



BAY OF BENGAL PROGRAMME  
Small-Scale Fisherfolk Communities

BOBP/WP/86  
GCP/RAS/1 18/MUL

Nursery cage rearing of post-Larvae  
of *Penaeus monodon* in West Bengal, India

by

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Ever since the shrimp farming industry took off in Bangladesh and West Bengal, shrimp fry collection has developed into a major income-generating activity for thousands of people living in the coastal belts of these areas.

This paper describes trials with nursery rearing of the tiger shrimp (*Penaeus monodon*) in floating cages. They were carried out in Ramnagar, Medinipur District, West Bengal, India, from 1990 to 1992. The purpose was to introduce a technology by which the fry-catchers could augment their income by nursing the shrimp fry to a larger size, with higher market value, and be in a better bargaining position *vis-a-vis* the traders.

The trials were undertaken by a group of shrimp fry-catchers in Ramnagar, with support from the Bay of Bengal Programme (BOBP). The subproject was sponsored by BOBP's "Small-Scale Fisherfolk Communities in the Bay of Bengal", (GCP/RAS/18/MUL), a project jointly funded by SIDA (Swedish International Development Agency) and DANIDA (Danish International Development Agency) and executed by FAO (Food and Agriculture Organization of the United Nations).

The Bay of Bengal Programme (BOBP) is a multiagency regional fisheries programme which covers seven countries around the Bay of Bengal — Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka and Thailand. The Programme plays a catalytic and consultative role: it develops, demonstrates and promotes new technologies, methodologies and ideas to help improve the conditions of small-scale fisherfolk communities in member countries. The BOBP is sponsored by the governments of Denmark, Sweden and the United Kingdom, and also by UNDP (United Nations Development Programme). The main executing agency is the FAO (Food and Agriculture Organization of the United Nations).

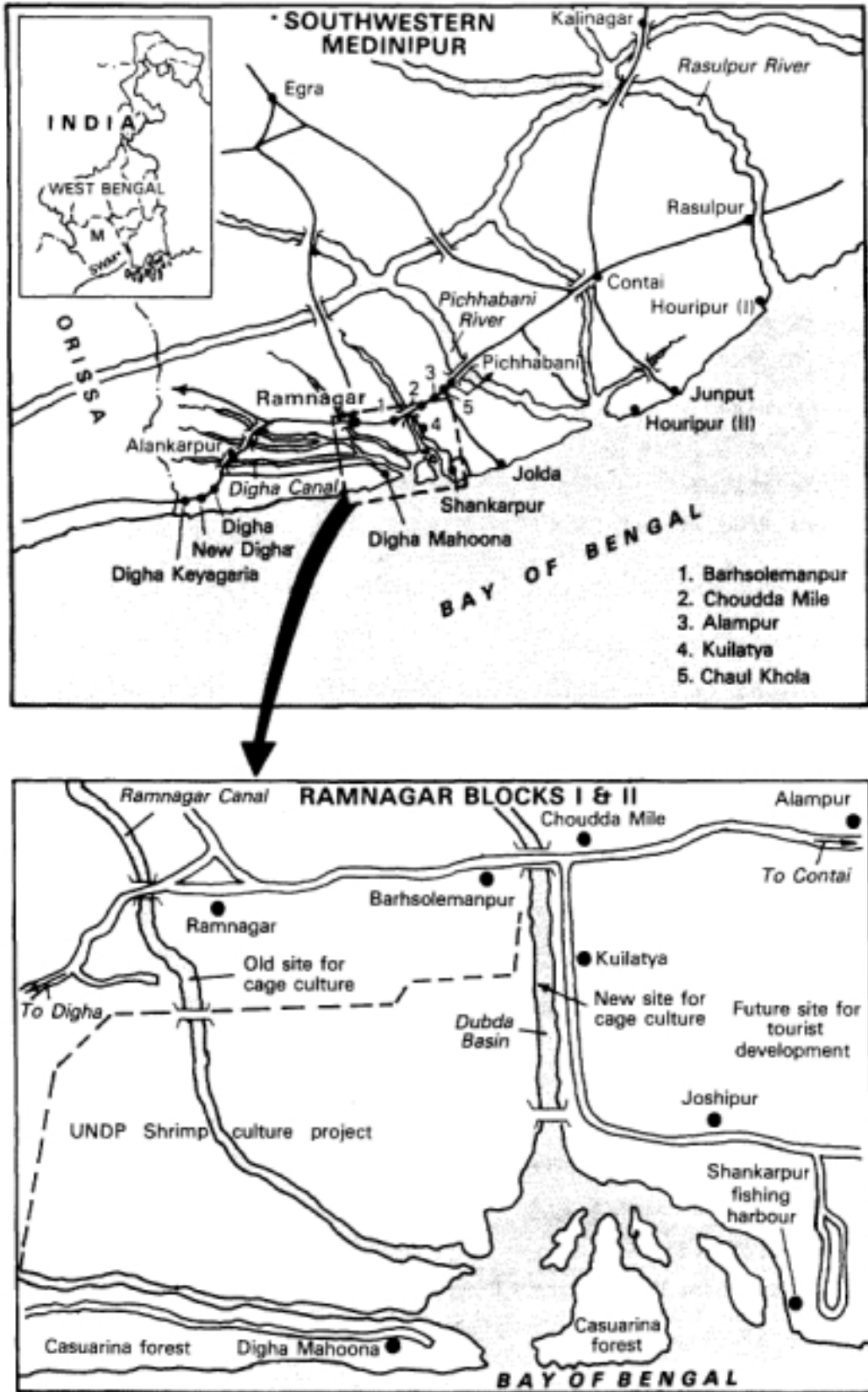
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Fig. 1. The Ramnagar blocks I and II and Southwestern Medinipur, West Bengal



## 1. INTRODUCTION

Shrimp farming in Asian countries has enjoyed a boom during the past decade. Among the different species, it is the tiger shrimp (*Penaeus monodon*) that has been most widely farmed due to its adaptability to culture in ponds and its export value. Some shrimp-producing countries have developed their hatcheries to such an extent that they can meet the entire needs of shrimp fry for their farms. Others, *e.g.* Bangladesh and India, still rely mostly on fry from natural sources. The vast delta of Bangladesh and neighbouring West Bengal, with its numerous tidal rivers and channels, offers an excellent brackishwater environment for the tiger shrimp fry. Following the shrimp culture bonanza, fry\* collection has developed as an important income-generating activity for thousands of people living in the coastal areas of Bangladesh and West Bengal.

