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PREFACE

Shrimp culture has been making rapid progress in India during the last ten years. The area has increased from 60,135 ha in 1989-90 to 82,500 ha in 1993-94. The average annual growth rate in area expansion during the above five-year period has been 7.25%. The annual increase during the last year of the period was 16.69%, showing a very rapid growth trend. Shrimp hatchery production in the country has not kept pace with the growth of the Industry and the gap between demand and supply has been very large. An estimate made in 1994 showed that there were 54 shrimp hatcheries in the country with a total capacity of 3 billion seed. However, the actual production would not have been more than 40% of the rated capacity.

The scramble for shrimp seed has been so much that prices shot up very high and quality of the seed could not be maintained. Sensing this demand, a large number of hatcheries have started coming up particularly along the coast of Andhra Pradesh and Tamilnadu. The concentration in certain areas suitable for hatchery is an average number of 1 hatchery for every 2 km.

The Central Institute of Brackishwater Aquaculture has been advocating adoption of backyard hatchery technology to decentralise production and to reduce the risk elements. The Institute has conducted a number of trials on seed production of white prawn Penaeus indicus and has evolved the protocols for seed production, following the concept of backyard hatchery technology. The techniques are simple, which can be followed by educated farmers and skilled technicians. The information has been presented in this Bulletin as a technology package. While the same can be effectively used for the tiger shrimp P. monodon, the Institute is working on a technology package for this species.

It is hoped that the backyard hatchery technology will become popular in the country and will help solve the problem of shrimp seed for the farming industry. The efforts of scientists, Dr. A. Laxminarayana and Dr. S.M. Pillai and technical staff, S.shri. K.K. Surendran and C.S. Sasidharan in the preparation of this publicatiion is appreciated.

Madras - 8
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K. ALAGARSWAMI
DIRECTOR

CONTENTS

1. INTRODUCTION

The existing commercial shrimp hatcheries employ different techniques which need considerable skilled manpower and greater investment. These hatcheries are location-specific and at times are not in a position to meet the seed demands of small and marginal farmers of far-flung areas. To meet the seed requirements of such categories of farmers, the Central Institute of Brackishwater Aquaculture (CIBA) has developed a simple, indigenous and low-cost Backyard Shrimp Hatchery Technology for the Indian white prawn, *Penaeus indicus*. This hatchery can be set up and operated in the coastal farms by the farmers themselves, where good quality seawater is available.

2. BACKYARD HATCHERY TECHNOLOGY

The technology package is specific to *Penaeus indicus* and consists of the following components:

1. Procurement of spawners
2. Mass culture of phytoplankton for feeding earlier larval stages
3. Preparation of mantis shrimp particulate diets for postlarvae
4. Rearing of nauplii to postlarva - 1 stage (PL - 1) by feeding mixed culture of phytoplankton, without water exchange
5. Rearing of postlarva 1 to postlarva 20 (PL 1 to PL 20) using mantis shrimp diet with a minimum exchange of water.

2.1. HATCHERY OPERATION

2.1.1. Procurement of spawners

The impregnated females of *Penaeus indicus* with fully developed ovaries can be obtained from the gill nets and trawl nets operated in the inshore sea. The gravid females can be easily identified by the presence of a diamond-shaped ovary present in the first abdominal segment, if the prawn is viewed against a torch light or the sunlight.

2.1.2. Spawning and hatching

The gravid females are placed in 200 litre round tanks containing sea water filtered through 50 micron mesh bolting cloth. Spawning usually takes place during the midnight and early morning hours. It takes 12 to 18 hours for the eggs to hatch, depending upon the water temperature.

2.1.3. Preparation of algal food

Mass culture of phytoplankton, dominated by *Chaetoceros affinis* is raised for feeding larval stages from protozoea 1 to PL-1 stage.

Mixed culture of phytoplankton is done in 1 ton capacity white coloured FRP tanks. The tanks are placed in the same shed where the rearing tanks are kept. The tank is filled with fresh seawater (32 ± 1 ppt) filtered through 50 micron mesh bolting cloth and it is fertilized with the following nutrients:

Sodium nitrate	12 ppm	or	12 g/1 ton
Potassium orthophosphate	3 ppm	or	3 g/1 ton
Sodium silicate	6 ppm	or	6 g/1 ton
Ethylene diamine tetra acetic acid (EDTA)	6 ppm	or	6 g/1 ton

The light intensity under the plastic sheet roof shed varies from 20,000 to 1,20,000 lux during the day. The atmospheric temperature ranges from 28 to 35°C, while it is 27 to 32°C in the algal culture tanks. It takes about 3 days to develop full algal bloom, which is characterised by golden-brown colour of the water. This culture is dominated by *Chaetoceros* sp. (75 to 90%), followed by *Thalassiosira* sp., *Skeletonema* sp. and *Nitszchia* sp. (10-25%). The cell density is around 3 to 4 lakh cells/ml. Apart from using this culture as feed for shrimp larvae, it is also used as inoculum for fresh batch of cultures. Normally, 50 litres of the previous day's culture is used as inoculum. In subsequent days, the full blooming of algal culture is achieved within 16-20 hrs after the introduction of inoculum to filtered and fertilised sea water.

