

Prospects of Farming the Indian White Shrimp *Penaeus indicus* H. Milne Edwards in Gujarat, India

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Nauplii of *Penaeus indicus* H. Milne Edwards brought from Kerala were raised in hatchery to postlarvae stage and stocked @ 5.5 nos m^{-2} in a prepared pond and reared to marketable size. The survival in 150 days was 60% with an average weight of 16 g. The adults of average weight 27 g and above, collected later from the pond were matured in hatchery and spawned. The spawn was raised to postlarvae stage. The overall survival rate was 28%. A model self supporting aquaculture project having a hatchery of 5 million, postlarvae yr^{-1} to stock in an 8 hectare farm (water-spread) @ 25 nos m^{-2} and to produce annually 38 tonnes of shrimp (Head-on) was considered. The cost analysis indicated annual net income of Rs. 15 lakhs after depreciation and interest on capital but excluding repayment of capital investment. The potential of establishing such projects in Gujarat is discussed.

Key words : Shrimp farming economics, *Penaeus indicus*, Gujarat, India.

Coastal aquaculture is gaining momentum in India as a source of shrimp for export. The Govt. of India, through several agencies is encouraging scientific semi-intensive shrimp farming projects to supplement the shrimp production from coastal fishing. Cultured shrimp being superior in quality, fetches higher value in export markets.

It has been reported that Gujarat State has over 3,76,000 hectares of saline marshy land along its coast potentially suitable for aquaculture, but as of today, a meagre 360 hectares (Dixitulu & Paparao, 1994) only are under shrimp farming. The coastline of the state, however, does not have much brackishwater area. Nevertheless, by identifying the right species of shrimp suited to culture in sea water salinity, it is possible to augment coastal aquaculture production in the state. The cultivable species of penaeid shrimp occurring in Gujarat are *Metapenaeus* sp. *Penaeus semisulcatus*, and *P. merguensis*. While *Penaeus indicus* is listed in several reports, Joseph & Soni

(1990) who intensively studied the shrimp catches of this region have not recorded this species from Gujarat. *P. indicus* has tolerance to high salinity ranges and records quick growth as well. The hatchery production and semi-intensive culture of this species were therefore considered. Based on the data of experimental hatchery and farm rearing of the species, techno-economic feasibility of a self-reliant aquaculture project having both hatchery and farm is discussed.

Materials and Methods

Nauplii of *Penaeus indicus* were obtained from the MPEDA hatchery, Cochin, Kerala and reared to postlarval stage. The seed was stocked @ 5.5 nos m^{-2} in a 680 m^2 pond which was earlier fertilised with organic and inorganic fertilisers to induce natural food production. The experiment was conducted during August to December 1991. Daily exchange of water @ 10% in the first month to 25% in the fifth month was done. Artificial pellet feed prepared in the farm was fed @ 10% of body weight

in the first month to 4% in the fifth month. Artificial aeration was not done. The temperature and salinity of the pond were recorded. The adult female shrimp from the pond were matured by eye stalk ablation and spawned in the hatchery. The nauplii were raised to postlarvae.

Results and Discussion

The culture of *P. indicus* in high salinity coastal areas has been reported to yield encouraging results (Mohamed *et al.*, 1980; Marichamy & Motha, 1986). In an earlier experiment to grow the postlarvae of the species in high saline areas of salt-works, the growth rate was found better but the survival was poor due to uncontrollable increase in salinity (Gopalakrishnan *et al.*, 1990). In the present experiment, the postlarvae stocked in an earthen pond of 680 m² @ 5.5 nos m⁻² from August to December 1991 (Table 1) showed a survival of 60% in 150 days recording an average length of 112.8 mm (TL) and weight of 16.0 g. The salinity was below 45‰ and the only problem observed was the lowering of temperature below 25°C during winter, from October, recording a steep fall in the growth rate.