Most of the people engaged in shrimp fry-catching are to be found among the landless peasants and poor fishermen, who often have very limited opportunities for subsistence income. Equipped with scoopnets, shootingnets and set bagnets, they collect the tiny and fragile fry of tiger shrimp and sell them to middlemen at a price determined by the latter. Needless to say, the fry-catchers' desperate need for money makes them an easy target for exploitation.

Before the fry are stocked in the shrimp farms, they may go through the hands of one or two other middlemen, be stored for 6 - 12 hours and counted for a second time before liberation in the grow-out ponds. Mortality due to stress and release into a new environment may be as high as 50 - 70 per cent. This loss can only be compensated by additional fry, and that eventually puts pressure on the natural resources.

In late 1989, the Bay of Bengal Programme (BOBP) launched shrimp nursery trials in cages in West Bengal, aiming to improve the fry-catcher's income. Villages in the southern Medinipur District (Figure 1) were selected (see Appendix I) on the basis of the importance of fry catching to the local economy.

The idea of nursery rearing is that:

- It greatly increases the survival rate of fry in the grow-out ponds; the farmer needs fewer fry and pays a higher unit price.
- It gives the fry-catchers a chance to rear and keep the fry till he or she feels the price is reasonable, instead of having to sell the fry for low prices, to middlemen, immediately after catching them. And,
- It provides a profitable link between upcoming hatcheries and shrimp farms; if hatcheries sell post-larvae (PL) to nursery operators, as is widely practised in Indonesia and the Philippines, hatchery efficiency would be improved.

## 2. NURSERY CAGE AND REARING METHODS

### 2.1 Site selection criteria

A preliminary survey of a potential site for nursery cages in West Bengal needs to include the following:

- Salinity tests, to ensure that salinity in the channels is within the acceptable range, of 10-35 ppt, for tiger shrimp post-larvae.
- Water quality assessment, to ensure that there are no household discharges which could pollute the water and compromise the success of the project.

\* 'Fry' is taken to include postlarvae and juveniles

- Water depth measurements, to guarantee sufficient depth at low tide – at least 2 m being necessary – to keep the cages safely afloat and to avoid interference between the free-hanging *happas* and the bottom.
- Study of local conditions. In Ramnagar, sluice gates control the water level in the Dubda and Ramnagar Canals. Irrigation authorities were contacted to coordinate sluice gate operations with the nursery cage culture activities.

## 2.2 Description of the cage

The basic design of the floating cage consists of a raft frame of four narrow bamboo platforms. The sides measuring 0.45 x 6.00 m and the ends 0.45 x 3.00 m are bound together by rope to form a rectangular raft frame with inside dimensions 2 x 5 m. Four to six 100-litre plastic barrels are attached under the raft as floats. Two HDPE bags of 1 mm mesh, called *happas* and measuring 2 x 1 x 1 m, and one *happa* of 2 mm mesh, with dimensions 3 x 2 x 1 m, are hung inside the raft frame. The *happas* are supported by *happa* frames of welded galvanized wire. Stone sinkers are hung along the bottom edge of each *happa*. These measures are required to prevent the *happas* from collapsing in strong tidal currents.

Numerous variations in design and choice of materials exist. The floats may be made of styrofoam or PVC tubes, the bamboo frame could be exchanged for wood or galvanized pipes and different net qualities are available in the market. Locally available, low-cost material makes the replication easier at village level.

## 2.3 Stocking

For a rearing volume of approximately 8 m<sup>3</sup>, when the upper 20 cm portion of the *happas* is above the waterline, the stocking capacity is up to 20,000 fry, with 5,000 in each of the two small compartments and 10,000 in the large *happa*. Since the number of fry stocked is dependent on the collection, variations in stocking density will be experienced.

The intention of having three *happas* rather than one large one is to permit segregation of the shrimp fry according to size. Size differences often lead to cannibalism during moulting, when the shrimp are rendered defenseless.

As the cages are placed in the natural environment, no acclimatization is necessary prior to stocking, except in cases where fry are kept for prolonged periods in the fry-catcher's holding pots (*hundis*) and a difference in temperature arises.

## 2.4 Feeding

Feeding nets, measuring 0.5 x 1.0 m and made of 5 mm galvanized wire and 1 mm mesh HDPE net, are suspended vertically in the *happas*. Small shrimp and trash fish, caught by local fishermen or the fry-catchers themselves, are minced in a mortar, or on a plain hard surface, and applied by spreading the flesh on the stretched nylon net. In order to allow the flesh to attach properly to the surface, the feeding net is exposed to the sun for about half an hour.

Normally, feed for fish and shrimp fry is given at a quantity of 5-25 per cent of the biomass. However, it is not possible for the fry-catchers to precisely weigh or calculate the amount of feed. Even 10,000 fry are a small biomass, of which 5-25 per cent is almost negligible.

A small tin can with a volume of 5 centilitres can be used by the cage operators to quantify the amount of feed to be given. The rule-of-thumb is to give a reasonable amount of feed and then adjust the quantity by observing the feeding tray. If all the food is consumed, additional material should be given at the next feeding. Proper feeding techniques require some husbandry skills.



## 2.5 Harvest strategy

There are two strategies for harvesting. The fry-catchers, working as a group, may accumulate a sufficiently large number of post-larvae (PL) to attract a second level middleman with a truck. At least 100,000 PLs must be offered and should not have been kept for more than 12 days.

Alternatively, PLs can be held long enough to become juveniles. If this strategy is followed, lower stocking densities are used (5000-7000) and 2-3 weeks are required before sale. Careful sorting and segregation is essential to keep mortality at a minimum.

The strategy to be followed depends on the abundance of fry and the season. Early or late in the season (November-December or April-May), it may be more profitable to produce juveniles.

Harvesting takes place in the early morning to avoid the hot sun and high temperatures. First, the *happas* are released from the lower part of the frame and pulled by strings to raise them off the bottom. After this, the net is pulled to one side to minimize the volume and to facilitate concentration of the juveniles at one end. These are finally harvested by scoopnet.

It is usually not possible for the fry-catchers to obtain uniform sizes of fry from the channels, so it is necessary to grade and distribute the seed into the three compartments. Differences in growth rate require that the PL be frequently graded during the nursery rearing.

