Grow-out Culture of High Value Finfishes in Cost-Effective Cages

K. K. Philipose
Central Marine Fisheries Research Institute, Kochi - 18

Introduction

Capture fisheries is undergoing tremendous changes either due to increased fishing pressure or due to decrease in the production of certain groups due to fishery dependent or fishery independent factors. In spite of increasing effort the catch of almost all commercially important fin fishes and shell fishes is on the decline and results in severe resource depletion and unemployment. Fishermen community solely depending on fishing for their livelihood is facing an uncertain future. Decline in marine capture fishery also affects the availability of cheap protein for the masses and also affects the GDP growth of the country. It is estimated that the demand for fish will increase by 4% in developed countries and by 57% in developing countries. It is in this context cage farming of fin fishes and shell fishes assume importance as a means to increase fish production. Since cage farming is done in open waters were wave action and current takes care of the day to day maintenance of the cultured fishes. Unlike pond cultured fishes the carbon foot print in cage culture is relatively low and therefore more eco friendly.

Cage Culture

Cage farming was originally developed in Asia especially in China almost 200 years ago. Initially net bags were attached to fixed poles and fishes were reared in these net bags. Later this has developed into a practice that supports the livelihood of the traditional fishermen. In all the Asian countries cage farming is more of a livelihood activity than an industrial activity. The primary reason for this is the large number of fishermen population who are marginalized and poor. Fishermen in many Asian countries are landless people and cage farming is a boon to them. In many Asian countries fishermen families live in the floating cage farm with their children and pets. Where as in the western countries cage farming is an industrial activity or a business activity. Here cages are large managed by advanced equipments for maintenance, feeding, growth monitoring etc. Here cage farming is done by companies and generates huge profits. The main reason for the development of industrial cage farming in the west is lack of manpower to engage in cage farming.

There is a distinct difference between livelihood cage farming and industrial cage farming and one should not get confused between the development models a country like India requires to address the livelihood issues of poor fishermen. India has 14 million fishermen living along both the West and East coast of India. These fishermen are a marginalized group who has limited access to the welfare schemes of the government and solely depends on the declining marine fishery resources in the coastal waters.

In India Central Marine Fisheries Research Institute (CMFRI), initiated research on cage culture in 2007 with the help of the Department of Animal Husbandry Dairying and Fisheries (DADF), Ministry of Agriculture, Government of India and later by National Fisheries Development Board (NFDB), Hyderabad. No country was willing to share cage technology with us and CMFRI scientists has to start from text book pictures and photographs collected while on visit. Initially an experimental HDPE cage of 15 meter diameter was made and deployed at a few selected locations like Visakpatanam, Diu etc. This model failed and again the cage was redesigned with the help of scientists from IIT Kharagpur and another 15 meter HDPE was designed. This model succeeded the rough sea conditions off Visakpatanam. Seabass was cultured in this cage and a successful demonstration was carried out there.

Lot of difficulties was faced in handling this 15 meter cage in the sea. The inner and outer net experienced heavy fouling and there was no mechanism to change the nets manually. This cage provided 1060 m^3 water volume for farming and even at 50 Kg per M^3 it had a production potential of 53 tonne fishes. Considering the management issues of this cage CMFRI designed a smaller version of this cage having 6 meter diameter. This cage has 141 M^3 water volume and a production potential of about 7 tonne fishes. The cost of the HDPE 15 meter cage frame was about Rs.8 lakhs and that of the 6 meter was about Rs.4 lakhs. The cost of a 6 meter cage including one outer net, 3 grow out net and one bird net and the mooring cost, cost 5000 fish seed and cost of feed etc is about Rs.10 lakhs. This is a huge investment for an average fisherman and even with 50% subsidies no fishermen will be willing to take cage farming as a livelihood activity or as a business activity. The risk was too much, which can even wipe out his family.