Table 1. Growth of pond-reared *Penaeus indicus* during August - December 1991

No. of days after stocking	Average size		Growth rate day ⁻¹	
	mm	g	mm	g
0	30.2	0.3	-	-
30	80.4	5.0	1.67	0.16
60	86.3	7.0	0.20	0.07
90	102.3	12.4	0.53	0.18
120	111.7	15.4	0.31	0.10
150	112.8	16.0	0.04	0.02

Several formulae for preparation of pellet feed are available (Michael, 1990). By using indigenous ingredients and adopting

a suitable composition, dry pellet feed having 25% protein content was prepared. The protein content could be varied by rearranging the proportion of ingredients. It was observed that the farm made feed was at least 60% cheaper than marketed indigenous feed used in semi-intensive shrimp farming in the country. Besides, the farm prepared feed also generated additional rural employment.

Table 2. Details of hatchery experiment on *Penaeus indicus*

Date	No. of spawners	Nauplii produced, nos.	Survival of post-larvae, nos.	% of survival
13-4-1992	1	42800	18229	24.4
14-4-1992	1	32000		
15-4-1992	1	101500	24015	23.7
16-4-1992	1	53000		
18-4-1992	2	38000	18222	20.0
20-4-1992	5	110000	53999	49.1
22-4-1992	4	77000	4505	5.9
24-4-1992	2	22000	14587	66.3
Total	17	476300	133557	28.0

Successful maturation and breeding of *P. indicus* have been reported from other parts of India (Muthu *et al.*, 1986; Muthu & Pillai, 1991). The present experiment is the first of its kind in Gujarat. Thirtynine adult female specimens (mean size; 27g) raised in the pond were matured by unilateral eyestalk ablation. The maturation took place in 5-8 days. While all the ablated females matured and some of them rematured, only 17 spawned. Altogether 476300 nauplii obtained during 22 spawnings were raised to postlarva-5 stage (Table 2), recording a 28% overall survival. The quality of the eggs and the larvae depended upon the spawner (Data not presented). By using bigger sized spawners, improved results could be achieved. One of the major problems, encountered in

the hatchery was fungal infection during transition stage of larva at zoea and postlarva. It was found that by disinfecting the rearing tanks and by maintaining better hygiene and controlled medication, the problem could be solved. The easy maturation of the pond reared spawners has solved a major problem for setting up hatchery, making it independent of 'wild' stock of spawners from sea fishing.

Table 3. Details of estimated capital investment

Sl No.	Item	Amount Rs. Lakhs
1.	Civil jobs;	
	i) hatchery shed, maturation tanks, rearing tanks, seawater storage and treatment tanks, algal culture chamber, laboratory store, machinery store, etc.	6.00
	ii) land site clearing, construction of 16 ponds of 0.5 hectare each	14.40
	iii) buildings for store, feed, watch & ward posts, fencing, etc.	3.60
2.	Pumps & machinery:	
	Seawater pump, air blowers, foundation, pipings, etc.	12.00
3.	Equipments:	
	Cartridge filters, FRP algal culture jars, electrical heating system for seawater used in hatchery during winter, electronic balance, air conditioner, microscope, autoclave, paddle wheel aerators, micropulveriser, dough kneader, hand pelletiser, etc.	15.60
4.	Power supply:	
	Electrical power supply for pumps, heating system, paddle wheel aerators, lighting; diesel generator for stand-by power, etc.	15.60
5.	Miscellaneous	0.80
Total		68.00

The overall results of the investigations indicated feasibility of creating self supporting farming projects or "aquaculture estates" in the saline areas of Gujarat coast. Taking into account, the norms

presented by the Govt. of India and the Govt. of Gujarat, for financial assistance, a compact unit having hatchery capacity of 5 million postlarvae annum⁻¹ and farm having 8 hectares of water-spread area to produce 4.8 tonnes hectare⁻¹ yr⁻¹ of shrimp (head on) in two crops is proposed. A stocking rate of 25 nos m⁻² postlarvae to enable to achieve this production and 80% capacity utilisation of the hatchery in rural working conditions, is reasonable, considering unexpected setbacks. The estimates of capital investment needed are given in Table 3.

