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ICAR - CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE

A Guide to Milkfish (*Chanos chanos*) Aquaculture



ICAR - CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE
75, Santhome High Road, R.A.Puram, Chennai - 600 028



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Edited by **Ms. Babita Mandal, Dr. Aritra Bera, Dr. M. Kailasam,
Dr. Arun Padiyar, Dr. K. Ambasankar, Dr. S.V. Alavandi,
Dr. K.K.Vijayan**

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E-mail : vpriatchennai1@gmail.com; vpriatchennai@gmail.com

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Published by **Dr. K.K.Vijayan**
Director, CIBA
Chennai - 28

Front Cover: Milkfish Harvested from Farmer's pond in Navsari (Gujarat)

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INTRODUCTION

Herbivorous Fishes can ensure nutritional security with simple farming technologies which farmers can quickly adopt and produce with less input cost. Among many other cultivable fishes, Milkfish is cultured in many countries since long back. Milkfish (*Chanos chanos*) is naturally present in Indian and Pacific Ocean. It is a national fish of Philippines where it is known as ‘Bangus.’ Milkfish is a delectable fish which grows fast and can tolerate a wide range of salinity. The culture of Milkfish in brackishwater ponds and pens is an age-old and traditional practice in many tropical countries such as Philippines, Taiwan, Indonesia and Pacific Islands countries. In these countries, it is farmed in freshwater ponds, lakes, reservoirs and marine cages. Global production of Milkfish was about 10 lakh metric ton during 2014 (Source: FAO Fish Stat 2014) which was majorly contributed by Philippines, Taiwan, and Indonesia. In India, the occurrence of fry and fingerling and its traditional culture has been reported in coastal waters, estuaries and brackishwater water bodies since many decades back. It is called as *Paal Meen* in Tamil, *Pala Bontha and Tulli Chepa* in Telugu, *Poomeen* in Malayalam, *Hoomeenu* in Kannada, *Golsi* in Goa and *Sebakhainga* in Oriya. In the past, seed collected from natural resources were the only supply source to culture in traditional coastal farms which were again irregular due to non - availability of spawners. Many important characters make Milkfish a desirable species to culture:

- * Herbivorous feeding habit, which reduces production cost and gives more profit to the farmer.
- * Rapid growth rate compared to other herbivorous fishes.
- * Readily acceptance of formulated pellet feed under culture conditions.
- * Easy culture practice with other cultivable species like Shrimps, Mullet, Tilapia, and Carps, etc.
- * Due to Non – Cannibalistic nature stocking density can be high in culture conditions compared to other finfishes.
- * Tolerance of wide range of salinity makes them suitable to culture in different salinity.
- * Shiny, attractive appearance makes it potential live bait in the tuna industry.
- * High fecundity of female spawner ensures availability of seed in adequate quantity.
- * Low disease occurrence, which reduces the risk of sudden mass mortality and leads to higher profit to the farmer.
- * Ready domestic market availability in states like Kerala, West Bengal, and North East states of India. Huge Demand is available in South East Asian Countries also.

DISTINGUISHED FEATURES

Milkfish is a large and long-lived species (Bagarino, 1994) and it is the only living species in the family chanidae. *Taxonomic position* of milkfish is:

Kingdom – Animalia

Phylum – Chordata

Order – Gonorynchiformes

Family – Chanidae

Genus – *Chanos*

Species - *Chanos chanos*

In nature, adult milkfish are found in marine systems with distinguished and prominent features like :

- * Elongated, moderately compressed, smooth and streamlined body.
- * An adipose layer on eyes.
- * Attractive silvery body colour and sides grading to olive-green or blue.



Milkfish in Broodstock tank of MES hatchery (Tamil Nadu)

- * Deeply forked large caudal fin
- * Cycloid scales
- * Dorsal and anal fin with basal sheath of scales
- * Numerous long Intermuscular bones

Fry (10 – 17 mm body length) collected from natural resources are generally mixed with the seed of other predatory species like *Megalops cyprinoides* and *Elops machnata* species which are very similar looking. Thus, identification of milkfish fry can be done based on mentioned characteristics:

- * Large black eyes
- * Elongated transparent bodies and a single line of black pigments on the ventral edge
- * Energetic schooling and circling behavior
- * They are very hardy compared to other fry species and can be easily kept alive for transport to ponds with proper handling procedures.

STATUS OF SEED SOURCES

Adults Milkfish spawns at sea though larvae migrate to their nursery grounds in lagoons, mangroves, and swamps in coasts where they grow and subsequently sub-adults return to the sea. World wide, Milkfish seeds are collected abundantly from coastal areas in Indo-pacific region since time long past for farming which has led to declining the fry availability in nature subsequently. In 1970's Philippines developed hatchery technology for seed production of Milkfish which has given an impetus to its farming.