Under such a circumstance promoting cage farming among fishermen was not a viable proposition. While interacting with the fisherman they expressed their desire to have cage costing less then Rs. 1,00,000/- and lasting at least for 5 years to make it sustainable and economical in the long run. It was with their interest in mind the Karwar Research Centre has looked for alternatives for HDPE cages for promoting Cage Culture in the coastal waters and developed this fifth generation cage. Cage design and mooring technology underwent refinement through the dedicated and committed efforts of the scientists of CMFRI. Efforts were continuously made to reduce the cost of the cage and mooring systems so as to make it affordable for the fisherman and also to help them to take it up as a lively hood alternative.

Design

Considering the effect of climate change on the fisheries resources and to kitigate its effect it was decided that under NICRA an initiative will be made to design a cage to meet the requirement of the fishermen farmers to take up open sea cage farming as a livelihood alternative. The low cost cage developed at Karwar is made of good quality 1.5" GI pipe (B class). The design details of the cage are given in fig-(1) and Fig-(2). The diameter of the cage was 6 meter and the height was 120 cm from Base to the railings. Fig (3). All the joints are double welded for ensuring extra strength. Fig (4). After fabrication the structure was provided with single coat epoxy primer and double coat epoxy grey paint to prevent rusting. The total weight of the cage is about 300 kg only.

Floatation

Puff or foam field HDPE cage is buoyant enough to float in the water however, metal cage needs additional floatation. Eight fiber barrels of 200 lit. Capacity filed with 30 lb air was used for floating the cage. One of the cap of the barrel is fitted with a valve tube for inflating with air and both the caps are then sealed with M'Seal to prevent air leakage. The cage when floated on inflated barrels provides a stable platform around the cage where fisherman can stand and safely attend work like net cleaning, net exchange etc. Fig. (5).

Advantage of the low cost cage

The HDPE cages floats on water surface hence the outer net is always in the water level and predatory fishes enters into the area in between outer and inner net. In the case of low cost cage the outer net is 60cm above water level and provides no chance for predatory fishes to enter in the middle space.

HDPE cage sinks if more than three person climb on the side frame where as the low cost cage can take the weight of as many as 20-25 persons on the platform safely. The cost of 1HDPE cage including netting, mooring etc, together costs about Rs. 5,50,000, whereas the low cost cage including netting, mooring all together cost only Rs. 1,00,000. The HDPE cage may take a minimum 4 to 5 Crops to recover the input cost whereas low cost cage can recover the investment in a single crop itself. The diameter of the HDPE cage and low cost cage is 6 meters and Depth of the net also is 6 meters. Hence area wise both the cage gives the same performance.

Disadvantages

Unlike HDPE cage wind action is more on metal cage as it is floated on barrels. Hence it will be difficult to float in open sea condition from June to August unless Heavy duty mooring is provided. Except for this the metal cage performance is far superior to HDPE cage. For fabrication of HDPE cage costly parts and specially trained persons are required. Hence fabrication charges are very high. Whereas for GI cage once the design is provided any small scale workshop can make it. HDPE cage once abandoned is an environmental hazard whereas GI cages once abandoned can be recycled.

Open Sea Cage Culture in India is promoted by the government of India in a big way to increase fish production from coastal waters and to provide livelihood option to the fishermen. In this context CMFRI's initiative to reduce the cost of the cage to make it affordable to the common fishermen, will go a long way in resource and employment generation.

Dismantling type Cages

GI cages reduce the cost of the cage by almost one fifth of the HDPE cage and increase the profitability of the operation. The whole concept of developing the low cost cage was to reduce the input cost and increase the profitability. The earlier GI cages were designed as fused cages where all the joints are welded. In such cages transportation of the cage was a problem and once the cage is welded it cannot be transported from one place to another by road. Another issue was that for the final welding of the cage power was not available at many places and hiring generator works out very costly. Another issue was that the water volume available inside the cage decides the number of fishes that we can grow in that a six meter dia cage gives 141 m^3 water for rearing so providing more cultivable area in a single cage is very important. Another important observation was that all other expenses like mooring materials, floatation materials etc remain more or less same. Considering all this an attempt was made first to make the cage a dismantling type without affecting its strength.

