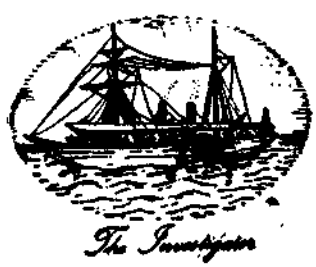
PROCEEDINGS OF THE SYMPOSIUM ON COASTAL AQUACULTURE

Held at Cochin

From January 12 to 18, 1980

PART 1 : PRAWN CULTURE

(Issued on 25th February 1982)



MARINE BIOLOGICAL ASSOCIATION OF INDIA

POST BOX NO. 1244, COCHIN 682 011, INDIA

Price : Rs. 400.00

SYMPOSIUM SERIES 6

Abbreviation

Proc. Symp. Coastal Aquaculture, Pt. 1.

PRINTED IN INDIA BY K. G. JOHN AT THE DIOCESAN PRESS, MADRAS 7 AND PUBLISHED BY E. G. SILAS ON BEHALF OF THE MARINE BIOLOGICAL ASSOCIATION OF INDIA, COCHIN-682 011.

Proc. Symp. Coastal Aquaculture, 1982, 1 : 285-294

BRACKISHWATER PRAWN FARMING IN THE ASHTAMUDI LAKE AREA (S. W. COAST OF INDIA) — ITS PROSPECTS AND PROBLEMS

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ABSTRACT

In the Ashtamudi Lake area (Quilon Dist., Kerala) where scientific aquaculture practices of any kind were not in existence, the CMFRI initiated a demonstration project for the culture of marine prawns in 1978. Fourteen ponds having a total extent of 2.06 ha, owned by M/s. Blackstone Industries at Neendakara were selected for the above purpose.

Pre-stocking observations on bio-ecological parameters were carried out which indicated that the ponds were highly productive and provided optimum conditions for culture operations. Early juveniles of *Penaeus indicus* of 15-25 mm (18.2 mm mean length) size groups were stocked during June-July 1978 at a rate of 50,000 to 70,000/ha. During the pre-monsoon period of 1979 (January to June) the stocking rate of *P. indicus* seeds (mean length 18.0 mm) varied from 56,000 to 252,000/ha. The average growth per day was found to be 0.73 mm and 0.54 mm respectively in the culture experiments of 1978 and 1979. The difference observed in the growth rate was mainly due to the increase in stocking density in 1979. However, growth rate of the species during the first 20 days after stocking was consistently faster in both the years, average being 1.86 mm/day in spite of varying environmental conditions and stocking density.

The feed back data collected during the demonstration experiments provided baseline information for the introduction of scientific farming of penaeid shrimps in this area.

INTRODUCTION

IN RECENT years, the prospect of aquaculture has been gaining wide recognition throughout the country. However, it is yet to become popular as a profession or occupation for the farmers in view of the paucity of information on the economic viability and financial dependability. In order to fill up this lacuna, the Central Marine Fisheries Research Institute has taken up demonstration projects in aquaculture in several parts of the country.

Convinced of the potentialities of areas of unused marshy lands available on both sides of the lower reaches of the Ashtamudi Lake in the Quilon district, Kerala, and in view of the meagre developments made in aquaculture in this coastal area, a project was undertaken from 1978 as a pioneering attempt for the cultivation of prawns in a perennial field owned by a private entrepreneur. The present paper deals with the culture operations carried out in two seasons and the results obtained therefrom under the project.

The authors are grateful to Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute, who identified the farm and gave all

encouragements in carrying out the experiments. They are also thankful to the Proprietor and staff of Quilon Dairy, Neendakara for their active co-operation. The authors wish to record their sincere thanks to Dr. P. Vedavyasa Rao, Senior Scientist for critically going through the manuscript and suggesting improvements.

ENVIRONMENT

Topography

The farm, where the operation was undertaken, is in Neendakara, a major fishing port of Kerala and is about 160 km south of Cochin.

