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Milkfish Culture: Alternative Revenue for Mandapam Fisherfolk, Palk Bay, Southeast Coast of India

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Abstract

Milkfish (*Chanos chanos*) is one of the most important brackishwater finfish species being cultured in Southeast Asia. Natural milkfish fry occur along the southeast coast of India in fairly large numbers during the months of March-June and October-November. Present study emphasizes the seasonal variation and distribution of milkfish along the southeast coast of India. Milkfish culture has to be economically competitive compared to shrimp and other fish culture which do not contribute to local food supply. Annual total production from the Philippines, Indonesia, and Taiwan has been exceeding 0.5million tons since 2009. The industry has relied on wild-caught milkfish fry, which is unpredictable, until hatchery fry became available in 1987. This paper compares the collection of wild seed near mandapam area as well as production costs in cage. Milkfish eggs (1.1-1.2 mm in diameter) and larvae (3.5 mm at hatching) are pelagic and stay in the plankton for up to 2-3 weeks. This would be a good source of income to coastal fisherfolk in Mandapam.

Keyword: *Chanos chanos,* fry, Chinnapalem, Economics

1. Introduction

The milkfish is an important food fish in Southeast Asia (Sumagaysay, 1998). Aquaculture of milkfish was begun in Indonesia over 500 years ago, followed by Taiwan and Philippines. In 2007, the global production reached more than 0.5 million tones and the major producing countries were the Philippines, Indonesia and Taiwan (FAO, 2009). The milkfish is a marine inhabit commercially cultured in brackishwater ponds and oceanic waters as well as in hypersaline lagoons (Lin et al.,

2003). Milkfish can tolerate salinities ranges from 0~158 (Lin et al., 2001). Fry, juvenile or later stages of development can survive well in fresh water, which indicates that they can be cultured in freshwater ponds or stocked in cages in freshwater lakes and reservoirs (Alava, 1998; Lin et al., 2003). Marine or freshwater adaptation by euryhaline teleosts is a complex process involving a set of physiological responses related to ionoregulatory requirements; nevertheless, the milkfish is considered to be an efficient osmoregulator with a high capacity for adaptation to freshwater production systems (Lin et al., 2003). Apparently small milkfish tend to adapt better in fresh water than hypersaline water and larger milkfish find hypersaline water less stressful than fresh water (Ferraris et al., 1988).

The milkfish is one of the best candidate species suited for brackishwater aquaculture. In India, milkfish and mullets have been cultured experimentally in salt water ponds (James, 1996). Polyculture of *Chanos chanos*, *Valamugil seheli* (mullets), *Liza macrolepis* and white prawn *Penaeus indicus* gave a production of 1364 – 1864 kg/ha. Mixed culture of *V. seheli* and *Chanos chanos* yielded 1422-1600 kg/ha. An estimated production of 499-739 kg/ha/hr of milkfish, mullets and shrimps was obtained through polyculture in Tuticorin (James, 1996).

Occurrence and abundance of milkfish seed along the Indian coast was observed by Chacko and Mahadevan (1956), Tampi (1968), Silas et al., (1980), Mohan (1984) and Mohanraj et al., (1984). Though investigation on the chanos seed and its possible utilisation for culture started about 80 years back, the culture of milkfish has not become popular in India. One of the main developments of chanos constraints for the culture is the non-availability of the seed to the farmers at the required period in required quantity. Lack of Infra-structural facilities for storing and transport are also the reasons for the unsatisfactory state of chanos culture in India. It has been recently observed that the seed abundance has declined in many areas along the Indian coast due to habitat degradation.

Chanos is a high quality food fish with a rapid growth rate and it is highly resistant to diseases. They feed on algae at the near bottom and known to spawn annually or biannually in the coastal waters of around 25 meters depth. Each female is capable of releasing up to five million pelagic eggs which was hatched in about 24 hours. The larvae seek out clear coastal and estuarine waters and require the temperature of around 23°C, 10 to 32 of salinity and an abundance of phytoplankton.

