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Success story of large scale adoption of "Backyard model small fishrearing cages" in estuaries of Karnataka

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Fig 1: Cages setup in Uppunda, Karnataka

Background

Aquaculture is currently the fastest growing food producing sector in the world and is considered as an option for nutritional security and alternate livelihood. It accounts for almost 50 percent of the food fish produced across the world and is perceived as having the greatest potential to meet the growing demand for protein. It also contributes in a large way to the country's export earnings. The fish production from capture fisheries is stagnating and one method of augmenting fish production from the marine sector is by the introduction of location specific

Captions for the above Figures:

2) Construction of first model cage. 3) Popular model of cage 6 m x 2m x 2m) which is widely adopted in Karnataka. 4) Feeding of fishes in cages. 5) Cages installed in Karkikala with backyard cage farming concept. 6) Redsnapper harvest from the cage. 7) Seabass harvest from the cage. 8) Harvest from the cage. 9) Fishes ready to be harvested from the cage. 10)Seabass harvest . 11) Farmers with harvested fishes. 12) Farmers with harvested fish. 13) Cage farmer being honoured by Member of Legislative Assembly during the harvest mela

mariculture practices.

The future development of aquaculture depends on adoption of new and innovative production technologies, management and utilisation of less utilised water resources and proper market tie-ups. In spite of having many estuaries, backwaters, mudflats etc., in Karnataka, brackishwater fish culture has not been practised till 2009. Marine fish production was mainly through fishing and during the lean months these fishers generally did not have any other income generating occupation. Keeping these facts in mind the team of Scientists at Mangalore Research Centre of CMFRI designed rectangular cages suitable for mariculture of commercially important finfishes such as red snappers and sea bass in the estuarine areas of Karnataka.

Extensive survey conducted by a team of researchers at Centre has shown that juveniles of many cultivable fishes are being caught during different fishing operations including the traditional shore seine *kairampani* operation. However, the juveniles caught in the traditional gears are usually in live condition but as they have no value they are discarded on the beach. The major species with very high mariculture prospects and caught in the traditional gears included pearlspot, mullets, red snappers, sand whiting, carangids, *etc*., In order to utlilise these seed resources, Capture Based Aquaculture (CBA) concept was introduced for the first time in coastal Karnataka in 2009. By this method fish seeds collected live were reared in confinement to marketable size. Small scale custom made cages were designed, fabricated with locally available materials and installed in the estuary waters close to the fishers house to demonstrate the growth and survival of finfishes in cages. By demonstration of capture based aquaculture (CBA) the concept of family farming was introduced and the fishermen families were empowered to undertake mariculture activity in estuarine areas as a profitable alternate livelihood option. The family members gained experience and confidence in fin fish farming and in turn encouraged them to continue mariculture in cages using seeds collected from the wild as well as hatchery bred fingerlings.

The programme implementation had different process such as stake holders selection, site selection, fabrication of cages, installation maintenance, feeding and harvesting. This initiative to take up fin fish culture in small cages in the estuarine and brackish water areas by Mangalore Research Centre of CMFRI is the first of its kind along coastal Karnataka. The work was taken up with the following objectives:-

- To create awareness of the methods of culturing fishes in cages in coastal waters as an alternative livelihood option for fishers especially during the lean season (South-west monsoon).

- To improve socio-economic condition of the marginal fishers and their families.

- To address the issues of dwindling fish catch from coastal waters, food and nutritional security of fishers living along coastal Karnataka.

- To promote sustainable use of marine and coastal resources.

Stake holder selection

Kundapura Taluk in Udupi District, Karnataka was known for shrimp farming and it was the vocation of many people in that region. Hence the first demonstration of the cage farming was done in the Uppunda village in Udupi District. Uppunda is a small traditional fishermen village which has Arabian Sea on western side and estuary on the other side. It is a village with progressive fishers. Most of the fishers who evinced interest to take up brackishwater fish culture were rural youth. The stakeholders age ranged from 15 to 45 years. The men were active fishers involved in traditional fishing using ring seines, *kairampani etc.* Hence the first small scale cage farming was initiated in this area.

