

Cost-benefit Analysis and Input Requirements for Mariculture of Finfishes in India

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Global aquaculture production stood at 66.6 million tonnes in 2012. Two third of the total aquaculture production is contributed by finfish species from inland sector (44.2 million t) and mariculture (5.6million t). Even though finfish from mariculture contributed 12.6% of the total finfish production, it represented 26.9% of total farmed finfish owing to better value realization compared to inland species. More than 600 aquatic species are cultured worldwide in freshwater, marine and brackish water. Cage culture of fishes was originated in South East Asia and later spread to other countries. Cage farming of marine fishes was initiated in India by CMFRI in 2007 in Vizakhapatanam. Cage culture experiments were carried out at 14 different locations along the west and east coast of the country from Veraval in Gujarat to Balasore in Orissa. Initially 15 m diameter cages were used which were subsequently replaced with 6 meter diameter HDPE and then with low cost GI cages in 2009.

The economic and financial feasibility indicators are crucial in the successful adoption of any new technology. The gross income obtained from an enterprise can be maximized either by reducing the costs of inputs or by increasing the revenue. The initial investment cost on cage structure, operating cost components such as feed, seed, labour as well as consistent production and prices decides the economic viability of cage farming. The initial investment on a 15 meter diameter cage was Rs. 8 lakhs and that of 6m diameter was Rs. 4 lakh during the experimental trials. With further research interventions and participatory methods, the size and cost of the cages were further reduced to suit various locations as well as brackish water areas in the country. Different economic and financial feasibility indicators used for assessing the economic viability and feasibility of investment are discussed below.

Different economic and financial indicators

Net operating income = Gross revenue- operating costs

Net profit = Gross revenue minus all costs including the costs of depreciation and imputed interest. The NCF or net profit can be seen as the reward for entrepreneurship and expresses the absolute income of the entrepreneur

Operating ratio = Operating costs / Gross revenue



Net –benefit-Earnings ratio=Net Profit/Gross revenue

Net Cash Flow (NCF)/Total earnings (TE) ratio expresses the NCF or net benefit as a percentage of TE. A ratio of more than 10 % can be considered as good (Pradoand Tietze, 1999, Tietze and Lasch, 2001).

The financial performance is usually measured by NCF/investment ratio or rate of return on investment (ROI), IRR, and BCR.

ROI = Annual net profit/Initial investment expressed as a percentage

A level of 10 % is generally considered as a good indicator. The NCF or net profit expressed as a percentage of the invested capital indicates the profitability of the investment in relation to other alternative investments.

BCR is the ratio of present discounted benefits to the discounted cost.

$$BCR = \frac{\sum_i B_i / (1+r)^i}{\sum_i C_i / (1+r)^i}$$

Where B_i is the total revenue earned at year i , C_i is the total costs at year i , i is the average number of years of operation of fishing units and r is the discount rate.

IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.

$$NPV = \sum_i B_i / (1+r)^i - \sum_i C_i / (1+r)^i = 0$$

Where NPV is the net present value and r is the internal rate of return. An investment is considered acceptable if its internal rate of return is greater than an established minimum acceptable rate of return or cost of capital.

The economic performance of cage culture demonstrations done in various parts of the country are presented below. The analysis shows that the feed cost varied widely in different demonstrations and with type of fish cultured. The capital productivity was almost same in different demonstrations and return on investment was high for low cost GI cages with reduction in initial investment cost. (Table 1).

Table 1. Comparative economics of cage culture demonstrations in various locations

Particulars	HDPE cage in Balasore (Orissa) with seabass	Low cost GI cage in Karwar with cobia	Etroplus in Kerala using HDPE cage
Initial investment	300000	100000	200000
Annual fixed cost	54000	16000	40000
Annual variable cost	231750	314820	215750
Annual Total cost	285750	330820	279750
Feed cost	175000	120000	30000
% Feed cost to total operating cost	0.76	0.38	0.13
Yield	3T	2T	1T
Gross revenue	575760	600000	400000
Net profit	290010	269000	120250
Operating ratio	0.5	0.52	0.54
Return on investment	96.67%	269%	60%

The economic and financial feasibility analysis is presented using a model lowcost cage farming project for a period of 5 years for brackish water areas. The analysis shows that cage farming is a viable enterprise with BCR more than one and internal rate of return well above the prevailing bank rates under the assumptions of constant input and output prices.