After approximately a year of inshore life, the young attains about 20 cm long, 200 g weight and move out to the sea to attain its maturity. Adult milkfish feeds on both phyto- and zooplankton, reach weights of up to 20 kg. Milkfish fry and fingerlings, varying in length from a few mm up to 10 to 15 cm, are gathered from areas such as gently sloping sandy beaches, the mouths of tidal creeks, leeward sides of bars (where fry often seek cover), together with natural pools or ponds close to the sea. Depending on the geographic locality, the best months for the collection of fry and fingerlings extend from March to August and from September to early February. There appears to be a definite lunar and tidal association with the occurrence of milkfish fry, and the best collections are made during high tide and during full or new moons. Clear water is essential, and collectors prefer calm water.

Numerous techniques are employed to gather fry. Collectors may lure them by constructing low rock walls; by floating plaited strips of coconut palm or banana leaves and other materials on the surface (at right angles to the beach); or by using very fine gauge mesh nets in suitable areas. Fry are then simply dipped out of the sea and transferred to suitable containers for transportation to nursery or production ponds. Following collection, the milkfish fry must be separated from other fishes. Characteristics used in identification include two black spots on the head, another in the centre of the body and well-defined movements. Acclimatization to brackish water may commence at this stage, as some collectors dilute the sea water in the containers with up to ten parts of fresh water. Once transferred to the production ponds, the fish are self-supporting, consuming blue green algae and higher plants. Supplementary feeding is not required in well-managed ponds, although organic manures are sometimes employed to maintain algal growth. Cultured milkfish are remarkably free of parasites. Although milkfish may attain lengths of up to one meter in ponds, they do not mature sexually in confined waters and up to the present time, it has not been possible to spawn them in captivity. They are generally harvested at between 300 and 800 g but may occasionally grow to weights of one to three kg (Bardach et al., 1972).

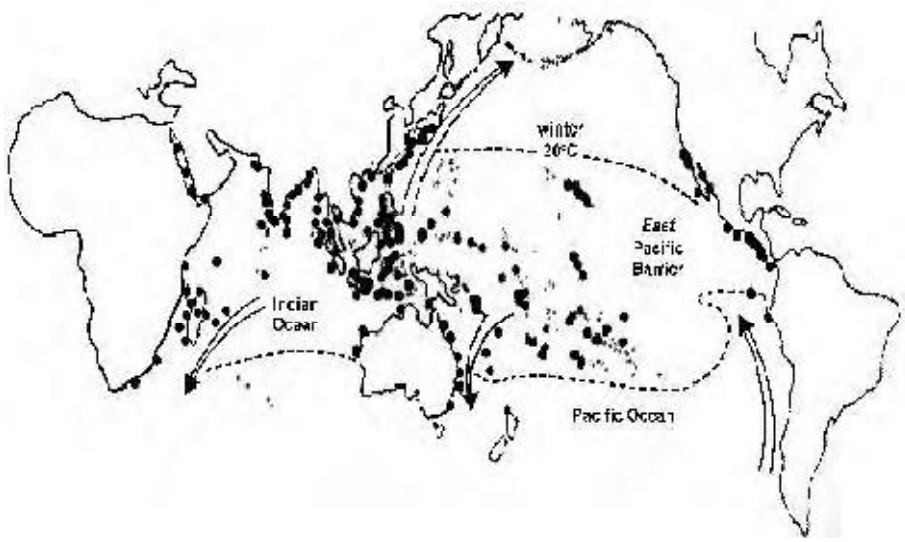


Figure 1. Occurrence of milkfish in the Indo-Pacific. (Source: Kumagai, 1990)

1.1 Habitat and biology

Milkfish is the only species in the Family Chanidae. Its distribution is restricted to either low latitude tropics or the subtropical northern hemisphere along continental shelves and around islands (Fig.1), where temperatures are greater than 20°C (Red Sea and South Africa to Hawaii and the Marquesas, north to Japan and south to Victoria, Australia; and in the Eastern Pacific from San Pedro, California to the Galapagos). Adults occur in small to large schools near the coasts or around islands. They are well developed, migratory, large (up to 1.5 m and 20 kg), and mature sexually in five years. Milkfish only spawn in fully saline waters. The activity is most often correlated with the new or full moon phases, takes place mostly in the night and,

in most regions, and has one or two seasonal peaks. In the natural environment, spawning takes place near coral reefs during the warm months of the year, and populations near the equator spawn year-round. Juveniles and adults eat a wide variety of relatively soft and small food items, from microbial mats to detritus, epiphytes and zooplankton. Milkfish is a heterosexual fish in which hermaphrodism has not been reported. In natural spawning stocks, the sex ratio is almost equal, with a slightly higher amount of females. The determination of sex is very difficult, because there are no easily identifiable morphological differences between males and females; however, the pheromone PGF2a (prostaglandin) has been found to be an effective way to identify mature male milkfish.