Initially a 6 meter cage was designed and fabricated as dismantling type and tested it for strength, transportation efficiency and cost difference. When we found the design strong as a next step we designed a 10 meter circular dismantling type GI cage and later a 12 meter circular dismantling type GI cage. The water volume of the 10 meter cage is 392 m^3 and that of the 12 meter cage 565 m^3. This innovation has increased the cage volume by 4 times and the production per cage to 21.6 tonnes (Table-2). Another advantage is that cages can be fabricated in small scale industries units where they get subsidized power and transport it anywhere by road. Similarly after the harvest the cage can be dismantled, serviced and stored in a shed and used again for the next farming when climate is favourable. 6 meter cage can be managed by 6 persons where as for the 12 meter cage 10 persons are required. In short having one 12 meter cage is like having 4 cages of 6 meter diameter. So this path breaking design is going to make cage farming very profitable.

Cage Cost

Sl.No	Material	Cost-6 meter cage	Cost-10 meter cage	Cost-12 meter cage
1	GI Pipe	18900	37400	45900
2	Welding Charges	10000	20000	24500
5	Epoxy Paint	1600	2600	3600
6	Labour charges	1000	1500	2500
7	Floatation	7500	12000	13500
8	HDPE Rope	1000	1500	2000
Total	**40,000**	**75000**	**92000**	

Table-1.Cost estimates of the GI Cages

Cage Production (Sea bass)

Sl.No	Details	Cost-6 meter cage	Cost-10 meter cage	Cost-12 meter cage
1	Cultivable Water Volume (M^3)	141 m^3	392 m^3	565 m^3
2	Stocking Density	5000	15000	20000
3	**Sea Bass** Production capacity in Kg. (60% survival rate and average weight 1.8 Kg weight after 8 months grow out (October – May)	5400	16200	21600
4	Gross Revenue (Without deducing expenses) assuming that Sea bass fetches an average price of Rs.250/Kg	Rs.13,50,000	Rs.40,50,000	Rs.54,00,000

Table - 2. Production Capacity of GI cages

Cage frame is only a structure to hold the cage net safely throughout the culture operation in the sea. Since the cost of the cage nets mooring etc are same for any type of cages it is advantageous to go for a cost effective structure so that the input cost for the farming greatly decreases and profitability of the cage farming increases.GI cages are being used in Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu effectively. Low cost GI cages are playing a major role in popularizing open sea cage farming among the farmers and fishermen along the Indian coast catalyzing the growth of the blue revolution in the country.

Cage culture in open seas requires a fish variety with the basic characters like, suitability for marketing, commercial importance, consumer accepted fish, easy to culture, adaptability to the cage environment, acceptance to artificial diets, faster growth rate and resistant to common diseases.

A variety of commercially important marine fishes including, Cobia (*Rachycentron canadum*), Seabass (*Lates calcarifer*), Snappers (*Lutjanus* sp.), Carangids (*Trachinotus* sp.) and Groupers (*Epinephelus* sp.) and lobsters are highly suitable for cage farming. Commercial level seed production technology for majority of these fishes has been developed in many of the South East Asian countries.

Cage culture of Cobia (Rachycentron canadum)

Cobia has gained popularity as a good species for mariculture due to its rapid growth and white meat of versatile use. It is considered as one of the most promising candidates for warm-water marine fish aquaculture in the world. Being the only member of the family Rachycentridae, it is found in the warm, temperate to tropical waters of the West and East Atlantic, throughout the Caribbean and in the Indo-Pacific off India, Australia and Japan. To date, research and development of cobia aquaculture has been initiated in over 23 countries and territories, half of them in the Asian-Pacific region. Statistics of FAO (2009) show that the global aquaculture production of cobia has been increasing rapidly from only 9 tonnes in 1997 to nearly 30,000 tonnes in 2007. Since late 1990, cobia aquaculture production has been steadily expanding in Asia, primarily in Taiwan, Vietnam and China, but also in other Southeast and Indo-Pacific Asian countries including the Philippines, Indonesia, Iran and Reunion Island. Although cobia production is expanding rapidly, combined production of Asian countries is still rather lower.