Milkfish Early fry at MES hatchery

In India, wild seeds are collected during March to June and September to December from coastal states of Tamil Nadu, Andhra Pradesh, and Kerala, etc. by traditional methods. Fry are more abundant during the new and full moon periods. It is estimated that nearly 50-100 million Milkfish seeds enter nursery grounds of Indian coast every year and local fishermen collect these

seeds by using seine nets and drag nets for further sales. In India, increasing trend of the milkfish farming still depends on the availability of wild seeds which suffer problems like lack of quality and presence of other predatory fish seed. Thus, technology developments for breeding and seed production as well as refinement of scientific culture practices in brackishwater resources are essential for the development of Milkfish production in India.

SITE SELECTION FOR CULTURE

Milkfish farming can be started in any existing developed and operational brackishwater fish farms. The site should have a minimum water depth of 0.8 - 1 meter; good quality of water with optimal Salinity of 10 - 30 ppt, Temperature of 20 - 30° C, Water pH of 7.5 - 8.5, Dissolved Oxygen (DO) of 4.0– 5.0 ppm around the year. Milkfish can be grown in freshwater and tolerates low levels of DO and high levels of Ammonia compared to other cultivable fish species. Pond soil should be sandy / silty clay loam. Good access to roads from farm site and the power supply is also necessary for Milkfish farming site to reach markets for easy culture operation.

NURSERY POND PREPARATION AND LAB-LAB (BENTHIC ALGAE) PRODUCTION

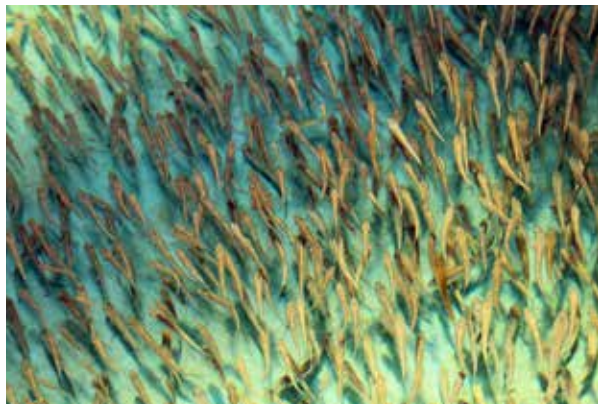
- * Milkfish fry of 1.0 – 1.5 cm. size can be stocked in outdoor nursery ponds after 25 – 30 days of indoor nursery rearing.
- * Pond preparation such as complete pond draining, drying, soil sealing, pond bottom and bund repair, predator eradication, liming and tilling should be carried out before starting nursery rearing.
- * Fertilization of pond with the application of required organic/inorganic fertilizer in the pond water for the stimulated growth of natural food organisms is to be done.
- * Initial manuring with the application of chicken manure at the rate of 2 tons/ha followed by water level increment up to 5 cm water depth can be carried out. After 2 – 3 days, apply urea at the rate of 15 kg/ha necessarily for the breakdown of applied chicken manure.
- * Water depth should be increased gradually over a period of 15 – 30 days to make final water depth of 0.8 – 1 meter for stocking of Milkfish fry in the pond.
- * Abundant growth of naturally-grown micro-benthic food also known as “lab-lab” can be achieved by an extended period of pond preparation (up to 45 days) which would serve as a natural diet for Milkfish fry during nursery rearing phase.

REARING IN NURSERY PONDS



Milkfish Nursery pond (Andhra Pradesh)

- * Milkfish fry of 1-2 cm can be stocked at a density of up to 20-30 no/ m² (2-3 lakhs/ha) and can feed on lab-lab.
- * Urea at the rate of 15 kg/ha can be applied every 7-10 days to maintain the continuous growth of natural food “lab-lab.”
- * After fertilization, pond water should not be freshened/released for at least three days to facilitate the natural growth of Benthic Algae.
- * In brackish water ponds or lagoons, hapa can be used for nursery rearing of Milkfish Fry.



Milkfish fry at MES hatchery

- * Along with natural food “lab-lab” artificial feeds such as rice bran, corn bran or formulated feeds can be provided.
- * After 4-6 weeks of nursery rearing in pond Milkfish fry attains 5 – 8 cm (fingerling) body size and can be subsequently transferred to grow out ponds/pens for culture.
- * Harvest damage to Milkfish fingerlings can be avoided by using drag nets made of knotless nylon net or mosquito net.

