along the Indian coasts is estimated to be of the extent of about 50 lakh acres 20,24,291 hectares) which is greater than the estimated areas of cultivable fresh water.[3] Eventhough all these waters may not be ideally suited for commercial fish farming, much of these could be utilised for cultivating one species or the other. The coastal mud flats and lagoons along the east coast of India, though extensive are supposed to have some limitations in biological productivity, probably because these environments get cut off from the sea during summer and become warm and highly saline.

Species which lend themselves to salt water farming are from estuarine or coastal habitats. Many of them spend a part of their early life cycles in the backwaters or in tidal inlets. This habit makes it easy to collect their young ones for purposes of stocking. The following species are noted for their adaptability to thrive in farms.

Milk Fish *(Chanos chanos)*

Milk fish is distributed in the tropical and subtropical waters of the Indian and Pacific oceans. The species has not been recorded from the Atlantic. It is widely cultivated in east Asian countries and also in India. It is a quick growing fish. Reported growth rate during the first year is 38 cm in salt water, 48 cm in brackish water and 64 cm in fresh water.[4] The fish attains over a metre in length and 20 kg. in weight. Spawning of milkfish takes place in the coastal waters. The females release between 1.5 and 1.7 million eggs during a single spawning. The fry and fingerlings enter the estuaries and backwaters and are readily available from tidal creeks and mud flats, seasonally, in several centres along the peninsular India. The fish can adapt itself to freshwater conditions extremely well. They are mainly herbivorous and feeds on vegetable matter like algae, phytoplankton and detritus. The larvae can

be transferred from salt water to fresh water directly and transported. The young fingerlings are not as hardy as the fry. Average annual production of this fish in the farms is 300 kg. per hectare (2.47 acres) in the Philippines, about 2000 kg. in the fertilised ponds of Taiwan and 5000 kg. in the sewage fed ponds of Indonesia.

Mullets *(Mugil* spp.*)*

Mullets have a world wide distribution. They are found in temperate and tropical regions and are cultivated largely in brackish water environment and occasionally in fresh water. There are about a dozen species of mullets known from the Indian waters.[5] They are known to tolerate wide variation in salinity and feeds mainly on detritus and vegetable matter. *Sicamugil cascasia* and *S. hamiltoni* are purely fresh water forms inhabiting large rivers of northern India and Burma. *Rhinomugil corsula* occurs even beyond the range of tidal influence in the river Ganges and Mahanadi and in the sea off their estuaries. *Mugil cephalus* and *M. tade* are the two larger mullets suitable for salt water farming. These are cultivated in India to a limited extent. The former species grows to a length of 45 cm in one year and attains a maximum length of 90 cm. *M. tade* attains only about 70 cm. Other common mullets are *M. macrolepis*, *M. parsia* and *M. cunnesius*. All these attain a length of about 30 cm. Salt water mullets breed in the sea. Fry and fingerlings live in shallow coastal areas, creeks and backwaters and can be easily obtained seasonally from these environments for culture purposes. However, in areas like Narakkal, *M. cephalus* seeds are not found in abundance as before. Attempts are being made to induce spawning in mullets in India and other countries. Recently it has been reported that the Tunkang marine laboratory, Taiwan, has succeeded in artificially breeding and rearing the hatchlings of grey mullet to stocking size. The success achieved in artificial propagation will surely give an impetus to mullet farming.

Pearl spot *(Etroplus suraetensis)*

This fish is a common brackish water perch of peninsular India, Pakistan and Ceylon. It thrives in fresh water also. It is more a herbivorous fish that eats mainly aquatic vegetation, small plankton and detritus. The fish breeds in all types of water including ponds, almost throughout the year. Sexual maturity is attained at about 15 cm length. Males are generally larger than the females. Spawned eggs[5] numbering about 2000 are attached to submerged objects and the female guards the eggs and the newly hatched larvae. Fry and fingerlings do not withstand a direct change from brackish water to fresh water, but buy a gradual acclimatisation it is possible. The fish grows to about 12 cm and weigh 1½ kg.

The *orange chromide* (*Etroplus maculatus*) is related to the pearl-spot and found in the same environment. It grows to only about 10 cm in length. This species can be a forage fish when the culture of carnivorous species is planned.

The cichlid *Tilapia mossambica* recently introduced into India is a prolific breeder. It has great adaptability to environmental changes. Though not relished as a good table fish, it can probably be a suitable forage fish.

The Indian Tarpon
(Megalops cyprinoides)

It is an average sized fish of the coastal waters of the Indian and Pacific oceans. It is possible to cultivate this fish in brackish or fresh water ponds. The fish breeds in the sea when about 25 cm. long. The larvae are flat and ribbon-like. The young ones enter estuaries and backwaters. They are hardy and can be transferred directly to fresh water. The fish grows to a length of 40 cm. in one year and attains a maximum length of about a metre. It is a carnivorous fish.

Cock-up (*Lates calcarifer*)

This is a carnivorous perch found in coastal waters of India, east Asian countries and Australia. It enters the estuaries, backwaters and rivers. The fish breeds in the sea when 50 — 60 cm. long and the young ones enter the backwaters and estuaries. It grows to about 1.5 m. in length.

Gizzard shad (*Nematolosa nasus*)

This is an Indo-Pacific species occuring in coastal waters and estuaries. The fish belongs to the family clupeidae which also comprises the sardines. It has been observed to breed in enclosed bodies of water such as the coastal lagoons of Mandapam, South India. This habit is advantageous as not much effort is needed to collect and stock the fish in impounded water.