Cobia farming techniques developed by CMFRI

India is late starter in cobia research. Seed production of cobia was achieved for first time in India by the Mandapam Regional Centre of Central Marine Fisheries Research Institute (CMFRI). Later the farming protocols in the High Density Polyethylene (HDPE) cages and Galvanized Iron (GI) cages with different feeding strategies were developed tested and validated at Karwar Research Centre of CMFRI and Mandapam RC of CMFRI. After repeated farming experiments an economically viable farming methods has been evolved.

The basic protocols followed for cage culture of cobia in different phases are narrated as below:-

Nursery rearing

The nursery rearing has to be carried out in specially designed sea cages or indoor tanks. At Karwar FRP tanks of 2.5 M x1.5M x 1.2M size with central drain facility was used for nursery rearing. Each tank was of 4.5 tonne capacity with 4 tonne water storage limits. Fingerlings of 6 cm size, packed in polythene bags of 10 litre capacity stocked with 125 gm to 150 gm of seed was transported from Mandapam Regional centre by road to Karwar. On arrival these seeds were acclimatized to the tank water temperature. Later 1000 seeds were stocked in each tank. The fingerlings were fed @ 5% total biomass of fish with imported weaning feed having 58% protein, 12% fat and 4% fibre. Feeding was done thrice a day followed by 100% water exchange. Grading was done every 10 days using a mechanical grader. Growth was monitored on every 5^{th} day.

Grow-out

Once the seeds reached 15 cm sizes, the seeds were transported to the cage in oxygenated syntex tanks and stocked in cages. The stocking density in the grow out cages has to be maintained at 3.0-5.0 kg/m^3 or 750 nos of juvenile cobia per cage. The juveniles can be fed @ 5% total biomass of fish with chopped low-value fishes (sardine, lesser sardine, rainbow sardine, etc.) twice daily. Net cages have to be changed based on the subjective assessment of fouling of the net in order to have sufficient water exchange. Random sampling has to be carried out at monthly intervals with the sample size of 30 nos. per cage. The entire grow-out culture can be carried out for a period of 6- 7 months.

Performance

The juveniles would reach an average weight of 1.0 kg in 4 months and 2.5 – 3.0 kg in 6- 7 months of grow-out culture in sea cages. The grow-out fishes would reach an average weight of 7.0 kg with a maximum weight of 8.0 kg within the culture period of one year which is almost 100 times the growth of the initial weight.

The unit cost estimate, performance of production and economics of operation gained through the farming trials and participatory demonstration were worked out and given below:-

UNIT COST ECONOMICS FOR CAGE FARMING OF COBIA (IN A 6 METER DIA GI CAGE)

Sl.No	Head of expense	Cost in Rs.
	Capital Expenditure	
	Cage and Net	
1	Cage (6 meter dia) made of 'C' class GI Pipe of 1.5 inch dia)	50,000.00
2	Mooring	15,000.00
3	Nets (2 Inner net and one outer net with ballast pipe)	60,000.00
	Sub Total	**1,25,000.00**

Operational Expenditure*

1	Cost of 750 Numbers of cobia seeds @ Rs 10/seed	7,500.00
2	Transportation	5,000.00
3	Cost of 12.82 tonnes of low value fishes @ Rs.25,000/tonne	3,20,500.00
4	Labour Charges @ Rs.1000/ Person for 7 months for 2 persons	14,000.00
5	Boat Hire & Fuel Charges	10,000.00
6	Harvesting Charges	5,000.00
7	Miscellaneous Expenses	10,000.00
	Sub Total	**3,72,000.00**
	Grand Total of Capital & Operational expenditure	**4,97,000.00**