## 2.6 A pictorial record of nursery culture



*Castnet fishing in Dubda Creek channel, Ramnagar*





*Child seed-collector with her fry-catching equipment*



*Segregating *Penaeus monodon* fry from other species*



*Women participant preparing bamboo for cage frame*



*100 l plastic drums used as floats for the cage*

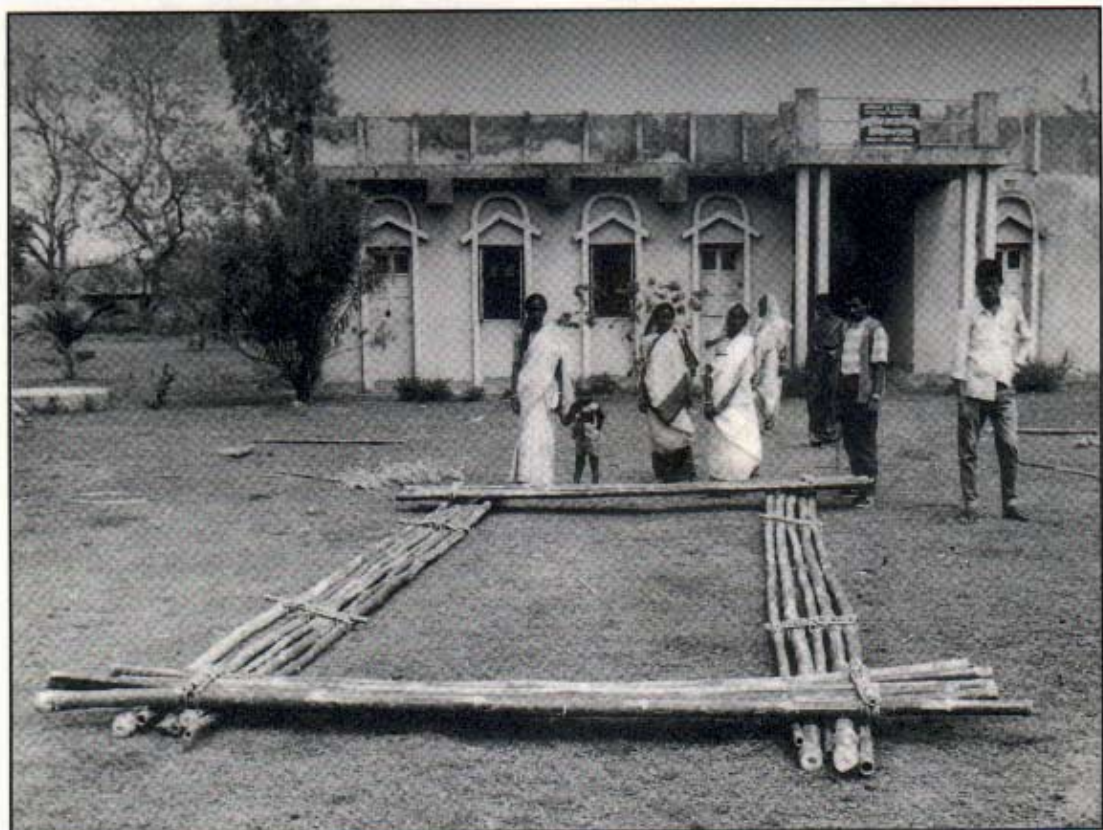




*Painting iron frame for happa nets*

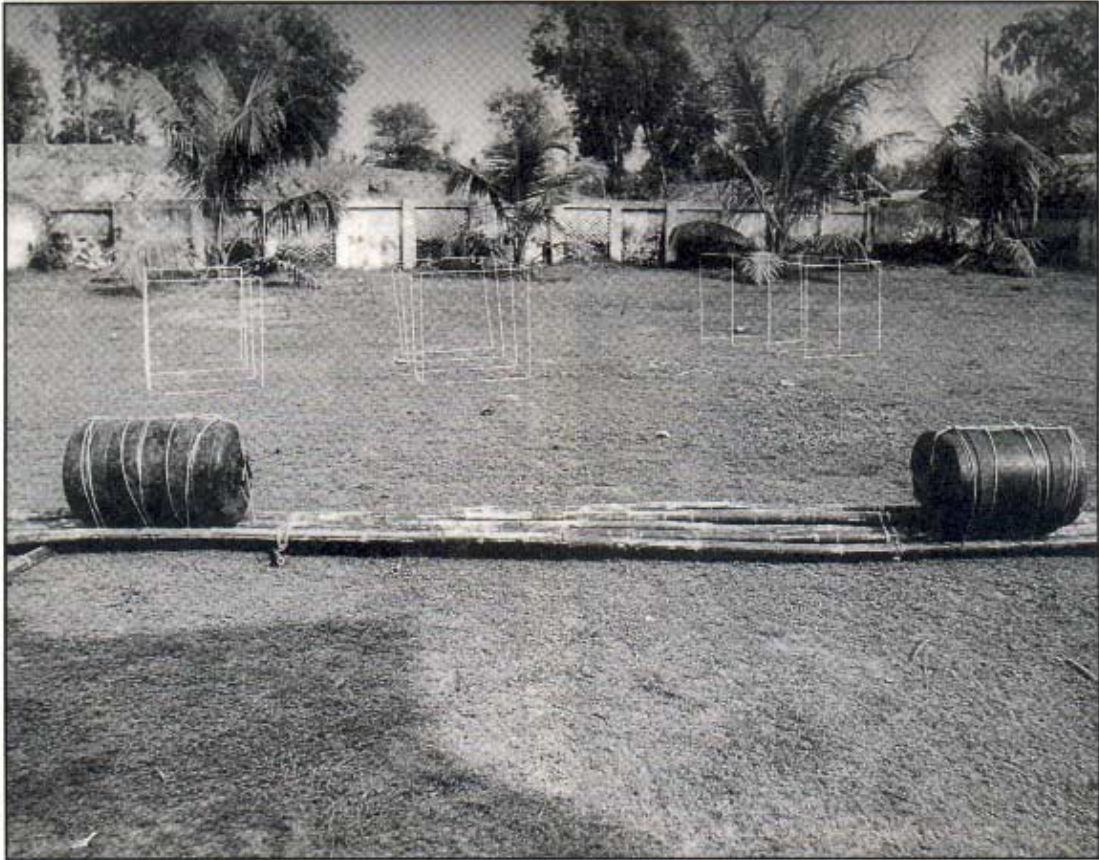


*Trainees assembling the bamboo frame  
for a cage*



*The basic bamboo frame elements in a cage*





*Plastic floats are attached by iron wire and rope to the bamboo frame*



*The complete cage frame ready for launching*





*The weight of the bamboo frame makes several persons necessary for launching*



*Checking the rigidity of the bamboo frame*





*Installation of happa nets inside the frame of the cage*



*Anchored nursery cages ready for use*

### 3. *THE SHRIMP FRY MARKET*

Of all the maritime states in India, West Bengal has the largest area under brackishwater culture. It has been estimated that West Bengal has about 200,000 ha of tidal lands, of which 85,000 ha are suitable for culture. At present, about 40 per cent of the suitable acreage has been brought under culture. The production of cultured shrimp increased from 3600 tin 1980 to 6800 tin 1987. It is reported that about 900 million tiger shrimp fry are collected annually to meet the demand for the extensive and semi-intensive farms located mainly in North 24 Parganas District.