Table 4. Operating cost estimates

Item	Amount Rs. lakhs
Chemicals, fertiliser and maturation feed	2.88
Power & fuel	11.52
Raw materials for shrimp feed	9.12
Staff salary & workers' wages	3.84
Maintenance (1.5% of capital)	1.00
Miscellaneous including land rent @ Rs. 100 hectare ⁻¹ , administrative and unforeseen expenses	0.64
Total per year	29.00

The annual operating cost of the hatchery and farm are shown in Table 4. It may be noted that power is a major requirement for the aquaculture facility. Heavy dependence on diesel will be needed due to erratic state of power supply in rural areas from the State Electricity Board and to cut down this major foreign exchange consuming expenditure, alternate energy sources like windmill or solar power generation could be considered.

The shrimp produced in the farm will be 71/90 (Headless) or 41/50 (Head-on) category fetching around Rs. 160/- (farm gate) at current prices prevailing for this variety of farmed shrimp. The quality of

Table 5. Analysis of cost of production

Sl. No.	Item	Amount Rs. lakhs
1.	Capital investment	68.00
2.	Working capital (operating expenses for 6 months for hatchery & one crop of shrimp)	14.50
3.	Total capital employed	82.50
4.	Gross income during the year from sale of 38.4 tonnes of shrimp @ Rs. 160 kg ⁻¹	61.44
5.	Less Operating cost for one year	29.00
6.	Gross profit	32.44
7.	Depreciation (@ 10% on capital invested)	6.80
8.	Less depreciation	25.64
9.	Annual interest on capital employed (@ 12.5% on total capital)	10.31
10.	Net annual income	15.32
11.	Return on capital employed, % $(25.64 / 82.50) \times 100$	31.08
12.	Breakeven, % $[(32.44 + 6.80 + 10.31) / 61.44] \times 100$	80.65

aquaculture shrimp is suited not only for head-on frozen packs, but even for live export consignments to fetch premium price in countries like Japan. Based on this, it could be seen that an annual return of

Rs. 61.4 lakhs per unit could be generated. The cost analysis of the total operation (Table 5) shows a net annual income of Rs. 15.3 lakhs, after depreciation, interest and before repayment of capital loan. A working capital equivalent to the operating cost of one term (6 months) is provided to cover the marginal money and other initial expenditure. The capital repayment out of this net annual income, distributed over a 7 year period is shown in Table 6. Subsidy from the MPEDA, Govt. of India which promotes the shrimp aquaculture and also from the BFDA (Brackishwater Fish Farmers Development Agency) of the Govt. of Gujarat, would make the project more remunerative.

It may be noted that besides generating foreign exchange valued at US \$ 2.0 lakh annually, each aquaculture estate can contribute to the creation of at least 10,000 man days of employment of technical and non-technical nature in the rural location. In the present scenario of all round efforts to increase substantially the marine products exports from India, setting up of aquaculture estates using *P. indicus* as the core species offers bright prospects all over

Table 6. Distribution of net annual income (Rs. lakhs)

Year	Principal	Annual instalment	Annual interest @ 12.5%	Total	Gross annual income after depreciation but before interest and loan repayment	Net annual profit
1.	82.50	11.79	10.31	22.10	25.64	3.54*
2.	70.71	11.79	8.83	25.64	25.64	5.01
3.	58.92	11.79	7.37	19.16	25.64	6.48
4.	47.13	11.79	5.89	17.68	25.64	7.96
5.	35.34	11.79	4.42	16.21	25.64	9.43
6.	23.55	11.79	2.94	14.73	25.64	10.91
7.	11.76	11.76	1.47	13.23	25.64	12.41

* Subsidy for shrimp hatchery and farm available from Marine Products Export Development Authority or Brackish Water Fish Farmers' Development Agency would be additional income during the first year.

Gujarat coast. The pace of development can be accelerated by involving the primary co-operative societies through the financial and technical assistance and control mechanism of the apex fisheries co-operative body in the state.

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