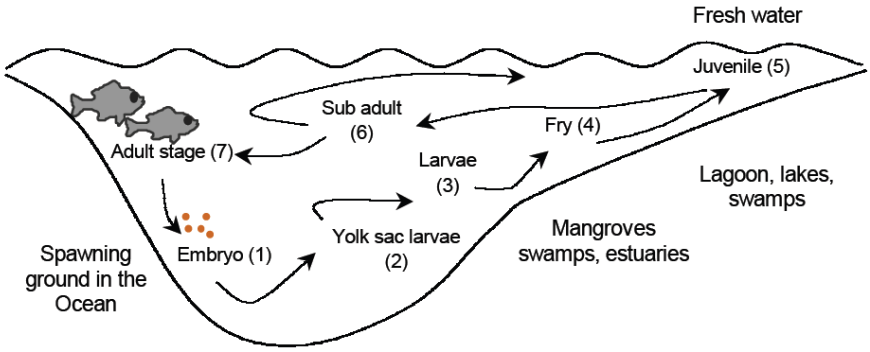


Figure 2. Life history of milkfish represented by seven developmental stages from embryo to adult (modified from Lee, 1995)

Milkfish eggs (1.1-1.2 mm in diameter) and larvae (3.5 mm at hatching) are pelagic and stay in the plankton for up to 2-3 weeks. Egg division begins an hour after and hatching occurs at 35-36 hours after spawning. In the wild, eggs are probably released in deeper oceanic waters and in the outer reef region. Older larvae migrate onshore and settle in coastal wetlands (mangroves, estuaries) during the juvenile stage, or occasionally enter into the freshwater lakes (Fig. 2). They then migrate onshore and where they can be caught by fine-mesh nets operated along sandy beaches and mangrove areas; these 'fry' are 10-17 mm long and are used as seed stock in grow-out ponds, pens and cages. In the wild, juveniles are found in mangrove areas and coastal lagoons, and even travel upriver into lakes; they go back to sea when they get too large for the nursery habitat, or when they are about to mature sexually.

Milkfish can reach a maximum size of 180 cm (male/unsexed) and 124 cm (female). The maximum recorded weight and age is 14.0 kg and 15 years respectively. Resilience is low, with a minimum population doubling time of 4.5 - 14 years. Its fisheries importance is highly commercial, especially in aquaculture, and is also used in game fish as bait. It is especially valued as a food fish in Southeast Asia. Milkfish are similar in appearance to many other species of fish but can be distinguished through a number of distinctive features (Fig. 3). Body is fusiform, elongated, moderately compressed, smooth and streamlined and it has silvery color on belly and sides grading to olive-green or blue on back. Dorsal, anal and caudal fins are pale or

yellowish with dark margins and it contains single dorsal fin with two spines and 13-17 soft rays. Short anal fin contains two spines and 8-10 soft rays located close to the caudal fin. Caudal fin is generally large and deeply forked with large scale flaps at base in adults. Pectoral fins are low on body with axillary (inner basal) scales. Pelvic fins are in abdomen with axillary scales and 11 or 12 rays. Scales are cycloid shape, small and smooth of 75-91 on lateral line. No scutes (modified pointed scales) along belly. Transparent 'adipose' tissue covers the eye; mouth is small and terminal without teeth. Lower jaw with small tubercle at the tip, fitting into notch in upper jaw. No bony gular plate between arms of lower jaw. Four branchiostegal rays supporting the underside of gill covers. Gill rakers are fine and numerous attains typical length of one meter but may reach the maximum length of 1.8 m (male).