Shrimp fry are collected by fry-catchers all along the coastal belt of West Bengal. There exist a number of shrimp fry collection centres, of which Harwood Point in South 24 Parganas District is one of the biggest. From these local markets, the fry are transported to the Najat market in North 24 Parganas, from where they are sold to the numerous shrimp farms located in the area. An unknown number of shrimp fry are also illegally shipped from the Najat market to Bangladesh, as they fetch higher prices there and meet the demands of the shrimp farms in Satkhira and Khulna Districts. Shrimp culture development in other Indian states may also be adding to the demand for West Bengal tiger shrimp fry.

The shrimp fry market in West Bengal is seasonal. The trade begins slowly in January, following a peak in March-April, and declines again in June. However, it is possible to observe the fry-catching activity in the lean season, indicating a small but consistent demand. While the price of fry in the peak season varies from 120-230 IRs\*/thousand, depending on the number offered, the price in the lean season may drop to as low as 10 IRs/thousand.

The fry-catchers are entirely dependent on the middlemen who come from the North 24 Parganas region in West Bengal. The fry-collectors are not organized and do not have any control over market transactions. They are, it is reported, often cheated by the middlemen while making payments for their products and are forced to take loans from them to supplement the low prices.

The market for tiger shrimp juveniles is still very much in the early stages of development. No clear market information is available, though initial reaction is positive. Generally speaking, juveniles can be sold at 50 IRs/thousand more than the prevailing rates for post-larvae. The market is anything but stable. However, there seems to be a definite annual pattern of price fluctuations as a result of varying fry supply and farmer demand. Marketing does not require large producer groups or centralized sites. As many agricultural producer co-operatives have shown, there are advantages to common marketing that can be seized upon without co-ordinating physical production.

A more complete description of the market in West Bengal is given in BOBP/WP/93 — *Market Study of Tiger Shrimp Fry in West Bengal*. But a few aspects of marketing strategy are considered here, based on test marketing during the trials.

The price for juveniles is dependent on, and proportional to, the number offered to the middlemen at the time of sale. This is because transportation cost to Najat market is the same, irrespective of the number of fry, making large shipments more economical. For the small and unorganized fry-catchers, it is typically not possible to collect enough fry to have any leverage on the price.

The price also seems to increase with the size of the juveniles, with specimens of 4-6 cm being sold at a price 2-3 times the normal market rate for post-larvae. Again, it is difficult for the individual fry-catcher to rear the post-larvae to the juvenile stage. Organizing the fry-catchers and simultaneous stocking and harvesting would appear to be the answer.

\* US \$ 1 = IRs 28/- appx. (1992)



## 4. OBSERVATIONS

### 4.1 The production unit

One standard raft design was used throughout the trials, though minor design details were altered from time to time. Theft of floats remained a major problem. Initial cost was IRs 4361 (see Table I) for a raft with four *happas*, in which 20,000 tiger shrimp post-larvae could be reared during each 12-15 day cycle.

Alternative designs were costed (see Table 2). PVC materials are not yet common in this part of West Bengal and, so, the cost is prohibitive. A simpler cage design of iron rods with permanently attached floats appears to be an attractive alternative at only Rs. 2590 for four independent *happas*. This design solves the theft problem and increases *happa* mobility. On the other hand, storage in off-season is more difficult and poor tack welds suggest that rewelding might be necessary during the *happa's* 4-year life. This alternative design has not been field tested.

There are definite economic benefits to organizing rafts in clusters, as guarding (watch-houses), transport and the use of tools, even if infrequent, can be co-ordinated so as to reduce costs. Clusters of more than five rafts each are more likely to have socio-organizational limitations than techno-economic ones.

### 4.2 Resources

There has been much discussion on the problems of decreasing fry availability and decreasing productivity of the extensively cultivated shrimp *bheries* (pond farms). Fry shortage should not detrimentally affect cage culture if minimal stocking levels can be met. Dwindling supplies will mean higher prices and maybe higher mark-ups for juveniles. Shortages might force groups involved in rearing in cage nurseries to include more fry-catchers in each group to ensure stocking to capacity.

Table 1. Schedule of investment costs

	Cost (IRs)	Avg. life (yrs)	Annual depreciation (IRs)
1. Bamboo poles	660	1.5	440.00
2. Floats	MO	5	168.00
3. Iron rods	330	4	82.50
4. Paint	37	1	37.00
5. Kerosene	3	1	3.00
6. Net materials	746	4	186.50
7. Rope	610	4	152.50
8. Assorted brushes	31	5	6.20
9. <i>Happa</i> labour	140	4	35.00
10. Transport (floats)	8	5	1.60
11. Transport, bamboo	100	1.5	66.70
12. Misc, tools	351	10	35.10
13. Guardhouse	309	3	103.00
14. Torch light	80	5	16.00
15. Welding charge	116	4	29.00
<b>Total</b>	<b>4361</b>		<b>1362.10</b>

Table 2. Comparative raft costs

Type	Density	Initial cost/raft (IRs)	Annual cost/raft (IRs)
Standard raft	single	4361	1514
Permafloat	single	2590	671
PVC float	single	6384	1589
Standard raft	cluster of 3	3780	1360
<b>Standard raft</b>	cluster of 5	3689	1342

### 4.3 Results of trials

Five trials in succession were carried out in the first season (one year) by the participants, designated here by the letters A-J. The results are summarized in Table 3.

Table 3: Results from trials during the 1990.91 season.

<i>Trial</i>	<i>Participants</i>	<i>Culture period (days)</i>	<i>Stocking (No)</i>	<i>Harvest (No)</i>	<i>Survival rate (%)</i>
I	A	40	6,500	1,600	25
	B	40	6,500	4,300	66
	C	40	10,000	2,800	28
	D	40	6,000	4,000	67
	E	40	10,000	3,490	35
	F	40	9,000	3,940	44
	G	40	6,500	2,536	39
II	H+I+J	40	3 x 10,000	17,064	57
	D	21	15,000	8,402	56
	H	21	7,200	4,800	67
	J	21	5,000	4,200	84
III		21	7,000	5,003	71
	J	21	5,000	4,200	84
III	J	10	4,000	3,200	80
IV	D	14	8,944	4,300	48
V	D	4	6,712	700	10

The data show a great variation in survival rates, ranging from 10 to 84 per cent. Trials IV and V were affected by heavy rain. The results from Trial I reveal a survival rate of 25-67 per cent which could suggest differences in rearing and culture management by the individual participants.

