Sea cage farming of cobia

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Introduction

In recent years interest in aquaculture is gaining greater momentum. The breeding and rearing of aquatic plants and animals in enclosures/ confinements, has increased mainly due to over exploitation of aquatic resources and declining of fish catches in major traditional fishing grounds at a global level. The farming of fish is widely recognized as the best alternative to meet the protein requirements of the expanding population and to provide them with alternative livelihood opportunities for their socio-economic upliftment. In many countries, especially in the developing world, fish and other aquaculture products serve as the main source of cheap protein to combat malnutrition and under-nutrition. Fish are having essential amino acids that are often lacking in cereal protein substitutes. Value-wise, cultured fish products compete with poultry and livestock in the local market. Nutrition - wise, however, aquaculture products are more efficient in converting food into body tissue than poultry or livestock. Aquaculture is the fastest growing animal food producing sector in the world. It has delivered growth in production volumes of almost 8% per annum over the past 50 years, approximately twice the rate of global GDP growth during this period. From output of less 1 million tonne per year in the 1950's, aquaculture now produces almost 100 million tonnes per year. Globally, fish today provides more than 1.5 billion people with almost 20% of their average per capita intake of animal protein, and 3 billion people with 15% of such protein. The average person consumes 18 kilograms of fish products per year. With a growing global population and health awareness the per capita consumption of fish and fisheries products are expected to grow further. Commercially important marine fishes can be cultured in any of the four culture systems like ponds, raceways, recirculation systems or cages. In the simplest term, a cage is an enclosure in the water body whereby the juveniles of aquatic animals are kept, fed and grown to a marketable size. Cage culture uses existing water resources (ponds, rivers, estuaries, open ocean, etc.) but confines the fish inside some type of mesh enclosure. The mesh retains the fish, making it easier to feed, observe and harvest them. The mesh also allows the water to pass freely be¬tween the fish and surrounding water resource, thus maintaining good water quality by removing wastes. In recent years, cage culture has emerged as the most viable method of sea farming.

Cage culture probably originated with fishermen who used cages to accumu¬late fish for market. Over time, they learned to feed the fish in these cages to increase their size and improve their overall health. The first cages used for just holding fish were probably developed in Southeast Asia at the end of the 18th century. These cages were constructed of wood or bamboo and the confined fish were fed trash fish and food scraps. Modern cage culture in the U.S. began in the 1950s with the advent of synthetic materials suitable for cage construction. There has been little research on marine cage systems because of regulatory issues, a limited number of good quality sites and high cost of research. In freshwater sector, cage cul¬ture allows farmers to use existing water resources that may or may not be used for other purposes. The fish produced are usually sold to local niche markets. As wild-capture fisheries have declined and aquaculture has ex¬panded, these niche markets have also grown. As a result to cater the demand more entrepreneurial opportunities have grown

for cage farming. The cage culture was initiated in Norway during 70s and developed into an organised industry, particularly for salmon farming. Similarly the cage culture has spread in South East Asian countries for culture of a variety of fishes. The major advantage in these countries is that they have large, calm and protected bays to accommodate the cages safely against natural bad weather conditions.

Advantages of Cage Culture

1. Effective use of Resources

Cage culture can be established in any suitable body of water, including open seas, backwaters, lagoons or river mouths with proper water quality, seed, feeding strategies, access and permission from local authorities. This flex¬ibility makes it possible to exploit un¬derused water resources to produce fish.

2. Low investment

The investment for pond construc¬tion and its associated infrastructure (electricity, roads, water wells, etc.) are much higher than the cage farming, which is practiced in an existing water body and can be less expensive. At low densities (when compared to pond water spread area) cages placed in open seas, backwater and lagoons do not require aeration. Cage materials are not much ex¬pensive and can be mended with little experience.

3. Simple farming operations

In cage farming, observation of the growth and health status of the fish is easy and simple. The observation of fish behaviour, espe¬cially feeding behaviour, is critical in avoiding problems related to stress and disease outbreak.

4. Easy harvesting methods

Cages are usually harvested by mov¬ing them into shallow water, crowd¬ing the fish into a corner of the net. Otherwise, the cage net can be lifted par¬tially out of the water so that the fish are crowded into a smaller volume, and then it can be harvested. This makes it possible to partially harvest fish from cages as and when needed for local markets.

5. Multi-use of water resources

The confinement of fish in cages will not affect other uses of the water resource, such as fishing, boat¬ing, swimming, irrigation or livestock watering.

Cage farming requires low capital investment and the farmer can expand production with additional cages or intensify production by increasing the stocking density at an optimal level.

Species selection

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.

Cobia (Rachycentron canadum)

Cobia has gained popularity as a good candidate 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. Global aquaculture production of cobia has been increased rapidly from only 9 tonnes in 1997 to nearly 30,000 tonnes in 2007. Statistics of FAO (2009) show that the 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 and the 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. Out of this farming trials an economically viable farming methods has been evolved. These farming methods have been executed in a participatory farming demonstration with M/s. Vitality Aquaculture Pvt. Ltd., Tuticorin and successful harvest of cobia was made during May 2013 in the presence of the Director General, ICAR, New Delhi. The basic protocols followed for cage culture of cobia in different phases are narrated as below:-

Nursery Phase 1

The 4 weeks old fingerlings were reared for 6 weeks indoor (Nursery Phase 1) followed by 8 weeks outdoor (Nursery Phase 2) before stocking in grow-out cages. The nursery phase 1 can be carried out in FRP tanks of 7 ton capacity with 5 ton filtered sea water. The stocking density has to be kept as 8 nos. per litre. The fingerlings have to be fed with INVE (Thailand) formulated diet (assorted size from 400 μ to 1200 μ) thrice daily. The weaning to chopped low-value fishes can be practised during the last week of this phase. The water exchange has to be done 100% daily.