Figure.3 Adult Milkfish

1.2 Seed Collection

Ganapathi et al., (1950); Chacko and Mahadevan (1956), Tampi (1957), Mohan (1984) and Dorairaj et al., (1984) dealt with collection of milkfish seed. 'Kondodi' net, a modified drag net along with a scare-line was used for collecting fingerlings. The mesh size of the net was 15 mm. Fingerlings were collected during the early mornings before the sun rise. The catches declined with the sun rise and the subsequent increase in water temperature. The favourable period of collection was 05.30-07.30 hrs. At Rameswaram Island, near the Pamban sea shore, large pools were made during the low tide. The milkfish fry that came along with the tide got stranded in the tidal pools and collected by velon screen or cotton cloth when the tide receded.

2. Areas of occurrence

Along the southeast coast of India the seed of milkfish occur in large quantities from Manouli Island, Rameswaram Island (Pamban, Chinnapalam creek etc.), Pillaimadam lagoon, Panaikulam, Vaalinokam, backwaters of Vedarnyam, Pulicat lake etc. Apart from these areas the milk fish seed was reported along the west coast from Cochin backwaters, Calicut and Elathur (Mohan, 1984; Lazarus and Nandakumaran, 1987) but their abundance is not appreciable. Tampi (1959) estimated that 400-600 million chanos fry occur in Peninsular India, but the present estimate is considered to be about 200-250 millions based on the observations along east and west coast.

2.1 Seasons of abundance

Milkfish seed occur in southeast coast of India during two periods (Evangeline, 1967). The primary season was found to be from March-June and the secondary season from November-December in south east coast. During the primary season the

catch per haul was as high as 1200 fingerlings in the Pillaimadam lagoon when a seine net of 2- 3 meter long dragged for 30 minutes by two people. Maximum numbers of seed measuring 20-30 mm were collected during the first week of April from Manouli Island, Rameswaram Island and Pillaimadam lagoon. During the secondary season the fingerlings were collected from Panaikulam creek near Mandapam during second week of November.

2.1.1 Size range of the seed

Length range of the seed varies according to the period of collection. The needle shaped fry measuring 10-15 mm were collected from Manouli Island, Rameswaram Island and Pillaimadadam lagoon during March. Feeding on the abundant growth of algae found in the area, the seed grow fast attaining a length of 20- 40 mm, 40-80 mm and 80-110 mm in April, May and June respectively. After July the fingerlings of length more than 120 mm were only collected and at this size range the fishes were observed to migrate towards the sea. During the secondary season fingerlings of length 40-60 mm occurred during October in the Panaikulam creek near Mandapam. Along the west coast, fry of length 30-40mm occurred at Calicut coast during July and the fingerlings of length 50-80 mm were collected in August. Remark Collection and marketing of chanos seed in southeast coast is under the control of Department of Fisheries Tamilnadu, Pamban. The fry is collected from the tidal pools of Pamban sea shore kept in Aluminium containers with perforated lids and transported. Due to the habitat degradation the abundance of milk fish seed has declined considerably along the Pamban coast which was once valued as the most productive area for the seed. The Chinnappalam Creek of Rameswaram Island which was also one of the important seed collection center before 4 to 5 decades is no more a collection centre (Fig.4). The creek, though retains its mangroove vegetation, has silted with heavy organic debris. Further in such areas as Pillaimadam lagoon, the seed caught in large quantities and dried. Large drag nets with 8-10 mm mesh were used. Nearly 20 fishermen operate each net. It was observed that the average number of milkfish seed collected from Ramnad and Tirunelveli coast during 1950-1955 was 26.4 million and it has come down to 0.62 million in 1957-1960, (Tampi, 1968) indicating the decrease in the abundance of seed in the traditional seed collection grounds.