Site selection

Preliminary survey was conducted before installation of the cages. All environmental parameters were monitored and other factors which were considered were minimum water depth of 2.5 m during lowest low tide, river flow, tidal flux, distance from navigational channel, the proximity of the area to the farmers, accessibility, *etc.*

Cage fabrication

Initial fabrication of the cages was with an outer net of *netlon* material and inner net of nylon. The *netlon* structure served as an effective barrier and protected the inner net from predators and big fishes. In addition the outer *netlon* cage held the shape of the cage even during heavy water flow without compromising the water holding capacity. PVC pipes were used for floatation. Research trials and viability studies were conducted during designing, structural modification and material selection for construction of cages and reducing cost of making small scale cages. The modifications were done to suit the water current, depth, local material availability in different areas. Over the years, three major versions of cages were fabricated since its inception and at present, cage Model version III is extensively used by the mariculturists of this area. Following are the different versions of the cages.

Cage Model Version I

The experiments on cage design were started in Uppunda creek, Kundapur. The average water depth at lowest low tide was around 2m. The tidal flow was found to be sufficient to make efficient water exchange in the cages. The first indigenously fabricated cage of 2.5 m x 2.5 m x 2m with bamboo poles as cage frames and *netlon* material as outer protective net was installed in this creek.

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Nylon net of varying mesh sizes were used as the inner net. PVC pipes were used as floats for suspending the cage in the water. Additional floatation was given by empty oil cans tied at the brim of the cages. Sufficient length for the cages leg (2 to 3 feet) was given to facilitate the cages to be rested on its leg at the bottom during lowest low tide. This avoided the damages to the nets by collision and abrasion with hard and sharp substances on the creek bottom. The effective volume available for fish rearing in cages of 2.5 m x 2.5 m x 2m was around 12 tonnes.

Cage Model version II

GI pipes were used for the cage making in the second phase in order to give more durability to the cage frame and also to have efficient harvesting with intact shape of frames. With stronger GI pipe frame of 1" gauge, the dimension of the cages was also increased in the second model. The size of second model was with 4m X 2mX 2m with GI pipe frames. One inch GI pipes were used for the construction of the cage frames, the cage were found to last for three seasons. Since the commercially available *netlon* material is of 2m width, the height and width of the cage was made to 2m., in order to reduce the wastage of material. These cages were suitable for most of the estuaries as far as height of the water column is concerned. The PVC pipes used for floating in Cage model I was replaced with empty plastic cans as they give more buoyancy to the cages. The quantity of water in this model was about 16 t.

Cage Model Version III

Cage model II was well accepted in all the areas tested, but wastage of GI pipes with 4m length model led to wastage since the GI pipes comes at a standard length of 6m. Hence the length of the cage was extended to 6m, with a dimension of 6mX2mX2m. The water holding capacity of this cage is approximately 24 tons. High density GI pipes with one or two supporting structure at the middle were found to be essential for 6 meter cages to keep the stability and shape.

Seed collection and stocking

The concept of CBA was introduced in this village by collecting the juveniles of *Lutjanus argentimaculatus, Etroplus suratensis and Lates calcarifer* fingerlings which were caught during the operation of traditional gears in Uppunda Estuary. The collected seeds were stocked in floating cages of 2.5 m x 2.5 m x 2 m, made of *netlon* (mesh of 30 mm) lined with nylon net. Initially, it was envisaged to use only locally available seeds for culture but later on, it was supplemented by seeds of *Latescalcarifer* procured from RGCA, Tamilnadu by CMFRI. The *netlon* cages were designed and fabricated by CMFRI with the participation of local fishermen. Five cages were provided to the fishermen for stocking the fingerlings in the first demonstration phase in which two fisher groups participated. Later on observing the success of cage culture, it was adopted by other groups in the village. Fish seeds (weighing 20-100 g) were stocked at a rate of 40 - 50