2.1.4. Preparation of mantis shrimp particulate diet

The mantis shrimp (*Oratosquilla nepa*) commonly available in commercial mechanised trawler catches is used for preparation of particulate diet for feeding post larvae. The mantis shrimp is first washed in fresh water to remove the dirt and then sun-dried. Dried animal is powdered in a domestic mixie and then passed through 200, 500 and 1000 micron meshed sieves to obtain particulate diets of required sizes.

2.1.5. Larval rearing

Six larval rearing tanks (circular, 2 tonne capacity) are placed in a shed of about 100 sq. m. area, covered with a translucent sheet to serve as a roof, in order to have diffused sunlight over the tanks. Initially, 2 lakhs healthy nauplii are stocked in each tank containing only 300 litres of sea water filtered through 50 micron mesh bolting cloth. The salinity of sea water used is 32.0 $\pm$ 1 ppt and pH 8.2. Aeration is effected from a 3 HP air blower. One aeration stone is provided to each tank through a PVC grid. No feed is provided during naupliar stages. When the larvae attain protozoea 1 stage (Z 1), 100 litres of filtered sea water and 50 litres of separately cultured phytoplankton (dominated by the diatom, *Chaetoceros* sp.) are added to each rearing tank. The concentration of algal cells in the rearing tank is maintained between 30,000 - 40,000 cells/ml. The quantity of algal water to be added is determined by the colour of the rearing medium. Generally, a golden brown colour of algal water indicates a cell density of 4 lakh cells/ml in the culture tank. When this concentrated algal water is added into the rearing tank, the colour of rearing medium becomes yellowish, indicating a cell density of 40,000 cells/ml. The hatchery operator can easily understand the cell density based on colour of the rearing medium and determine the quantity and frequency of addition of algal water.

It is to be noted that sea water is not exchanged from the rearing tank till the larvae attain PL-1 stage. Normally, the larvae attain PL-1 stage on the 10th day after stocking in the N 1 stage.The sequence of larval development and the volume of sea water and algal water added every day to the rearing tank is shown in Table 1.

Table 1. **The sequence of larval development, feed and water management.**

Stage	Larval development		Quantity in litres		
	Size range (Total length) (mm)	Av. duration (hours)	Seawater	Algal water	Total volume present in the tank
Nauplius 1	0.28-0.31	4		--	300
Nauplius 2	0.29-0.32	4		--	300
Nauplius 3	0.30-0.33	7	--	--	300
Nauplius 4	0.34-0.38	12	--	--	300
Nauplius 5	0.35-0.41	15	--	--	300
Nauplius 6	0.43-0.54	18	--	--	300
Protozoea 1	0.88-0.91	30	100	50	450
Protozoea 2	1.40-1.55	30	100	50	600
Protozoea 3	2.41-2.73	30	100	100	800
Mysis 1	3.07-3.65	30	200	150	1150
Mysis 2	3.39-3.58	30	200	200	1550
Mysis 3	3.43-4.17	30	250	200	2000
Post larva 1	4.55-5.36	27	--	--	2000

2.1.6. Postlarval rearing

The postlarval rearing is conducted in the same tank. From PL-1 to PL 20, mantis shrimp powder is provided as feed. The rate and frequency of feeding, particle size and the quantity used during different stages of postlarval rearing are given in Table 2.

Table 2. **Feeding schedule in postlarval rearing**

Stage	Particle size of of Mantis shrimp powder (microns)	Quantity of mantis shrimp powder (g)		
		0600 h	1400 h	2200 h
PL 1 to PL 5	200	3.0	3.0	3.0
PL 6 to PL 15	500	5.0	5.0	5.0
PL 16 to PL 20	1000	7.0	7.0	7.0

From PL 3 to PL 6, one third of the water and from PL 7 onwards, 50% of the water in the larval tank is changed on alternate days, using brackishwater having a salinity range of 15- 20 ppt. By this process, salinity of the rearing medium is brought down gradually from 32 ppt to 16 ppt, at the rate of 1 ppt reduction in each water exchange during PL 3 to PL 6 and at 2 ppt reduction during PL 7 to PL 19. The details of salinity reduction are presented in Table 3.