With further degradation of the ecology of the habitat, the milk fish seed resource may decline more. It is important to protect and preserve the traditional chanos seed nursery grounds. The areas should be identified and safe-guarded from human interference and pollution. Fishing should not be allowed in the nursery grounds of Palk Bay and Gulf of Mannar during March-May, the period of peak occurrence of seed. A comprehensive time bound survey should be conducted to study abundance of milk fish resources of India. This study should cover the ecology of the milkfish seed grounds, potential agencies contributing the degradation of the ecology of grounds and other man made causes. A general awareness should be created among the fishermen and the local population that the chanos seed resource is dwindling and proper care should be taken to safe-guard its habitat. Short-term training programme can be arranged for the prospective chanos fish farmers on the scientific handling of the chanos seed. Training should include better mode of collection, transport and stocking procedures. There is a good prospect of culturing chanos along the Kerala

coast from June onwards during monsoon depending on the seed collected from the southeast coast. The main problem of chanos culture in east coast in the summer months which succeed the chanos seed season. Many of the brackish water areas dry during summer months. Chanos can withstand transport for more than 12 hrs. (Ranganathan and Ganapathi, 1949; Dorairaj e t al., 1984; Lazarus & Nandakumaran, 1987), Hence the seed can be transported from south east coast to south west coast of India utilising the monsoon months.

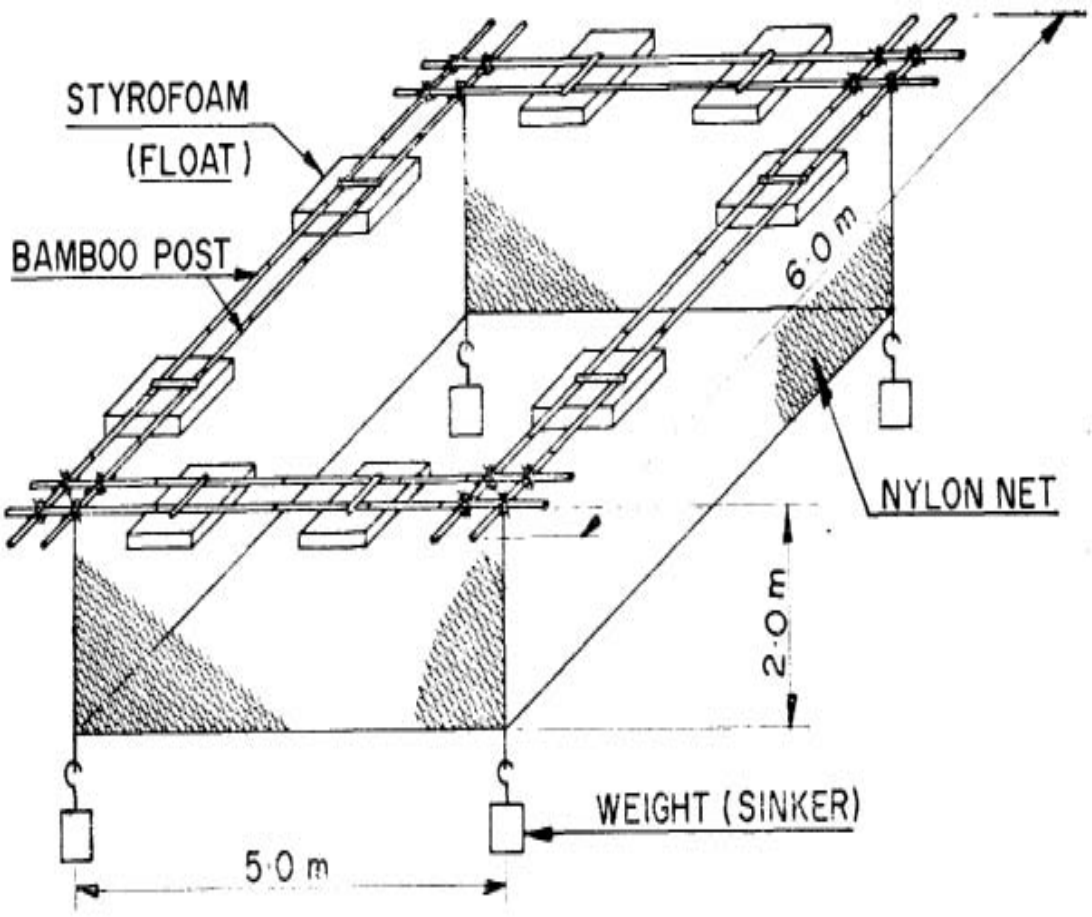
Figure 4. Map showing milkfish fingerling collection in Chinnapalam creek, Mandapam

2.1.2 Milkfish fingerling production in floating net cages

Several batches of hatchery-bred milkfish fry were stocked at 600 or 200/m^3 in fine-meshed floating net cages measuring and reared for 30 or 60 days. The first batch of milkfish fry reared at a higher stocking density of 600/m^3 suffered from slow growth. After 30 days at a stocking density of 200/m^3, the second batch of milkfish fry attained a higher average body weight of 1.7 g and survival of 21%. The

succeeding trials will aim at increasing the growth and survival rates of fingerlings in the marine net cages.