Nursery Phase 2

The nursery phase 2 has to be carried out in specially designed sea cages. These nursery cages should be made of HDPE pipes or GI Pipe (C - Class type) material. The dimension of the square sea cage has to be kept as 4x4 meter with the handrail fixed at one meter height from the base otherwise a circular cage of 6 meter dia can be used. The net cages fabricated with HDPE ropes of 2.5 mm thickness and the mesh size has to be used are 20 mm for inner net cage and 40 mm for outer net cage. The depth of the net cage shall be kept 3 meters from the base. The shape of the net cages has to be maintained with ballast. The buoyancy of the cages can be enabled by tying HDPE drums with the cage frame and has to be moored with two numbers of Galvanized Iron (GI) anchors of 70/100 kg each in opposite directions.

The fingerlings from nursery phase 1 have to be transferred to these floating nursery sea cages. The stocking density biomass at this phase can be maintained at 1.8-3.0 kg/m3. The fingerlings have to 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 clogging of the net in order to have sufficient water exchange. Random sampling has to be carried out weekly with the sample size of 30 nos. per cage. This phase can be continued for about 4 weeks.

Grow-out phase

The grow-out culture has to be carried out in circular floating sea cages of 6 meter diameter. The cage frames should be made up of HDPE pipes or GI pipes. The handrail has to be fixed at half meter height form the base. The space between inner and outer rings of the cage has to be kept as one meter. The net cages fabricated with HDPE ropes of 2.5 mm thickness and the mesh size of 40 mm for inner net cage and 60 mm for outer net cage has to be used. The depth of the net cages should be maintained at 4.0 meters from the base. The shape of the net cages can be maintained with circular ballast. The cages were floated and moored as mentioned in Nursery Phase 2. The juveniles from nursery phase 2 have to be transferred to these grow-out sea cages. The stocking density at this phase has to be maintained at 3.0-5.0 kg/m3 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.) once 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 fingerlings stocked in indoor nursery at around 2 grams and will attain an average weight of 45 grams in 6 weeks, followed and about 70 grams in another 4 weeks of outdoor nursery rearing. 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 m diameter 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 Harves	- 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 in 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/-**

Unit cost economics for a cluster of 10 cages to take up farming of cobia

Sl.No	Head of expense	Cost in Rs.
Capital Expenditure		
Cage and Net		
1	Cost of 10 Cages (6 meter dia) made of 'C' class GI Pipe of 1.5 inch dia)	5,00,000.00
2	Mooring materials for 10 cages	1,50,000.00
3	Nets (2 Inner net and one outer net with ballast pipe) for 10 cages	6,00,000.00
	Sub Total	**12,50,000.00**
	Operational Expenditure*	
1	Cost of 7,500 Numbers of cobia seeds @ Rs 10/seed	75,000.00
2	Transportation	50,000.00
3	Cost of 128.250 tonnes of low value fishes @ Rs.25,000/tonne	32,06,250.00
4	Labour Charges @ Rs.10,000/ Person/month for 2 Persons X 7 months	1,40,000.00
5	Boat Hire & Fuel Charges	1,00,000.00
6	Harvesting Charges	50,000.00
7	Miscellaneous Expenses	1,00,000.00
	Sub Total	**37,21,250.00**
	Grand Total of Capital & Operational expenditure	**49,71,250.00**

Sl. No	Production Estimates
1	Survival 95% = 7125 fishes
2	Feed Conversion Ratio = 1 : 6
3	Average size of each fish at the time of harvest =3kg
4	Total harvest = 21.375 tonnes/cage
5	Sale price of the produce @ Rs.280/kg = Rs. 59,85,000/-
	Gross Income from the harvest = Rs. 59,85,000/-

Sl. No	Economics
1	Gross income from Harvest = Rs. 59,85,000/-
2	Operational expenditure = Rs. 37,21,250/-
3	Gross income – Operational expenses = Rs. 22,63,750/-
	Net Profit = Rs. 22,63,750/-
4	Partial repayment of the capital expenditure = Rs. 25,000/year/cage
	(Capital cost Rs. 12, 50,000 – Subsidy Rs. 5,00,000 = Rs. 7,50,000)
	Repayment of capital @ Rs. 2,50,000/year x 3 years
5	Interest in the total project cost @ 11% = Rs. 5,46,838/-
6	Part of Capital + interest = Rs. 2,50,000 + 5,46,838 = Rs. 7,96,838/-
7	Rs. 22,63,750 – 7,96,838 = 14,66,912/-
	Net profit (after repayment of interest & part of capital expenditure) = Rs. 14,66,912/-

HDPE Cage (6 meter Dia)

GI Pipe Cage (6 meter Dia)

Cobia fingerlings (50 days old)

Cobia juveniles (While feeding)

Cobia Juveniles (3 kg size)

Harvested Cobia