### 5. FINANCIAL ANALYSIS

To assess the viability of rearing tiger shrimp fry in cage nurseries, a financial model was created using all available data from the Ramnagar experience after 1 1/2 seasons. The performance of one cage unit was projected for ten years. Stocking was 2500 PL/batch during the first half of each season, changing to 5000 PL/cycle in the second half. In the period of rapid price fall, late

February, the cage would not be stocked. The survival rates were estimated to begin at 90 per cent and slowly decline to 60 per cent by season's end, based on the improved survival results in late 1991 (see Table 4).

**Table 4. Economics of one *happa* stocking post-larvae**

	Cycle	Stock	Buying	PL Cost	Survival (%)	Selling (IRs)	Revenue (IRs)	Margin
1	(15.10)	2500	20	50	90	110	247.5	197.5
2	(1.11I)	2500	60	150	90	110	247.5	97.5
3	(15.11)	2500	60	150	90	140	315	165
4	(1.12)	2500	90	225	90	140	315	90
5	(15.12)	2500	90	225	90	150	337.5	112.5
6	(1.1)	2500	100	250	90	150	337.5	87.5
7	(15.1)	5000	100	500	80	200	800	300
8	(1.2)	5000	150	750	80	200	800	50
9	(15.2)	0	150	0	0	140	0	0
10	(1.3)	5000	90	450	70	140	490	40
11	(15.3)	5000	90	450	70	118	413	-37
12	(1.4)	5000	67.5	337.5	60	118	354	16.5
13	(15.4)	5000	67.5	337.5	60	95	285	60
14	(1.5)	5000	45	225	60	95	285	60
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### 5.1 Viability

The standard raft is shown to be financially viable. It has a payback period, on investment, of one year (or one season). The internal rate of return (IRR) based on a 10-year projection is 88 per cent, while the net present value (NPV) at a 14 per cent discount rate is Rs. 13,253 (see Table 5).

**Table 5. Cash flow analysis (10-year projection for one raft)  
(in IRS)**

	0	1	2	3	4	5	6	7	8	9	10
1. Investment	4361	40	800	650	1109	2742	999	1719	800	1567	1109
2. Operation cost		16540	16540	16540	16540	16540	16540	16540	16540	16540	16540
3. Total cost	4361	16580	17340	17190	17649	19282	17539	18259	17340	18107	17649
4. Sales revenue		20908	20908	20908	20908	20908	20908	20908	20908	20908	20908
5. Salvage											751
6. Total revenue		20908	20908	20908	20908	20908	20908	20908	20908	20908	20908
7. Cash flow	<b>.4361</b>	4328	3568	3718	3259	1626	3369	2649	3568	2801	4010
8. NPV (14%)	11624										
9. <b>IRR</b>	<b>88%</b>										

The alternative model mentioned in Section 4.1 (four independent permaflood *iappas*) would be even more profitable. Payback period would be reduced by half a season (just 7 cycles at 2 weeks! cycle). The IRR would increase to 167 per cent with an NPV (14 per cent) of Rs. 18,283. again calculated on a 10-year projection.

## 5.2 Sensitivity analysis

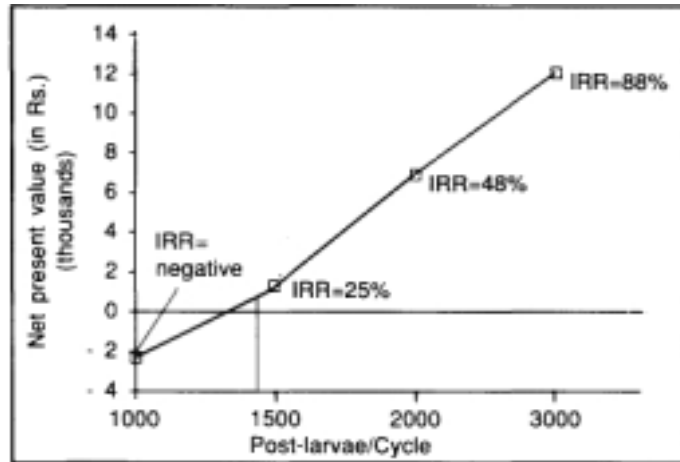
The investment cost is not the determining factor for viability; rather, it is the number and the price margin of fry bought and sold. If the standard raft or cage investment cost was to rise by 50 percent, the IRR would still be 56 per cent, with a NPV of Rs. 11,072. The number of fry stocked and the number that survive are much more important issues. If less than 1500 PL/cycle are stocked on average, the viability comes into question (Figure 2). If the average survival rate in the cage drops below 65-70 per cent, cage culture is not viable (Figure 3). Finally, the price mark-up for the nursery rearing is estimated to be Rs. 50. If the mark-up drops to 35 Rs/thousand, the project is not financially sustainable (Figure 4).

## 6. CONCLUSIONS

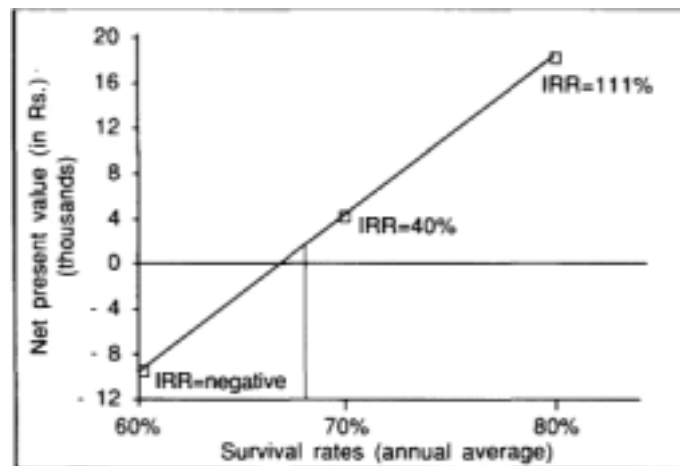
### 6.1 Technical aspects

The cage model presented in this trial has been shown to be appropriate for medium-size channels and estuarine rivers. When soundly constructed, it is able to withstand moderate waves and tidal currents. The construction materials are common items available in most places in West Bengal and, most likely, in any place in India where such type of cage culture would be feasible. As mentioned in Section 2.2, however, it is possible to change the existing design to accommodate a lower investment cost or a change in environment. The somewhat heavy frame of bamboo, which also serves as a footwalk, could be omitted and a galvanized iron frame