Design of floating cage



There are three types of cages used in aquaculture: (Diagram above)

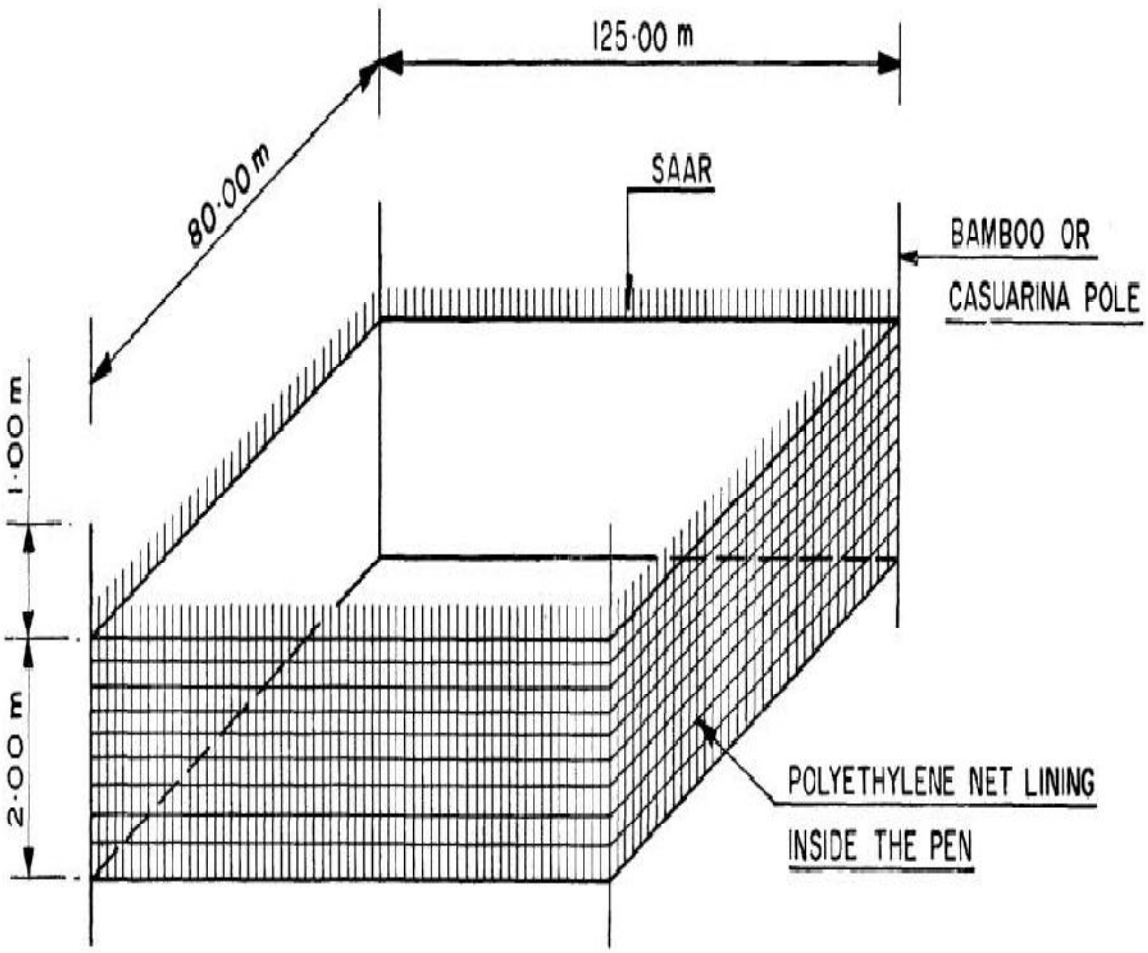
(a) Cage size 2 m x 1 m x 1 m constructed with fine mesh-size nylon net for juvenile fishes.
(b) Cage size 6 m x 5 m x 2 m constructed with 2.0 cm mesh-size net for growing fishes.
(c) Cage size 6 m x 5 m x 2 m, same size as (b), constructed with 4.0 cm mesh-size net for fishes of marketable size.