Table 3. **Salinity manipulation in nursery rearing.**

Stage	Rate of water exchange on alternate days	Total No. of exchanges	Rate of salinity reduction per water exchange (ppt)	Salinity in rearing tank (ppt)
PL-1 to PL-2	-	-	-	*32.0*
PL-3 to PL-6	One-third	2	1.0	30.0
PL-7 to PL-19	50%	7	2.0	16.0
PL-20		-	-	16.0

By the time the larvae attain PL-20 stage, they can be stocked directly into the brackishwater grow-out ponds without acclimation. For one larval cycle using one 2 t tank, the quantity of water required is 10.3 tonnes (1250 litres of sea water, 750 litres of algal water and 8300 litres of brackishwater). The average survival rate per tank is worked out to 35% from N-1 to PL-20.

A lay-out for a backyard shrimp hatchery is given in Fig. 1.

3. ECONOMICS

The approximate cost of a backyard hatchery which can produce 3.36 million seed of *P. indicus* annually is presented in Annexure 1.

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ANNEXURE 1

ECONOMICS OF A BACKYARD SHRIMP HATCHERY FOR WHITE PRAWN *PENAEUS INDICUS* **(CAPACITY 3.36 MILLION PL 20 PER ANNUM)**

A. CAPITAL COST

	No.	Rs.
1. Shed (14m x 7m) with transluscent sheet roof	1	50,000
2. Sea water storage tanks(RCC)(5m x 2m x 2m)	2	1,00,000
3. FRP larval rearing tank (2-tonne)	6	90,000
4. FRP spawning tank (200 l)	6	24,000
5. FRP algal culture tank(1-tonne)	6	45,000
6. 5 HP pump set for sea water pumping	1	15,000
7. 1 HP pump set for water exchange	2	9,000
8. 3 HP air blower (3 phase)	2	80,000
9. 7.5 KVA generator	1	70,000
10. Refractometer	1	7,000
11. pH meter	1	5,000
12. Haemocytometer	1	400
13. Domestic mixie	1	2,000
14. Oxygen cylinder (75 kg/cm^2)	1	2,000
15. Standard sieves(100, 200, 500 & 1000 microns)	1 set	1,500
16. Aeration system		5,000
17. 3 - phase electrification		10,000
18. Freshwater supply system		10,000
19. Seawater supply system		10,000
20. Land & Infrastructure development cost		1,00,000
	Total	6,35,900 or **6.4 lakhs**

B. OPERATIONAL COST FOR ONE RUN	Rs.
1. 16 Spawners @ Rs.50/-	800
2. Chemicals	500
3. Electricity	2,000
4. Fuel	2,000
5. Mantis shrimp powder	50
6. Netting materials	700
7. Glasswares	400
8. Plasticwares	300
9. Seed transport bags - 8 l cap, Nylobolt cloth 32 to 50 microns, closed mesh velon netting, tubs, buckets, mugs, etc.	800
Total	7,550
Total expenditure for 8 runs	60,400

C. Man Power	
1. Hatchery Operator at Rs. 3500 p.m.(1 post)	3,500
2. Skilled Labour at Rs. 1500 p.m.(1 post)	1,500
Total Monthly expenditure	5,000
Wages (Annual expenditure)	60,000

D. ANNUAL PRODUCTION	
1. No.of spawners required for 8 runs	128
2. Average No. of nauplii / spawner	75,000
3. No. of nauplii stocked / 2-tonne tank	2,00,000
4. Average survival from Nauplii to PL 20	35%
5. No. of PL 20 produced in a single run	4,20,000
6. Total production of PL 20 in 8 runs	3.36 million

E. INCOME

	Rs.
Sale price of annual estimated 3.36 million PL 20 @ Rs.150/ 1000	5,04,000

F. GROSS PROFIT (E - B + C)

E = Income, B = Operational cost and C = Manpower [Assuming 6 runs in the 1st year and 8 runs in the subsequent years]	3,83,600

G. NET PROFIT

(After allowing 20% interest on capital cost and 20% depreciation on equipment)	1,59,600