Ten pounder (*Elops machanata*)

This fish is cultured in brackish water ponds of Hawaii. It is seen abundantly in the estuaries of south west coast of India. The young fish enter the backwaters from where they can be easily collected for stocking. In early stages the larvae are flat and ribbon like. It is a carnivorous fish and feeds on crustaceans and small fish. It attains about 75 cm. in length and weighs over 4 kg.

PRAWNS

Prawns are reared in many Asian countries either by collecting and stocking the young or by allowing the young prawns to drift into impounded areas such as paddy fields or coastal swamps. *Penaeus indicus*, *P. monodon*, *P. semisulcatus*, *Metapenaeus monoceros*, *M. dobsoni*, *M. affinis* and *Macrobrachium* spp. are the main species concerned in such operations. Of these *P. monodon*, *P. semisulcatus* and *Macrobrachium rosenbergii* are the large varieties which need special attention for culture operations because of their lesser abundance in commercial fisheries.

Tiger prawns

Penaeus monodon: This is an Indo-Pacific species and is the largest of the marine prawns. The species is fished largely from the estuaries and backwaters. Known as 'sugpo', it is extensively cultivated in Philippines and Formosa either alone or along with milkfish. It is of common occurrence along the Indian coasts and has a non-gregarious habit. In the Philippine ponds it has been reported to attain a length of about 23 cm. and a weight of 95 gm. within one year. Trawl catches from deeper waters off the west coast of India commonly include specimens of the species which are larger than 30 cm. in length. Young ones of *P. monodon* can be obtained from the backwaters.

Penaeus semisulcatus : This species sustains a fishery in the brakish waters along the Indian coasts. Juveniles up to 15 cms. long are caught from this environment. 15—18 cm. length range is represented in the marine catches. Largest size recorded from the sea is about 22 cm. This prawn has been reported to be mainly carnivorous.

Giant fresh water prawn
Macrobrachium rosenbergii:

This is an Indo-Pacific palaemonid prawn which lives in rivers and brackish water and the young ones enter contiguous river systems where they grow to adult size. This prawn has been cultured from larval to adult stages and has very good farming potentialities. Fully grown specimens measure about 30 cm. in length. Males are larger than the females. The species supports a lucrative fishery in the Pamba river system and adjoining backwaters of Central Kerala and also forms a large fishery in the fresh water zones of Hooghly river and in the 'bheris' (saline coastal swamps) of Bengal.

The successful hatching and rearing of the 'kuruma' shrimp (*Penaeus japonicus*) in Japan, up to adult stage in controlled conditions have opened up an entirely new approach to prawn farming. This method has been demonstrated to be of practical value and can easily be adopted for species used for farming in India.

Molluscs

Oysters, mussels and clams are the main species of molluscs cultivated. Oysters and mussels are sedentary and therefore need not be impounded in ponds. All these animals grow by feeding on particles and vegetable matter brought to them by the tides. Highly sophisticated and careful methods are adopted for oyster farming like rearing them in trays, on sticks and ropes. Countries like North America, Australia, Japan, Holland, France and Spain have developed oyster farming on a commercial scale.

The Indian backwater oyster *Crassostrea madrasensis* is a fast growing species and has a high tolerance to variation in salinity. It seems to be a very suitable variety for intensive cultivation. Culture of oysters for producing pearls is a highly developed industry in Japan. The pearl oyster belongs to the genus *Pinctada*. P. fucata is the common species occuring on the pearl banks in India. Some attempts have been made to culture pearl oysters in India at Tuticorin as early as 1864 and later on at Krusadi island in 1928. The experiments conducted then did not succeed in making good quality pearls. There is growing world interest in mussel farming because of the great success of a new spanish technique in which ropes are suspended from pontoon rafts allowing the spat to settle on them. In the French 'bouchot' system, mussels are grown on ropes tied around or hung between the stakes. The Dutch mussel 'parks' are usually located in the intertidal zone and have mussels transplanted from poor growing areas.

The brown mussel *Mytilus* sp. and he green mussel *M. viridis* are available along the rocky coastal areas of the south west coast of India and at present they are used only on a limited scale as food, in the localities where they are easily available.

Clams live buried at the bottom, in shallow seas and backwaters. Edible

clams belonging to the genera *Meretrix*, *Villorita* and *Katelysia* are available in India and their meat is eaten by the poor sections of the community. Japan, United States and Britain have undertaken clam culture. It is reported that the yield per unit area is comparatively very high in the case of clams.

Seaweeds

Green, red and brown algae largely constitute the seaweeds of economic importance [9]. Seaweeds are the source of Agar and Algin used in food and for pharmaceutical industries. Red algae yield agar and brown algae algin.

Cultivation of red algae, *Porphyra* sp. (*nori*) is an industry in Japan. This species is eaten fresh, or sundried and is used for flavouring soups, sauces and broths. It is rich in vitamin A. Seaweeds occur in large abundance along the Gujarat and Tamilnadu coasts of India, as well as around Laccadives and Andaman-Nicobar islands. At present in India utilisation of naturally growing seeweeds is not done to the maximum. Some of the seeweeds like *Ulva*, *Porphyra*, and *Centroceras* abounding our waters are rich in protiens, vitamins and minarels and can be used as food directly. *Gracilaria lichenoides* is perhaps the only seeweed used in India as food in some coastal districts of Tamilnadu.

Many of these industrial seeweeds can be cultured in shallow coastal waters and lagoons and farming of suitable species for maintaining a stable supply of raw materials for the industries is worth a trial.

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