Materials needed for the cages:

1. Nylon nets of determined mesh-sizes.
2. Bamboo posts for frame
3. Styrofoams or gasoline drum.
4. Nylon rope for cage construction (different diameters).

5. Casuarina posts for fixing the cages at the selected sites.
6. Weights for stretching nylon nets.

Layout of one-hectare pen



2.1.3 Alternative feeding strategies for milkfish

Previous results showed that average body weight of milkfish subjected to 2-week alternate starvation and refeeding cycle was comparable with that of the control group that was fed daily. This indicated that compensatory growth mechanisms might be at work. Another experiment was conducted to assess the effects of different feeding regimes on growth of milkfish in a simulated marine cage environment. Milkfish fed on alternate days did not grow as well as milkfish fed daily. However, milkfish subjected to 2-week alternate starvation and refeeding cycle did not exhibit compensatory growth of comparable magnitude as that observed in tanks. Prolonging the starvation period to 3 weeks did not enhance the compensatory growth response.

The growth of milkfish fed a ration of 10% or 7.5% body weight was investigated and it showed that growth was not affected by reduction of ratio to 7.5% of average

body weight. Another experiment was conducted to assess the effects of different feeding regimes on growth of milkfish in a simulated cage environment. The finding was that prolonging the starvation period to 3 weeks did not enhance the compensatory growth response.

Table 1 Cost for construction of Chanos Seed rearing facility at Chinnapalam, Pamban

Assumption

S.No	Particulars	Particulate
1	Number of Cement Tanks	2
2	Area of each tank	200 sq.mtrs
3	Total area of two tanks	400 sq.mtrs
4	Stocking density of Chanos frys	1000/sq.mtrs
5	Duration of each crop	7 days
6	Survival expected	80%
7	Total seeds reared in one crop	3.2 lakhs
8	Number of crops in one season	8
9	Total seeds to be reared and supplied	2.5 million

Construction cost

S.No	Particulars	Rs.in Lakhs
1	Land 0.5 acres to be acquired from the government	Free
2	Cement concrete tanks of 200 sq.m capacity-2nos@Rs. 3000/-per sq.mtr	12.0
3	Air Blower 3 HP Capacity with aeration system	1.0
4	Disel engine operated air- blower	0.75
5	Shed for accommodating seawater pumps, air blowers and for seed packing	1.0
6	Seed collection Net, filter Bags, Plastic bins , buckets, Scoop-net, oxygen cylinder, furniture etc.	0.25
7	Electricity deposit and wiring	1.0
	Total	16.0

Operating cost

S.No	Particulars	Rupees
1	Cost of Feed @Rs.500/lakh for 2.5 million	12,500
2	Cost of Diesel	5,000
3	Electricity charges @Rs.5000/-per month for 3 month	15,000
4	Seeds will be collected by the members of the society	-
5	Packing Materials and Miscellaneous	67,000
	Total	1,00,000

Revenue Realization

Cost of Milk fish seeds@Rs.500 per thousand for 2.5 million Rs. 1.25 millions.
Less: Opearating cost (1.25million – 0.1 million =1.15 million)
10% of the gross revenue (i.e., Rs. 1.25 lakhs) will be set aside for operating cost in the next season. The society will 20 members will get an income of Rs.1.025million for each season i.e, amount Rs.0.34 million/month, and Rs 17,000/member/month approximately.

3. Conclusion

Therefore it is proposed to start nursery rearing in the collection centre itself and the budget also estimated (Table-1). Instead of selling the frys for Rs.150/1000 Nos., the reared frys in nurseries can be stocked in cages/ponds in the coastal area of Pamban and grown to harvestable size. Thus it is possible to develop chanos culture in Tamilnadu. This natural gift of chanos frys should be will protected from over exploitation and degradation of environment through prevent the cutting of mangroves.

Acknowledgement

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