TRANSITION / STUNTING PONDS

Abundant seasonal fry occurrence in nature or high juveniles produced in hatcheries can be reserved with stunting methods to stock later in grow-out ponds. Milkfish fry can be stunted from few months to a year in transition ponds for a year-round supply of fingerlings for stocking into rearing ponds. Stunted fry/fingerling shows similar growth pattern in culture pond compared to non-stunted fry/fingerling.



Stunted Milkfish juveniles in transition pond, KRC (West Bengal)

- * Stunted Milkfish production can be achieved with Milkfish fingerlings stocking at the rate of 15 fingerlings/ m² in transition pond for 6 – 12 months with natural food of lab-lab and occasional feeding of rice bran at the rate of 5 % of body weight.
- * After one year of stunting in transition pond, Milkfish fingerling attains a weight of 35-50 g with 50 – 60% survival.
- * Stunted milkfish Fingerlings of 5 to 150 g body weight are also used as tuna bait in tuna fishing sector due to their shiny appearance and active movement.
- * Bigger sized fingerlings of 40–80 g body weight are preferred for growout culture in pens and floating net cages.



Milkfish fingerlings from nursery ponds, MES (TamilNadu)

GROW OUT FARMING

Milkfish fingerling can be farmed in different Brackishwater culture systems for six months to 12 months to reach up to harvestable size.

1. Pen culture

In shallow brackish water areas (5,000–10,000 m² in size) of estuarine lagoons/ bheries with high natural primary productivity and having water depth minimum 1 meter can be utilized by the construction of easy manageable pen for grow-out culture.

- * In pen, Milkfish fingerlings of 40–60 g body weight can be stocked with the stocking density of 30,000–40,000 nos./ ha once or twice in a year depending upon the water quality and growth performance of the fishes and facilitate the partial harvesting of bigger sized fishes.
- * Milkfish fingerling feeds on naturally available lab-lab or Lamut in the lowstocking density pen culture system.
- * 10–20 tonnes/ha of Milkfish can be harvested by using supplemental feed in high stocking density pen culture growout system.



Milkfish harvested from growout pond, KRC (West Bengal)

2. Cage culture

- * Small cages can be staked in shallow waters depth up to 2 meters along the coastal bays or set-up in sea-based deeper water with appropriate floats and anchors for Milkfish culture.
- * Fingerlings of 40–60 g body weight are reared in net cages with a stocking density of 5 - 30 fingerlings/ m³.
- * Specially formulated floating or semi-sinking pellet feed can be supplied to the fishes @ 3-5% of the body weight daily basis
- * Depending on the water quality, Milkfish yield in cage culture could be 10-20 kg/m³.

3. Pond culture

3.1 Extensive traditional farming

In India, traditional milkfish farming were practiced in different brackishwater areas like Bheries in West Bengal, Chilika Lake in Odisha, Pokkali in Kerala and Ghazni in Karnataka & Goa by collecting and stocking the Milkfish seed from the natural water bodies.

- * Traditional ponds having a water depth of 40-60 cm are suitable to stock Milkfish fingerlings of 7–10 cm body size with a stocking density of 1000-1500 fingerling/acre/crop depending on the cropping pattern.
- * Two crops can be harvested in a year in batch stocking cropping pattern. In continuous stocking cropping system, partial harvesting can be done by using gill net after every 15 days which is followed by re-stocking with Milkfish fingerlings.
- * Extensive traditional farming solely depends on natural food. Hence, Milkfish fingerlings feed on only natural food like Lab-lab (Benthic Algae) and Lumut (Filamentous Algae). No artificial feed is provided.
- * Extensive traditional Milkfish farming with lab-lab feeding can produce a final harvest of 1.5 to 2.5 tons/hectare/year where as Lumut feeding yields only 500- 600 kg/ha/year.

3.2 Monoculture

- * Existing fish farms/un used shrimp farms can also be used for mono culture of Milkfish.
- * In this farming system, artificial feed (floating pellets) along with natural feed is provided to gain the highest production in short period.
- * Marketable Milkfish are having a body weight of 200 - 300 g can be harvested after 3-4 months in a mono culture system.
- * Based on water depth in 1-acreponds, the stocking density of Milkfish fingerlings and crop yield can be adjusted in non-aerated ponds accordingly:
 - 3 feet water depth: Stocking density 5,000 nos. with the final harvest of 1 ton/acre/crop
 - 6 feet water depth: Stocking density 10,000 nos. with the final harvest of 2 ton/acre/crop
 - 9 feet water depth: Stocking density 15,000 nos. with the final harvest of 3 ton/acre/crop

3.3 Polyculture

Polyculture of Milkfish with other brackishwater cultivable species viz. Crab, Pearl spot, Shrimp and Mullet can be done. In low saline ponds, it can be cultured with Carps, Tilapia and Freshwater Prawn. Carnivorous fishes like Seabass, Murrels and Cobia should be avoided for polyculture with Milkfish. In the extensive polyculture ponds, the stocking density of different species should be determined according to water depth of polyculture pond.

