Small Scale Cage Farming and Community Development in Fishing Villages

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The estuarine fishery which is one of the subsistence fishery of Indian coast is on a decline due to salinization of estuaries. Salinization is occurring mainly of two reasons, one the anthropological interventions to divert fresh water for irrigation and domestic and industrial use and the second one is the natural cause, due to slow process of climate change inflicted sea level rise which make most of the estuaries of India to remain more and more saline water dominated over the period of time. The impact of this is being felt by the fishermen living along the estuarine coast who are being deprived of livelihood. It is at this juncture the small scale cage farming is introduced along the coastal villages to augment the fish production and also as an alternate livelihood option for coastal fishers. There is scope for culturing euryhaline species in saline creeks and estuaries by installation of small cages along the coast the Indian coast.

Cage based aquaculture is practiced in many part of the world and capture based aquaculture in cages is also popular. Recently Central Marine Fisheries Research Institute (CMFRI) has initiated culturing of marine finfishes in cages and it has proven successful in many maritime states. In this the adoption of sustainable capture based aquaculture initiative by the traditional coastal fishers the state of Karnataka is note worthy. The participatory approach gave exposure to the local fishers on the finfish rearing aspects besides creating awareness on this lucrative farming technique. Encouraged by this success many fishermen group evinced interest in rearing finfish in suitable farming areas near their backyard. Thus the finfish culture in small cages are now propagated along the coast.

The species selected for small scale cage culture are red snapper *Lutjanus argentimaculatus,* seabass *Lates calcarifer,* Bigeye trevally *Cranxsex fasciatus,* pearlspot *Etroplus suratensis*. Factors such as their popularity as a food fish, high market pricehave contributed to substantial interest in these species.

Site selection: Proper site selection for cage culture is of paramount importance as it may considerably affect construction costs, operating costs, growth and survival rate of the fish and the period of usefulness of the cages. Although floating cages can be usually towed away, sometimes it is not economical to do so. The site selection criteria adopted for aquaculture should be followed in the cage culture also.The site selected should have a minimum depth of 2.5 m, it should be free from pollution, with minimum fouling , should have good circulation of water to remove the waste materials falling from the cage etc. It is better to avoid the areas were phytoplankton blooms occur frequently and places where boats are operated. The place selected should have good accessibility.

Fish Seed Source: The estuaries are rich source of seed resources of cultivable fishes. In the estuary fishermen use cast nets and dragnets for fishes. Usually small sized fishes thus caught are not of economical value and is discarded. The concept of cage based aquaculture could be popularized by judiciously utilizing these seed resources. Thus small sized red snappers, bigeyetrevally which is of low market value were used for the cage culture. In addition to that seabass seeds are transported from hatcheries in east coast and stocked in cages and grown to harvestable sizes.

Designing of low cost cages affordable for small scale fishermen

The success of cage culture depends on the rigidity and stability of cages and its popularisation depends on its affordability and ease in operation and the production from it. Cage designs for culturing seabass, snapper, pearl spot and carangids which can be reared in the estuaries is designed with these important requirements in consideration. Modifications according to the depths of the water, water currents, tidal influx, bottom structure, easiness of operation, economic viability as well as availability of the quality and dimensions of commercially available fabrication material etc. were experimented and standardised. By these studies research team from CMFRI Mangalore could come out with designs of estuarine cages to suit all the estuaries of Karnataka with suggested modification in difference river systems and saline creeks. These models can be adopted in almost all creeks along south west coast of India.

Three models of cages were experimented. The first model was of 2.5 x 2.5 x 2 m size with bamboo poles as frames and netlon material as outer protecting and cover and nylon net in the inside. The netlon structure serve as an effective barrier and protect inner net from predators and big fishes. It also hold the shape of the cage in even in heavy water flow without reducing the water holding capacity of the cage. PVC pipes were used as floats for suspending the cage in the water Additional flotation was given by empty oil cans. Sufficient length for the cages leg (2 to 3 feet) are given so that the cage will rest on this legs in the bottom in the case of lowest low tide. This will avoid the damages to nets by avoiding hitting and abrasion with hard and sharp substances in the bottom. The effective volume available for fish rearing in cages of 2.5 m x 2.5 m x 2m was around 12 tons. A stocking rate of 40 nos /m^3 is found to give a survival rate of 90-95% with average weight of 800g by the end of 8 month culture period.