Table 2. Economics of cage farming of (cobia) in brackish water using GI cages (5m X 2m X 2.5m)

Sl. No	Cost components	Rate (Rs.)	Cost (Rs.)
	Initial investment		110000
	Operational costs		
1.	Fish seed @ Rs.20/- for Stocking density @ 750 per cage unit	20	15000
2.	Fish feed 900 kg per cage unit	35	31500
3.	Labour charges	42000	42000
4.	Fuel / boat hiring & other expenses	10000	10000
	Sub total		98500
	Yield (at 80% survival and average weight of fish 800 gm)		480 kg
	Expected farm gate price (Rs.)		400
	Gross income (Rs.)		192000
	Annual Fixed cost (with 20% depreciation & 12% interest on investment)		24640
	Total production cost per crop (Rs.)		123140
	Gross revenue (Rs.)		192000
	Net profit		68860
	Operating ratio		0.51
	Return on investment		62.6%

Table 3. Cash flow analysis

Year	Investment	Annual cash outflow	Total cash outflow	Annual Cash inflow	Net cash flow
0	110000	0	110000	0	-110000
1		98500	98500	192000	93500
2		98500	98500	192000	93500
3		98500	98500	192000	93500
4		98500	98500	192000	93500
5		98500	98500	192000	93500
				NPV	203427
				BCR	1.46
				IRR	81%

Seed and feed requirement for cage farming in India

The finfish varieties which are preferred for seacage farming in India are seabass, cobia, pompano, groupers, Thilapia, snappers and Etroplus. At an average seed cost of Rs. 15-20/ piece, the projected seed requirement for the production of at least 1 lakh tonne of finfishes through cage farming is 290 million numbers consisting of seabass, cobia, pompano, etroplus, groupers and snappers.



Pelleted feed and chopped fish are used for feeding the finfishes in cage farming. The feed cost constitutes 30-60% of the total cost of production in cage farming of various finfishes. The lower FCR values indicated better economic viability with lower feed cost. The FCR values of cobia in the culture demonstrations in India ranged from 1.5-2.2 and that of seabass was 0.8-1 (S Mojjada, Philippose, 2014, Liao *et al.*, 2004, Benetti *et al.*, 2010). At FCR value of 2 at least two lakh tonnes of fish feed is required for the production of 1 lakh tonne of finfish. At the rate of Rs.25000/tonne of trash fish, the feed cost required for the production of 1 tonne of fish is Rs. 50,000.

Table 4. Projected seed requirements for the production of 1 lakh tonne of finfishes through cage farming

Name of fish	No. of cages	Av stocking density/cage	Survival %	Projected production (t)
Cobia	30000	1500	80%	36000
seabass	30000	1500	80%	25200
Pompano	30000	2500	80%	12000
GIFT Thilapia	10000	2500	70%	5250
Etroplus	10000	5000	70%	10500
Others	10000	5000	70%	14000

The major challenges for the popularization of cage farming in India are high feed cost and non-availability of quality seeds. Heavy dependence on fish based feeds or trash fish is a threat to the stagnating capture fishery resources. Even though finfish produced through cage farming command better price and provide quality fish for consumption, finfish farming with heavy dependence on fish based feeds or low value fishes need to be promoted with caution. It is essential to develop low cost alternate feeds which suit the dietary requirements of fishes through participatory methods. The wide variability in FCR values in various culture demonstrations and participatory trials suggest the need for developing optimal feeding schedules to improve the economic viability of cage farming. In addition, non-availability of sufficient seeds in time is another important constraint in cage farming. Currently CMFRI and Rajiv Gandhi Centre for Aquaculture (RGCA) of MPEDA are the chief sources for finfish seeds for cage farming in India. NFDB provides subsidy assistance upto 20% for commercial shrimp hatcheries for production of finfish seed. Production of quality seeds and development of alternate feeds at low cost through participatory methods through public funded programmes are essential for the widespread adoption of technology.