Item No. 4 & 5 worked out based on the average expenditure/month for a cluster of 10 cages

Sl. No	Production Estimates
1	Survival 95% = 712 fishes
2	Feed Conversion Ratio = 1 : 6
3	Average size of each fish at the time of harvest =3kg
4	Total harvest = 2.136 tonnes/cage
5	Sale price of the produce @ Rs.280/kg = Rs. 5,98,080/-
	Gross Income from the harvest = Rs. 5,98,080/-

Sl. No	Economics
1	Gross income from Harvest = Rs. 5,98,080/-
2	Operational expenditure = Rs. 3,72,000/-
3	Gross income – Operational expenses = Rs. 2,26,080/-
	Net Profit = Rs. 2,26,080/-
4	Partial repayment of the capital expenditure = Rs. 25,000/year(Capital cost Rs. 1,25,000 – Subsidy Rs. 50,000 = Rs. 75,000)Repayment of capital @ Rs. 25,000/year x 3 years
5	Interest on the total project cost @ 11% = Rs. 52,800/-
6	Part of Capital + interest = Rs. 25,000 + 52,800 = Rs. 77,800/-
7	Rs. 2,26,080 – 77,800 = 1,48,280/-
	Net profit (after repayment of interest & part of capital expenditure) = Rs. 1,48,280/-

The results obtained at Karwar shows that from a 6 meter diameter cage fishermen can obtain a net revenue of Rs.2,00,000 from a 6 month crop after meeting all expenses. Since open waters is common to all in order to avoid unnecessary controversies farming involving the fishermen community is promoted and each group having 10 members is encouraged to go for 5 cages. This will give a handsome profit of Rs.10,00,000 in 6 months. This makes cage culture attractive and profitable.

Cage farming of Asian Sea bass (Lates calcarifer)

Seed

Sea bass Seed for the cage culture operations were sourced from RGCA, Sirkali. The seeds were transported by road from Sirkali to Karwar. The size of the seeds varied from 5 cm to 7cm and was nursery reared in CMFRI nursery systems till they reached a size of 15 cm size and 20 to 25 gm in weight. Nursery rearing of sea bass helped to reduce mortality due to cannibalism in cages.

Nursery rearing technology

The average size of the seeds was 6.2 cm and the weight was 2.8 gm. The seeds were directly taken to the nursery for nursery rearing. FRP tanks of 4 tonne capacity with central drain were utilized for nursery rearing. Seeds were stocked in tanks after adjusting the temperature of the covers. Seeds were given a fresh water dip before introducing into the tanks in order to kill any external pathogens.

Feeding

Feeding was done with 0.8 mm pellet feed of 58% protein and 15% fat @ 5% body weight. Later the pellet size was increased to 1.2mm after 10 days and 1.8 mm after 20 days. Feed was given every day at 07.00 hrs, 12.00 hrs and 17.00 hrs. Feed was slowly dispensed taking almost 45 minutes per tank. Since the seeds do not take feed once it reached the tank bottom care was taken to see that all the seeds get feed in the column itself.

Aeration

Intense aeration with one air stone at every square feet of the tank area was given in the nursery tanks in order to meet the high oxygen demand inside the tank.

Hygiene

Hygiene in the nursery area is very important. All the equipments are washed before and after use. Dip pits with sterilized water was provided at the entrance for washing the feet of workers before entering the nursery area.

Siphoning out the waste feed and fecal matter immediately after every feeding

Water Exchange

Water exchange is done with sand filtered and sterilized sea water. Since Screeting feed contains 11% fat, water quality gets deteriorated fast with unfed feed and fecal matter. In order to maintain water quality 70% water together with unfed food and fecal matter was siphoned out immediately after feeding. Water exchange was done at 08.00 hrs, 14.00 hrs and 18.00 hrs every day.

Grading

Grading of the seeds to segregate shooters is meticulously carried out using a mechanical grader. Seeds were graded into four groups after ten day intervals.