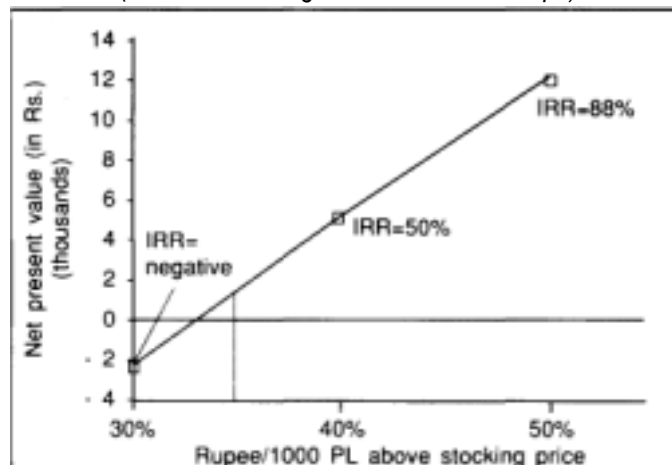
**Fig. 2. Effect of stocking on viability**  
(NPV of one cage at various rates)



**Fig. 3. Effect of survivability of viability**  
(NPV of one cage at various rates)



**Fig. 4. Effect of price margin on viability**  
(NPV of one cage at various mark-ups)



designed with improved welding. The iron frame should be designed to include provisions for attachment of small-size net floats. The cage would then appear as smaller units measuring respectively 1 x 2 m and 2 x 3 m. These smaller size cages would be suitable for individual operation in sheltered canals.

Stocking of cages should not be carried out in mid-February, when the price fall at the time makes profit almost impossible (Figure 5). Stocking can be resumed immediately after the main drop-out period (the beginning of March). Due to high mortality, stocking should conclude for the season in mid-May, prior to the onset of the Monsoon.

Natural variations in fry availability and water levels in the canals of the area prejudice the profitability of cage culture. Several more years of trials will be required to evaluate the impact of such environmental fluctuations.

Future expansion of cage culture should be directed to areas where salinity conditions offer the longest possible season.

Our activity was limited to tiger shrimp fry, but freshwater prawn fry nursery rearing also has potential and would provide income during the Southwest, or 'wet', Monsoon. However, full development of the technology would require the stocking of hatchery PLs. Hatchery production is still very low, but will increase substantially as new shrimp and prawn hatcheries are coming up rapidly.

## 6.2 Social aspects

It appears from the nursery cage culture trial in Ramnagar, that the participants' attitudes and determination to try out cage culture depends, to some extent, on their degree of engagement in seed collection and their socioeconomic background, with the poorer fry-catchers being most persistent. But skills of comprehension acquired during the shrimp nursery rearing have led to individuals carrying on. While it does not require sophisticated competence to nurse tiger shrimp fry, it does help if a little art, science and some understanding of husbandry are applied.

Sufficient time has to be provided for the formation and strengthening of fry-catcher groups. *Panchayats*, the local village governing councils, have to be consulted during selection of participants and sites.

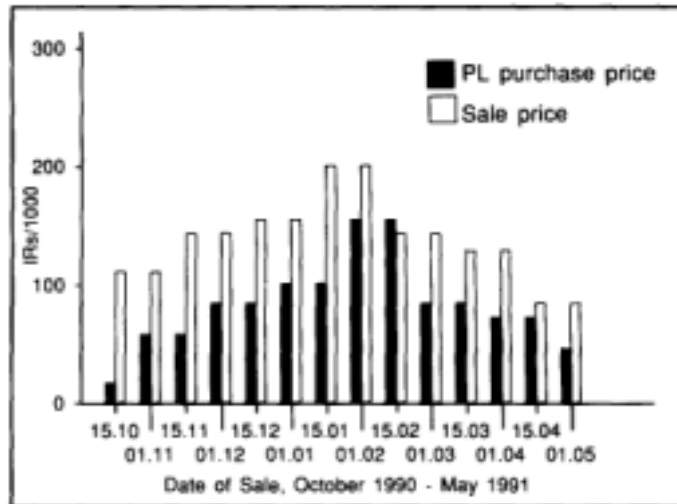
On a few occasions, theft of cage materials and fry from the *happas* has occurred, but it has never been a serious problem. Nursery culture has been accepted by all villagers, of whom quite a few use the channel for fishing with cast and stake nets.

## 6.3 Marketing

From the nursery cage culture trial, a few points can be concluded regarding the marketing of fry:

Stocking and harvesting of post-larvae should be done simultaneously by members of an organized fry-catcher group;

Fig. 5. Price margins of tiger shrimp fry



- Efforts should be made to offer at least 50,000 PL at a time in order to bargain and obtain a fair price for the product;
- Good transportation facilities do not seem to be a necessity as long as a buying agent or main road can be reached in one or two hours' time. Production from one raft would require only 8-10 *hundis* (40 litre aluminium containers) to be transported to a main road each month.
- A stable production of large post-larvae or juveniles should be ensured from the nursery cages throughout the season in order to establish a known source of juveniles and to maintain market position.
- Greater efforts should be made towards training of the fry-catchers in the fry-trading system existing in West Bengal, in order to encourage them to take a more active part in the marketing of their products.

#### 6.4 *Future directions*

Technically, the greatest challenge will be to maintain survival rates near 80 per cent to ensure sufficient profit.

Secondly, different cage designs should be tested with the objective of lowering the investment cost. Local, durable and sound construction materials at the lowest possible prices should be experimented with.

It will be necessary to duplicate the tentative positive results obtained, in order to convince local administrators and banks to provide loans to the shrimp fry-catchers for their initial investment on a cage.

An expected growth in the hatchery business in West Bengal could benefit the shrimp nursery cage operators in the long term. The hatcheries would have the opportunity of selling 5-10-day-old **PL**, increasing their turnover rate and, at the same time, minimizing the operation cost and risk, while the cage operators would have access to a more steady supply of PL for rearing.

Finally, efforts should continue to organize the fry-catchers in such a way so that they would be **able to market their product as a group.**



## Appendix I

### People's participation

#### 1. *Participant selection*

Community participation in the field trials was crucial to an assessment of the social feasibility of nursery cage rearing. A two-step approach was used, beginning with a broad survey by the Indian Institute of Management (IIM), Calcutta, to identify potential participating villages. The BOBP motivator undertook the second step, focussing on a few villages. Participants were selected through a dialogue with village leaders and fry catchers.

The main objectives of the Rapid Rural Assessment (RRA) undertaken late in 1988 by the IIM, in collaboration with the Directorate of Fisheries, Government of West Bengal, were to

- identify three villages in five blocks located in three districts of West Bengal;
- ascertain the socioeconomic conditions of the shrimp fry-catchers in the selected villages; and
- assist BOBP trainers with this information during the pilot training programme.