In the second model GI pipe was used for the frame as it was found that this could be used for more than a year when compared to bamboo poles. The dimension of the cage was about 4 x 2 x 2 m and the holding capacity was about 16 t of water. About 50 nos /m^3 was found to give a good survival and growth.

In the third model cage which is now popular in the Karnataka coast is of 6 x 2 x 2 m with GI pipe as frame and netlon net on the outer side and nylon net on the inner side. This has holding capacity of 24 t of water and 50 nos/m^3 was found to be good. About 1000-1200 nos could be stocked in these cages.

For floating of the cages PVC pipes of 4 inch diameter is used. For giving extra floatation plastic cans of about 200-300 litre capacity is also used. The anchoring or mooring of cages in proper position is the key factor contributing to the success of the cage. The depth, substratum and current speed are the important factors to be considered for mooring. Usually nylon ropes are used as mooring ropes and sand bags are used for anchoring the cages. Generally sand bags are given in two points, where the shore is too close and additional mooring is also given to void the cage touching the store.

Growout

The fishes are fed with sardine and low value fishes *ad libitum*. Good growth and survival was attained for seabass and redsnapper in the cages. The fishes are usually grown upto 10 months and harvested before the monsoon season. In some places were heavy flow during monsoon is not there and sheltered bays are present the cages are kept for 20 months . About 1 ton of fishes could be harvested from such cages.

Seabass. The fishes stocked at a size of 10-20 gms would attain a growth of about 1000-1200 gm in 12 months and after 18 months it would attain an average weight of 3.3kg. The survival reported for this species isfrom 85-95 %. Price of the fish range from 300- 500/kg.

Redsnapper: The fishes in the range of 50-100 gms are usually collected and stocked in the cages. These fishes were found to attain weight of 800-1200 g with an average weight of 900g after 9-12 months. The survival recorded was about 95%. In 19 months the fishes attained weight of 1.6 to 2.3 kg with an average weight of 1.8 kg. The price of the fish ranges from 300-400/kg.

The production economics of the small scale cage culture is given below.

1	Cage dimension	6m X 2M X 2M
2	Species cultured	Redsnapper and seabass
3	Suggested stocking density	1200 nos./per cage
4	Culture period	10 months
5	Survival expected	90% (app.1,100 nos.)
6	Average weight expected	1.2 kg.
7	Total production per cage	1,320 kg
8	Average price /kg	Rs. 350/-
9	Total revenue expected	4,62,000
Expenses		
10	Cage construction	Rs.
	Total construction cost (Structure last for 5 years)	40,000
11	Seed cost @ 15 Rs/ no for 7cm seed (from Hatcheries from TN)	1,80,000
	Transportation charges	20,000
	Total expenses for 12000 seeds	2, 00,000
12	Feed cost @ Rs.20/kg trash fish/ fish cutting waste 2,000kg	40,000
13	Maintenance coast	20,000
14	Total expenses	3,20,000
15	Profit in one year culture period.	**1.42 lakhs**

Thus the small scale cage culture is lucrative and could be adopted by the fishers living along the coast. One of the major constraint for the spread of this technology is adequate supply of seed and feed. Many artificial feeds are now available in the market and in addition to that a part of fish waste generated from the fish cutting sheds could be utilised for feeding the cage reared fishes. Finfish seed production and judicious exploitation of the seeds from the wild are the areas were interventions are required.

The technology of cage culture was disseminated successfully along the Karnataka coast and it involved technology demonstrations through participatory approaches, focussed group discussions, training by experts,

technical assistance in site selection, cage fabrication, management etc., sharing of information and development of linkages between stakeholders, governmental and non-governmental agencies. Over the past six years, the small scale cage farming initiative has paid rich dividends in terms of increase in fish production besides increasing the social and economic benefits to fishers. Technology adoption, increased production through farming, empowerment of fisher folks are visible and tangible outcomes of this venture.

The technology is viable and various modifications and diversification of the species cultured has occurred over the years.. In conclusion, the sustained cage farming initiative and interventions carried out by CMFRI has provided alternate livelihood options and livelihood diversification. This novel technology has brought in new vistas and avenues to explore for fishers and engage in activities which could help them to find an alternate livelihood.