Growth monitoring

10 individuals were collected from each group, narcotized with ***Aquis,*** length and weight taken and then in a separate container for 15 minutes. When they regain consciousness they are released into the respective tanks. The growth rate in the first 10 day was 3 cm i.e. 3 mm/ day. However the growth reduced to 2 cm/ day in the next 10 day as the required feed in the desired size was not available. Efforts are being made to source the required feed urgently. Although we have purchased 10100 seeds from RGCA we have lost 70 seeds in transportation due to the breakage of one bag. No mortality had occurred so far in the nursery system

Growth parameters

The following growth parameters were enumerated as per previous methods (Salama and Al-Harbi, 2007).

a. Average Daily Growth Rate (ADGR) was computed using the formula: ADGR (g/day) = W_2-W_1/d, where: W_2 is the mean weight of the fish in the following sampling, W_1 is the mean weight of the fish in the first or previous sampling and 'd' is number of days between samplings.

b. Specific Growth Rate (SGR) which is the growth of fish in percent per day was computed using the formula: SGR = InW_2-InW_1/d X 100, where: InW_2 is the natural logarithm of the mean weight of the fish in the following sampling and InW_1 is the natural logarithm of the mean weight of the fish in the first or previous sampling.

c. Survival Rate (SR) was computed based on the following formula: SR (%) = N_2/N_1 X 100, where: N_2 is the remaining number of fish and N_1 is the initial number of fish.

d. Biomass was computed by multiplying the mean weight by the number of remaining fish.

e. Biomass Increase (BI) is the difference in the biomass in kilogram between sampling.

f. Feed Conversion Ratio (FCR) was computed using the formula: FCR = TFC/BI, where: TFC is the total amount of feed (Kg) consumed and BI is the biomass increase.

g. Protein Efficiency Ratio was computed using the formula: PER = BI/TPC, where: TPC is the total amount of protein consumed.

Important observations

Nursery rearing is the most critical part of open sea cage culture. Seeds should be fed with high protein diet to get faster growth in the initial days so that stunted growth will not be there in the batch. Feed is the most critical part of the nursery rearing. Feed which remains in the column for longer period or slow sinking feed with a minimum 45% protein is required for sea bass nursery rearing. Water quality management is also very important. Water from the nursery tanks must be removed immediately after feeding at least by 50%.Feeding at regular intervals at pre determined time ensures better feeding. Intense aeration is required in the nursery tanks with air stones at least one per every square feet area for better oxygen levels and better oxidation of the waste materials.

Grow-out

Once the seeds reached 15 cm sizes with 30 gm weight, the seeds were transported to the cage in oxygenated Syntex tanks and stocked in cages. The stocking density in the grow out cages has to be maintained at 21 fishes/m^3 or 3000 nos of juvenile sea bass per cage. During 2010-11 a stocking density of 5000 per cage was tried, however the average growth of the fishes showed a decline. Feeding with the right feed at regular intervals is important to ensure faster growth and also to prevent cannibalism. Seeds were weaned from the pelleted feed used in the hatchery to chopped and minced oil sardine meat slowly. Feeding was done approximately at 5% body weight initially in the first month and then with chopped oil sardines at 10 % body weight subsequently. Feeding was done twice a day i.e at 1000 AM 0300 PM Demand feeding method was followed to avoid wastage of the feed. Net cages have to be changed based on the subjective assessment of fouling of the net in order to have sufficient water exchange. Random sampling has to be carried out at monthly intervals with the sample size of 30 nos. per cage. The entire grow-out culture can be carried out for a period of 6- 7 months.

Growth monitoring

Growth of the fishes was monitored weekly by observing their length and weight. Feed was regulated as per the growth in each cage. Fishes collected from the cage was carefully weighed by placing them in a bolting silk bag and using a field electronic balance. Length was monitored by using a half meter measuring board.

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c. Survival Rate (SR) was computed based on the following formula: SR (%) = N_2/N_1 X 100, where: N_2 is the remaining number of fish and N_1 is the initial number of fish.