Table 1: The economics of the three designs of the cages

Items	Cage Model Version I	Cage Model Version II	Cage Model Version III
Cage making cost (Rs)	8000	18000	25000
Effective water volume (t)	12	16	24
Stocking rate	500 nos @40nos/ton	800 nos @ 50 nos/t	1200 nos @ 50 nos/t
Survival (%)	90	90	90
Period of culture	8 months	8 months	8 months
Average weight (g)	800	800	800
Production (kg)	360	576	864
Average price (Rs)	400	400	400
Total revenue (Rs)	1, 44,000	2,30,400	3, 45,600

Table 2: Production levels and Revenue earned from 2009 - 2014

Year	No. of Cages	Fishes stocked nos/cage	Harvested (t)	Revenue (lakhs)
2009-10	5	500	1.8	6.8
2010-11	7	500	2.5	9.6
2011-12	10	800	5.76	23.0
2012-13	12	800	6.9	27.6
2013-14	14	1100	11.0	44.4
Total	28	111.4		

nos. /t. of water. After 8 months of rearing, the fishes attained 600-1200 g with an average weight of 800 g and survival was 90-95%. The stocking varied from 400- 1200 / cage from version I to version III cages.

Rearing and feeding

The fishes were reared in the cages for a period of 8 - 12 months and fed *ad libitum* with low value fishes. Routine cage cleaning was done to remove debris and fouling organisms attached to the cages. Feeding tubes were installed for the convenience of feeding from the shore by family members. The technology developed is less labour intensive and hence the fisherwomen can manage the feeding and maintain the cages as backyard activity since they reside on the banks of the estuaries where cages are located.

Labour cost

The technology was introduced as a family farming concept and cages developed are of backyard model. For the model developed, the operation is simple with minimum maintenance. The members of the family can take up feeding fishes and cleaning the cages as a part time vocation.

Harvest and marketing

The grow out period for the fishes was from 8 months to one year. With a suggested stocking density of 50 nos./ ton of water, 1200 sea bass or Snappers can be stocked per cage. With 90% survival and average weight per fish of 800g in a season, the production will be around 0.7 tons. Most important feature of GI pipe frames cages are that the cages can be retained in moored position over three seasons and the fish and grow for two seasons and attain a weight of 2.5 to 3 kg . In such cases three fold productions from these cages (up to 2t) can be attained with a much higher gate price for the fishes. The fishers usually harvest the fish during the period of trawl ban (monsoon season) when there is a greater demand for fresh fish. The fishers have thus a found a remunerative alternate livelihood option during the lean season.

Production and economics

When the CBA programme was initiated in 2008, cage model version I was used and about 5 cages were installed in the estuary. The production from one cage was about 360 kg (2.5 x 2.5 x 2 m). The fishes were sold at Rs 350/- and a total of Rs. 1, 26,000/- obtained from one cage. The success of this method of farming attracted more fishers to this method of culture and it spread along the coast of the estuary. The economics of the three types of cages are given in Table 1.

Some fishers had kept the sturdy cage model version III for two consecutive years (including monsoon season) and the fishes were grown up to 5 kg in the cages. One fisher got a record production of 1.3 tons from one cage of 6x2x2 m in 2014 by rearing the fishes for 20 months. The income realised from the harvest was about Rs. 5.2 lakhs. After witnessing this bumper production, the fishers have been encouraged to have an extended culture period of two years rearing.

Through the project the fishers were able to develop another source of employment and income besides sea fishing. The fishermen learnt how to rear fishes in the cages for the first time and gained skills in efficient management of fishes in the cages. The additional income has resulted in the improved socio-economic status of the fishers in the region.

INITIATIVES FOR POPULARISATION OF THE TECHNOLOGY

Awareness programs

Various group extension methods, such as training programmes, method demonstrations, group discussions and mass communication methods for educating the fishers through slide shows and film shows on the viability and feasibility of the technology were organised by the Scientists and Technical staff of the institute in different locations in three coastal districts (Dakshina Kannada, Udupi and Uttara Kannada).