3.4 Intensive farming

- * Intensive farming of Milkfish fingerling is suitable in pond having a water depth of 1.0–1.5 m with the help of Paddle-wheel aerators, feeding devices and pump for water exchange.
- * Milkfish fingerling of 7-15 cm body size can be stocked with a density of 8,000–12,000 nos./ha to the maximum density of 30,000 nos./ha in ponds.
- * Supplementary feeding with floating pellet (Crude Protein: 24-28%, Crude Fat: 3-4%) feed can improve Feed Conversion Ratio (FCR). Daily feed ration should not exceed 1.5% of total biomass in a pond.
- * After 3-4 months of culture, Milkfish (200-300 g) can be harvested by using Dragnet or Gill net.
- * Production of 4–6 tons/ha/year to 12–15 tons/ha/year can be achieved after a culture period of 6 – 8 months.

4. Integrated Multi-Trophic Aquaculture (IMTA)

Integration of different culture practices in Brackishwater ponds can be easily carried out for utilization of pond niches. Coastal Brackishwater ponds face challenges of water discharge management which can be addressed with the help of multi-species culture effectively in close proximity. A model IMTA culture can be defined as fed aquaculture (e.g., fish) combined with seaweed (inorganic extractive) and shellfish (organic extractive) aquaculture. Successful culture trials of Milkfish culture with other species like Shrimp (*P.monodon*), Tilapia (*Oreochromis niloticus*) and red seaweed (*Gracilaria spp.*) has been investigated in past.

5. Nutrition and feeding

Milkfish is considered as an herbivorous fish. Artificial or formulated feed in the form of slow sinking or floating pellets can be provided during culture operation. Feeding efficiency can be improved by providing pellets for feeding. Pellet, having diameter of 4-5 mm and length of

6-8 mm is suitable for Milkfish of more than 100g body size. Crude protein requirement of fry, fingerling, adult and brood milkfish is 40 %, 36 %, 24-28% and 36% respectively.

6. Occurrence of Disease

Milkfish is a hardy species. Prevalence of disease in Milkfish grow out system is less compared to other cultured finfish species. High stocking density may lead to parasitic infections. Wild seeds suffer from parasitic infections. Rough handling and stress induce deformities and mortalities due to bacterial infection during Milkfish farming.

HARVESTING AND MARKETING

Major producer and consumer of Milkfish is the Philippines, which consumes Milkfish mostly in fresh form and a small amount is processed for canned products. Milkfish can be harvested and marketed at the body size of 20 - 40 cm (body weight 200-500 g). Uniformly grown Milkfish having a body weight of more than 200 g are partially harvested from grow-out facilities using dragnets or gillnets. In complete harvesting, all fishes of one crop period are harvested from different grow-out facilities by using different methods like complete draining in the pond by gravity or by pumps, hauling of net-cage structure and use of seines or gill nets



Harvested Milkfish in Fish market

in pens. Milkfish is a very active fish and swims against the water current. Harvesting net can be towed in the direction of water current to catch Milkfish. Freshly harvested Milkfish can be sold in the nearby domestic market easily. Processing methods viz. filleting, deboning, smoking, canning, freezing increases the commercial value and palatability of Milkfish. Farmed milkfish (5-150 g body weight) are excellent live bait for tuna fishing. Milkfish fetches good price in national and international markets. Generally, in the domestic market of India milkfish fetches 150-200 INR/kg at farm-gate. Due to increasing demand in South East Asian countries, the introduction of intensive farming methods has led to an increase in demand for fingerlings by farmers.

Marketing status in India

Euryhaline fishes possess the virtue of thriving in different saline zones which gives scope for sustainable diversification for 21st-century Aquaculture. Milkfish (*Chanos chanos*) is an herbivore euryhaline fish and cost of farm production is 90 – 100 /kg. A survey conducted by ICAR-Central Institute of Brackishwater Aquaculture, Chennai in different markets of the



Milkfish harvest, KRC (West Bengal)

country revealed the consumer acceptability of milkfish in different sizes (50 g – 2 kg) which again open new avenues for adoption of short-term crops (4 – 8 months) by farmers.