H. PROFITABILITY INDICATORS

1. PAY BACK PERIOD:		2 years and 9 months	
DISCOUNTING RATE	30%	50%	90%
GROSS RETURNS (Rs.)	860319	602348	358215
GROSS COSTS (Rs.)	781489	632680	462475
2. NET PRESENT VALUE (Rs.)	78830	−30332	−104259
3. B/C RATIO (DISCOUNTED)	1.10	0.95	0.77
4. INTERNAL RATE OF RETURN		44.44%	

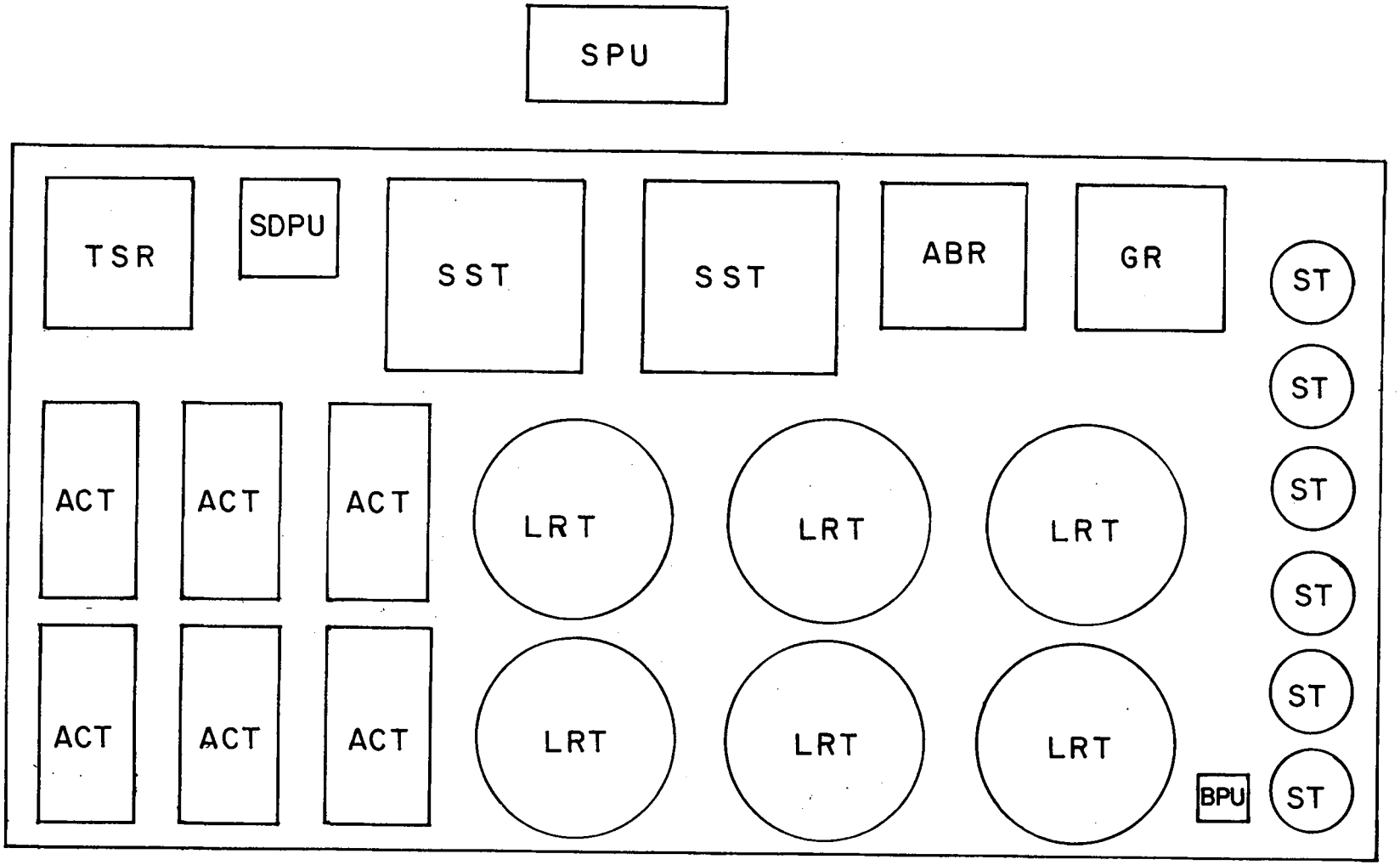

Fig. 1. SPU-Seawater pumping unit; SST-Seawater storage tank; SDPU-Seawater distribution pump unit; TSR-Technical staff room ABR-Air blower room; GR-Generator room; ST-Spawning tank; LRT-Larval rearing tank; ACT-Algal culture tank; BPU-Brackishwater pumping unit.