Ramnagar block in Medinipur District, located at the extreme south of West Bengal and bordered by the Bay of Bengal in the south and east and Orissa in the west, was one of the locations where a large number of households were found to be engaged in shrimp fry-catching for up to eight months in the year. According to the IIM study\*, an estimated 21,000 households belong to Ramnagar Block I. The total population of the block is estimated at around 120,000 people, the overwhelming majority of them Hindu.

Approximately 550 households (with an average of six family members each) from Ramnagar and Barhsolemanpur villages are engaged in shrimp fry-catching activity and 65 per cent of these households regard fry-collection as their primary source of income while the rest regard it as a secondary occupation. More than 50 per cent of the families catch fry, with an almost equal participation of male and female members.

Based on the findings in the villages and door-to-door household surveys, the study recommended a training and demonstration programme in the area to motivate the fry-catchers to deal with such problems as shrimp fry-catching methods, shrimp fry by-catch destruction, fry preservation, fry mortality, lack of organization, low prices, low market leverage, illiteracy and so on.

Utilizing the results of the study, the villages of Ramnagar and Barhsolemanpur of Ramnagar Block I were studied in December 1989 by SANLAAP, a Calcutta-based NGO for women's development, with the assistance of officials from the local brackishwater fishery station in Ramnagar.

The methodology applied by the staff of SANLAAP included daily visits to Ramnagar and Barhsolemanpur on the Ramnagar Canal. Through observing the daily life of the villagers, the SANLAAP team became familiar with the people and their socio-economic status, their work tendencies and character. Sixteen families were selected through a dialogue with village leaders and fry catchers as potential participants. Subsequently, in consultation with the government extension workers, ten couples were chosen as being the best motivated to participate in the cage nursery rearing trials.

\* Report on Rapid Rural Assessment Study (RRAS) to Select Participants in Shrimp Fry Catch in Selected Districts of West Bengal. Indian Institute of Management, Calcutta (1989). BOBP/FAO and DOF. Government of West Bengal.

The emphasis during this initial phase was on individual households. The approach posed problems because it was very difficult to transfer cage materials from undermotivated participants to more interested families or individuals.

Two other villages surveyed by SANLAAP were Joshipur and Kuilatya, located on the Dubda Canal. They too were found to be suitable for rearing trials using cages as nurseries. Here, SANLAAP's approach concentrated on group formation. The local village council, the *panchayat*, was consulted regarding participant selection and the rearing trials were undertaken by the group. Seventeen families of fry-catchers were involved in this second phase.

## 2. *Training methods*

On-the-job training and demonstration in cage construction and culture management were provided by representatives from BOBP and SANLAAP. On-the-job training was chosen because it would have the most direct impact on the participants as well as contribute best to their comprehension of all aspects of cage nursery rearing. It also ensured that women became actively involved in the actual construction process, an occupation otherwise mostly reserved for men (see picture Section 2.6).

The second training component for the fry-catchers and participants included workshops held by staff of SANLAAP on social and organizational awareness-building, adult education, credit schemes and health. Poster exhibitions, video shows and discussions led by teachers and social workers were employed during the sessions.

The third and, in the long term, the most significant contribution to training of the fry-collectors was the involvement of a female village motivator through BOBP-funding. She stayed in Ranmagar for long periods and assisted and encouraged the fry-catchers to undertake rearing trials and maintain records of them. She served as a link between the technical staff of BOBP and the participants.

Participant motivation was excellent; this is reflected by the fact that **no allowances have been** paid them. Also, the female motivator generated the necessary confidence among the female participants in the project. There have been a few dropouts from the trials, but the remaining participants have been remarkably united as a group, an achievement much due to the village motivator.

## PUBLICATIONS OF THE BAY OF BENGAL PROGRAMME (BOBP)

The BOBP brings out the following types of publications:

Reports (BOBP/REP/...) which describe and analyze completed activities such as seminars, annual meetings of BOBP's Advisory Committee, and subprojects in member-countries for which BOBP inputs have ended.

Working Papers (BOBP/WP/...) which are progress reports that discuss the findings of ongoing work.

Manuals and Guides (BOBP/MAG/...) which are instructional documents for specific audiences.

Information Documents (BOBP/INF/...) which are bibliographies and descriptive documents on the fisheries of member-countries in the region.

Newsletters (*Bay of Bengal News*) which are issued quarterly and which contain illustrated articles and features in nontechnical style on BOBP work and related subjects.

**Other publications** which include books and other miscellaneous reports.

Those marked with an asterisk (\*) are out of stock but photocopies can be supplied.

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34. *The Coastal Set Bagnet Fishery of Bangladesh — Fishing Trials and investigations*. S. E. Akerman. (Madras, 1986.)
35. *Brackishwater Shrimp Culture Demonstration in Bangladesh*. M. Karim. (Madras, 1986.)
36. *Hilsa Investigations in Bangladesh*. (Colombo, 1987.)
37. *High-Opening Bottom Trawling in Tamil Nadu, Gujarat and Orissa, India : A Summary of Effort and impact*. (Madras, 1987.)
38. *Report of the Eleventh Meeting of the Advisory Committee*. Bangkok, Thailand, 26-28 March, 1987. (Madras, 1987.)
39. *investigations on the Mackerel and Scad Resources of the Malacca Straits*. (Colombo, 1987.)
40. *Tuna in the Andaman Sea*. (Colombo, 1987.)
41. *Studies of the Tuna Resource in the EEZs of Sri Lanka and Maldives*. (Colombo, 1988.)
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44. *Report of the Fourteenth Meeting of the Advisory Committee*. Medan, Indonesia, 22-25 January, 1990. (Madras, 1990.)
45. *Gracilaria Production and Utilization in the Bay of Bengal Region: Report of a seminar held in Songkhla, Thailand. 23.27 October 1989*. (Madras, 1990.)
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47. *Exploratory Fishing for Large Pelagic Species in Sri Lanka. R Maldeniya. S. L. Suraweera. (Madras. 1991.)*
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49. *Introduction of New Small Fishing Craft in Kerala, India*. O. Gulbrandsen and M. R. Anderson. (Madras, 1992.)
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52. *Feeds for Artisanal Shrimp Culture in India — Their Development and Evaluation*. J F Wood et al. (Madras, 1992.)
53. *A Radio Programme for Fisherfolk in Sri Lanka*. R N Roy. (Madras, 1992.)
54. *Developing and Introducing a Beachlanding Craft on the East Coast of India*. V L C Pietersz. (Madras, 1993.)
55. *A Shri Lanka Credit Project to Provide Banking Services to Fisherfolk*. C. Fernando, D. Attanayake. (Madras, 1992.)
56. *A Study on Dolphin Catches in Shri Lanka*. L Joseph. (Madras, April 1993.)
57. *introduction of New Outrigger Canoes in Indonesia*. G Pajot, O Gutbrandsen. (Madras, 1993.)
58. *Report of the Seventeenth Meeting of the Advisory Committee*. Dhaka, Bangladesh, 6-8 April 1993. (Madras, 1993.)
59. *Report on Development of Canoes in Shri Lanka*. G Pajot, O Guibrandsen. (Madras, 1993.)