The market price of Milkfish in the different States of India

Sl. No.	Fish weight	Price	Place/Market
1.	50 - 100 g	₹ 60 /kg	Tamil Nadu
2.	100 – 200 g	₹ 150 /kg	West Bengal
3.	300 – 400 g	₹ 200 /kg	West Bengal
4.	600 g – 1.0 kg	₹ 200 – 250 /kg	Kerala
5.	1.0 – 1.5 kg	₹ 250 – 300 /kg	Kerala
6.	1.0 – 2.0 kg	₹ 150 – 160 /kg	Gujarat
7.	1.0 – 1.5 kg	₹ 140 – 180 /kg	Maharashtra
8.	1.0 – 1.5 kg	₹ 150 – 200/kg	Goa

Entrepreneurs engaged with fish seed production can also choose for a short duration (1 – 2 months) larval and nursery rearing with profit.

Milkfish fertilized eggs and juvenile price

Sl. No.	Size	Price
1.	Fertilized eggs	20 – 40 paisa/egg
2.	1.5 – 2.5 cm juvenile	₹ 3/pc
3.	2.6 – 3.5 cm juvenile	₹ 5/pc
4.	3.6 – 5.0 cm juvenile	₹ 7/pc

Future perspectives

- * Milkfish (*Chanos chanos*) can be a prime fish for species diversification in Brackishwater aquaculture sector in India, owing to its many suitable characteristics.
- * Milkfish is considered as an herbivore fish. Formulation of artificial feed for intensive milkfish farming is achieved in low cost, hence the cost of production is comparatively low.
- * Disease occurrence is very low, and no significant incidence of disease outbreak has been noticed in Milkfish farming sector until today.
- * Abandoned farms and hatcheries due to a disease outbreak in shrimp can be utilized for Milkfish farming and seed production.
- * Milkfish is recommended as biomanipulators to produce green water which further can be used for the profitable enterprise of environment-friendly shrimp farming.
- * Milkfish fingerlings are highly demanded in tuna fishing industry as live bait due to its shiny appearance.
- * A continuous supply of Milkfish seeds can be guaranteed from hatchery seed production technology in India.
- * In India, huge potential for development of feed manufacturing, feed input supplier, brood-stock supplier, seed production and marketing enterprises associated with Milkfish aquaculture already exists.
- * Milkfish is a reliable candidate species for farming in brackishwater areas. Ready markets are available at a national and international level for marketing of hatchery produced seeds and various processed Milkfish based products.

Identical looks of Milkfish as Hilsa can create a ready market in West Bengal, Orissa and other North Eastern states of India where it can be recognized as **Deccan Hilsa**. Milkfish culture has potential to revolutionize the Brackishwater farming due to its low input cost, high profit and environment-friendly farming systems. ICAR - CIBA has taken up initiatives in project mode to develop captive brood stock and seed production of Milkfish (*Chanos chanos*) at its Muttukadu hatchery facility. A Memorandum of understanding (MoU) was also signed with Aditya Fish Hatcheries, Kakinada (Andhra Pradesh) to give impetus to the production of hatchery-produced larvae in the near future.

BREAKTHROUGH IN THE BREEDING OF MILKFISH (*CHANOS CHANOS*)



First batch of Muttukadu Hatchery produced Milkfish fry being released by Dr. Madan Mohan, Ex- ADG (M.Fy.) ICAR and Dr. K. K. Vijayan, Director, CIBA

Foreseeing the benefits of Milkfish culture for environment sustainable Brackishwater farming, ICAR-CIBA underlined the need of hatchery produced milkfish seed. In June 2015, ICAR-CIBA has achieved the captive maturation and induced breeding of Milkfish at its Muttukadu Experimental Station, Chennai for the first time in India. On 10th July 2015, celebration of Fish farmer's Day, 30 days old hatchery-reared Milkfish fry were handed over to Farmers of Tamil Nadu and Andhra Pradesh by Ex- ADG (M.Fy.) ICAR, Dr. Madan Mohan which was witnessed by several farmers of different coastal states of the country. Consecutive spawning was achieved in the year of 2016 also which enabled the supply of hatchery-bred Milkfish fry from MES, CIBA to farmers in Tamil Nadu, Andhra Pradesh, Gujarat and West Bengal for Integrated Multi-Trophic Aquaculture (IMTA) and polyculture in ponds and bheries. Fertilized eggs of Milkfish were also supplied to a hatchery entrepreneur in Andhra Pradesh which will pave the way for setting up of satellite hatcheries by small entrepreneurs who are in the nascent stage of starting this venture.