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Where: TFC is the total amount of feed (Kg) consumed and BI is the biomass increase.

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TPC is the total amount of protein consumed to attain a marketable weight of 1.5 Kg.

Economics of cage farming: Economics of cage farming of one GI cage of 6 m diameter with stocking of 2500 juveniles of Asian seabass is given below.

Sl.No	Details of costs and returns	Amount (')
1	Initial investment for a 6 m diameter cage (Including nets, Barrels, Ballast and Mooring)	150000
2	Fixed cost (for crop duration of five months) a) Depreciation b) Insurance (2% on investment) c) Interest on fixed capital (12%) d) Administrative expenses	 30000 - 18000 4000
3	Total fixed cost (A)	52000
4	Operating cost (B) a) Cost of seed (2500 nos.) b) Cost of feed c) Labour charges including cost of feeding d) Interest on working capital (6%)	 40000 112500 60000 9120
5	Total operating cost (B)	221620
6	Total cost of production (6 months) (A+B)	273620
7	Yield of sea bass (Kg)	1875
8	Gross revenue from 1875 Kg (60% Survival, average weight-1.250 Kg@ Rs. 250/Kg)	562500
9	Net income (5)-(6)	288880
10	Cost of production (Rs /kg-) (6)/(7)	146
11	Price realized (Rs/Kg) (8)/(7)	300
12	Capital Productivity (Operating ratio;(5)/(8))	0.39

Monitoring the environment

Environmental characters like salinity, temperature, dissolved oxygen and nutrients in the farm site were regularly monitored to understand the best environmental conditions for optimum growth. It was observed that at Karwar best growth is obtained for sea bass from November to April.

The scale of environmental impact would depend on the amount of waste generated by the sea cages, which is decided by the stocking density, quantity and type of feed, feed composition, size of pellets and the hydrographic conditions where cages are located. During the present study, stocking density of sea bass is 3000 nos/cage during 2009-10, whereas, the stocking density was 5000 nos/cage during the period 2010-11. The higher stocking density and fluctuations in the salinity and dissolved oxygen levels might be the reason for the decrease of the average weight of fish after 7 months of culture period during 2010-11. Hence, regular monitoring and management of water quality, feed quality, stocking density and survival rate is the need of the day in marine cage farms in ensuring maximum growth and production of healthy fish.

Net Exchange

Periodic exchange of the inner net of the cage ensures less fouling on the net and better water exchange. Inner net was exchanged every month. Initially net with 14 mm mesh was used followed by 24 mm and 36 mm mesh size. Net exchange technology was simplified to enable the fisherman to do it effortlessly. While exchanging, the new net with ballast pipe is slipped under the old inner net and lifted up. The old inner net is slowly lifted up with the fishes and when the net reaches the surface the middle portion in the bottom of the old net is cut open and the fishes are allowed to move down into the new net.

Harvesting

Harvesting was done as per the market demand normally in the evening. Harvested fishes are brought ashore and packed in crushed ice in plastic boxes. 40 Kg fish was packed in each box. Fish was sent to Goa market and is sold in the next day morning.

The production potential of one cage in a year is about 5 tonne quality fishes thus it is very clear that the technology developed at Karwar is fishermen friendly and can contribute to the economic growth of the country. The coast line of Karnataka, Goa and South Maharashtra extending almost 750 KM in length has a number of protected bays and calm water bodies highly suitable for open sea cage culture. It is estimated that about 2000 cages can be deployed in these areas and a modest production of 25,000 tonne high quality fishes from these cages is possible initially and when fully developed can produce 100,000 tonnes. Once cage culture potential in the coastal waters is fully utilized open sea cage culture involving big industrial houses can be promoted. Big cages of 50 meter diameter or more producing upto 500 tonne fish per cage are possible from these cages and a production of 200,000 tonnes from these cages is possible. The work carried out and demonstrated at Karwar gives confidence to the fishermen and institutions to take up cage culture in a big way.

Further Reading

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