Harvest melas and field days and exhibitions

During the harvesting of the cage farmed fishes, series of harvest melas and field days were conducted for creating awareness of the State fisheries officials, bank officials, officials of Krishi Vigyan Kendra and prospective farmers along the coast. The fishers who adopted and succeeded in getting good harvest were honoured by Member of Legislative Assembly during these melas. This resulted in horizontal spread of this technology to other districts. The result of these programmes is that the KrishiVigyan Kendra and State Fisheries departments participated in the activity by providing part of the financial assistance to the fishers for procuring seeds from RGCA, Pondicherry. Exhibitions were conducted in different places displaying the success of the cage farming.

Training and workshops

Trainers training, Workshops and hands on trainings were conducted to popularise the technology. About 45-50 participants including State fisheries officials, faculties and students of Fisheries College attended the programme. Special effort was made to educate them about the technology developed, thereby expanding it to other areas. As a result, the technology of small scale cage farming has gained popularity in the State and neighbouring States *viz.*, Kerala, Goa and Maharashtra. Scientists from Mangalore Research Centre of CMFRI have imparted training to prospective farmers from these States and the technology has been demonstrated. Looking at the development in India, many farmers from

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other countries showed interest in this technology and requested for training. Hence, customised training programmes were developed and imparted training to international community.

Impact of the technology

The success of cage farming in estuarine areas which was launched as a pilot project in Uppunda village of Udupi district was received well by the fishers and has extended to other estuaries. The fishers in Alvekody, Kundapur and Mulki estuaries have adopted the technology and extensive rearing of fishes is in progress. The fish production in Uppunda from finfish farming was about 14 t during the period 2013-14 realising an amount of Rs 43 lakhs. This novel technology of cage farming of finfishes has brought in new vistas and avenues to explore for fishers and engage in activities which could help them to find an alternate livelihood. This would also address the nutritional and financial security of the coastal fishers in districts of Karnataka. In light of availability of unpolluted brackish water area of 8,000 ha in coastal Karnataka with 10 major and 16 small brackish water areas, a minimum of 260 cages could be installed without affecting the coastal environment there by augmenting a production of 260 t of fish every year which generates an income of around Rs 10 crores. By establishing hatcheries for seed production the production could be enhanced. Keeping this in mind, the Mangalore Research Centre of CMFRI has already prepared a project for the production and rearing of brackish water fish seeds along Karnataka Coast and the same was submitted to the Fisheries department of Karnataka.

Feed

The technology is being carried forward by active fishermen and at present they are feeding the fishes with whatever available low value fish available in their catch. However when the culture of high value fishes is extensively carried out in near future, there will be increased need for alternate feed. A survey was conducted along the estuaries of Karnataka and found that good quantity of *Ambasis sp.,* are available in the estuarine water. This fish was tested for both red Snappers and Seabass and found to be accepted. Anticipating the demand in future CMFRI has carried out extensive survey in the State for finding out fresh feed which is available for the fishermen. The survey revealed that waste generated from fish cutting and dressing fish for "surumi" has almost 10% of the meat left which is thrown as waste and this was found to be well accepted by Snappers and Seabass. As much as 1,000 ton of threadfin breams are being cut in these cutting plants of D.K [Dakshin Kannada] and Udupi in one year and the meet which can be retrieved from the waste is as a high as 100 t. This can be mobilised for the fish culture, which will form the preferred feed for these high value fishes. Further, the slaughter house waste available from the poultry and mutton shops when tested were accepted by the fishes. In addition, some of the feeds developed by different institutes and companies were procured and demonstrations are being carried out to check their suitability for brackishwater fish culture.

Conclusion

Thus this technology which is cost effective and environment friendly would help in sustainable use of water bodies along the coast and provides avenues towards alternate livelihood options for fishers along the coast generating income and food security. ■

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