### Working Papers (BOBP/WP/...)

49. *Pen Culture of Shrimp by Fisherfolk : The BOBP Experience in Killai, Tamil Nadu, India*. E. Drewes, G. Rajappan. (Madras, 1987.)
50. *Experiences with a Manually Operated Net-Braiding Machine in Bangladesh*. B.C. Gillgren. A. Kashem. (Madras, 1986.)
51. *Hauling Devices for Beachlanding Craft*. A. Overa. P.A. Hemminghyth. (Madras, 1986.)
52. *Experimental Culture of Seaweeds (Gracilaria) in Penang, Malaysia. (Based on a report by M. Doty and J Fisher). (Madras, 1987.)*

53. *Atlas of Deep Water Demersal Fishery Resources in the Bay of Bengal*. T. Nishida, K. Sivasubramaniam. (Colombo. 1986.)
54. *Experiences with Fish Aggregating Devices in Sri Lanka*. K.T. Weerasooriya. (Madras, 1987.)
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59. *Fishery Statistics in the Bay of Bengal*. T. Nishida, (Madras, 1988.)
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62. *Silvi-Pisciculture Project in Sunderbans, West Bengal: A Summary Report of BOBP's assistance*. CL. Angell, J. Muir, (Madras, 1990.)
63. *Shrimp Seed Collectors of Bangladesh*. (Based on a study by UBINIG.) (Madras, 1990.)
64. *Reef Fish Resources Survey in the Maldives*. M. Van Der Knaap et al. (Madras, 1991.)
65. *Seaweed (Gracilaria Edulis) Farming in Vedalai and Chinnapalam, India*. I. Kalkman. I. Rajendran, C.L. Angell. (Madras, 1991.)
66. *Improving Marketing Conditions for Women Fish Vendors in Besant Nagar, Madras*. K. Menezes. (Madras, 1991.)
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68. *The By-catch from Indian Shrimp Trawlers in the Bay of Bengal: The potential for its improved utilization*. A. Gordon. (Madras, 1991.)
69. *Agar and Alginate Production from Seaweed in India*. J. J. W. Coopen, P. Nambiar. (Madras, 1991.)
70. *The Kattumaram of Kothapatnam-Pallipalem, Andhra Pradesh, India — A survey of the fisheries and fisherfolk*. K. Sivasubramaniam. (Madras, 1991.)
71. *Manual Boat Hauling Devices in the Maldives*. (Madras, 1992.)
72. *Giant Clams in the Maldives — A stock assessment and study of their potential for culture*. J. R. Barker. (Madras, 1991.)
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77. *Development of Canoe Fisheries in Sumatera, Indonesia*. O. Gulbrandsen, G. Pajot. (Madras, 1992.)
78. *The Fisheries and Fisherfolk of Nias island, Indonesia. A description of the fisheries and a socio-economic appraisal of the fisherfolk*. Based on reports by G. Pajot, P. Townsley. (Madras, 1991.)
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83. *Survey of Fish Consumption in Madras*. Marketing and Research Group, Madras, India. (Madras, 1992.)
84. *Flyingfish Fishing on the Coromandel Coast*. G. Pajot, C. R. Prabhakaradu. (Madras, 1993.)
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87. *Market Study of Tiger Shrimp Fry in West Bengal, India*. M M Raj, R Hall. (Madras, 1993.)
88. *The Shrimp Fry By-catch in West Bengal*. B K Banerjee, H Singh. (Madras, 1993.)

#### **Manuals and Guides (BOBP/MAG/...)**

1. *Towards Shared Learning : Non-formal Adult Education for Marine Fisherfolk. Trainees' Manual*. (Madras, June 1985.)
2. *Towards Shared Learning : Non-formal Adult Education for Marine Fisherfolk. Animators' Guide*. (Madras, June 1985.)
3. *Fishery Statistics on the Microcomputer : A BASIC Version of Hasselblad's NORMSEP Program*. D. Pauly, N. David, J. Hertel-Wulff. (Colombo, 1986.)
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7. **Guidelines for Extension Workers in Group Management. Savings Promotion and Selection of Enterprise.** H. Setyawati. P. Limawan. Directorate General of Fisheries, Ministry of Agriculture. Government of Indonesia. Jakarta and Bay of Bengal Programme. (In Indonesian). (Madras, 1992.)
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13. **A Manual for Operating a Small-scale Recirculation Freshwater Prawn Hatchery.** R. Chowdhury. H. Bhattacharjee, C. Angell. (Madras, 1993.)
14. **Building a Liftable Propulsion System for Small Fishing Craft — The BOB Drive.** O Gulbrandsen, M R Andersen. (Madras, 1993.)

#### **Information Documents (BOBP/INF/...)**

10. **Bibliography on Gracilaria — Production and Utilization in the Bay of Bengal.** (Madras, 1990.)
11. **Marine Small-Scale Fisheries of West Bengal : An Introduction.** (Madras, 1990.)
12. **The Fisherfolk of Puttalam, Chilaw, Galle and Matara — A study of the economic status of the fisherfolk of four fisheries districts in Sri Lanka.** (Madras, 1991.)
13. **Bibliography on the Mud Crab Culture and Trade in the Bay of Bengal Region.** (Madras, 1992.)

#### **Newsletters (Bay of Bengal News)**

Quarterly, from 1981

#### **Other Publications**

1. **Helping Fisherfolk to Help Themselves : A Study in People's Participation,** (Madras, 1990.)
2. **The Shark Fisheries of the Maldives.** R C Andersen, H Ahmed. Ministry of Fisheries and Agriculture, Maldives. (Madras, 1993.)

NOTE: Apart from these publications, the BOBP has brought out several folders, leaflets, posters etc., as part of its extension activities. These include Post-Harvest Fisheries folders in English and in some South Indian languages, on anchovy drying, insulated fish boxes, fish containers, ice boxes, the use of ice etc. Several unpublished reports connected with BOBP's activities over the years are also available in its Library.

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