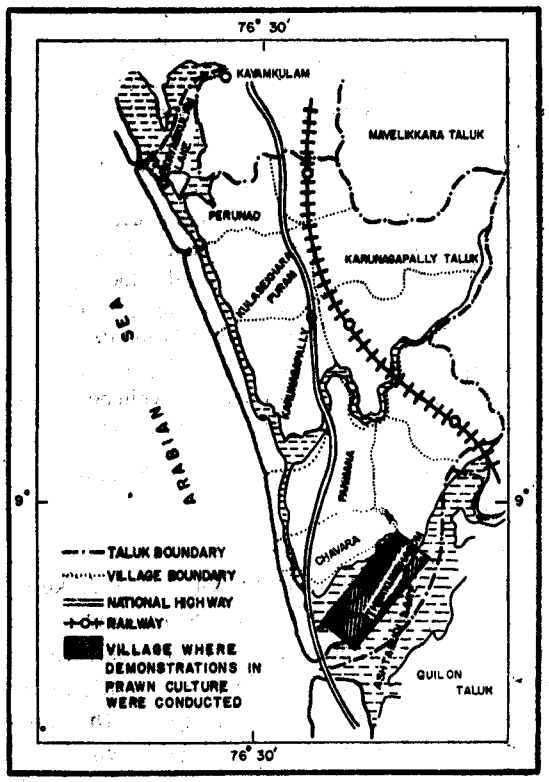

Fig. 1. Area of operation at Quilon District.

The area is situated on the banks of the estuary formed by the lower reaches of the Ashtamudi Lake and has a net work of canals and sub-canals and is greatly influenced by the tidal flow (Fig. 1).

Studies on prawn culture were conducted in 14 ponds having a total area of 2.06 ha owned by M/s Blackstone Industries, Trivandrum. The lay out of the farm and the extent of each pond are shown in Fig. 2. The farm is supplied with water from a feeder canal of about 6 m wide and 500 m long which has a direct connection with the lake. There is a main wooden sluice of one metre width, and it opens into the pond N (Fig. 2). From pond N, the water is supplied to all other ponds through interconnections protected with velon screens. The depth of each pond varied, and at low tide the average depth ranged between 0.55 and 1.0 m (Fig. 2).

Pre-farming environmental conditions

Two sets of prawn culture operations were carried out, one during the south-west monsoon period of 1978 (July-October) and the other during the pre-monsoon period of 1979 (January-June). In order to ascertain the viability of conducting prawn culture in the farm, pre-stocking monitoring of the environmental and biological parameters, such as temperature, salinity, dissolved oxygen, pH, primary and secondary production was conducted in May and June 1978. The results of the initial observations are presented in Table 1.

The surface temperature of the pond waters was found to range between 29.5 and 34.0°C and rose upto 35°C in one pond. There were wide variations in salinity which fluctuated between 0.09‰ in pond H and 18.54‰ in pond C. The dissolved oxygen values were always high and in pond D it went upto 7.06 ml/l. The pH values in most of the ponds were around 7. The primary productivity estimated by both oxygen and ^{14}C methods showed wide range of fluctuations in the rate of production in the different ponds. The results indicated that ponds B, C, F, G, I and K had high rates of production. Common forms of phytoplankters were desmids like

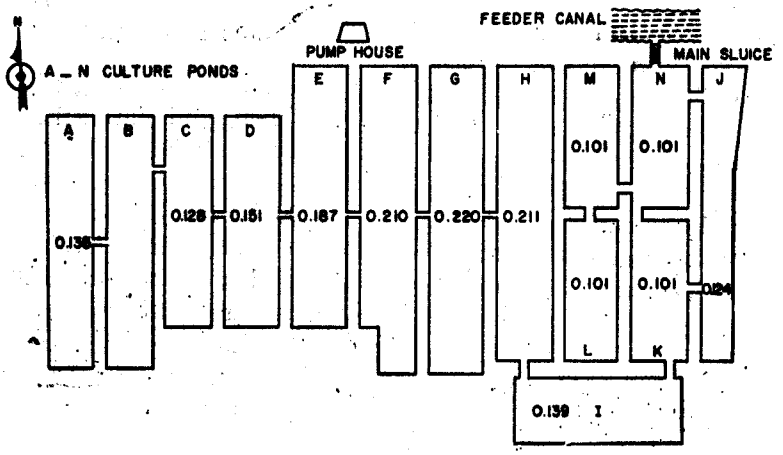

Fig. 2. Lay out of the farm where demonstration operations were conducted. Area of each pond (ha) is indicated.

TABLE 1. *Results of pre-stocking monitoring of environmental parameters in May* 1978

Ponds	Months and year	Average depth at low tide (m)	Temperature °C	Salinity ‰	Oxygen ml/l	pH	Organic Production gC/m³/day	Zooplankton biomass ml/100 l of water
A	May 1978	0.77	32.5	9.26	3.93	7.0	—	2.4
B	,,	0.70	32.0	16.72	3.20	7.16	1.93	2.9
C	,,	0.92	32.0	18.54	5.33	7.63	5.42	10.5
D	,,	0.95	32.0	17.90	7.06	7.69	—	—
E	,,	0.85	32.5	4.81	3.09	7.47	0.92	2.9
F	,,	0.85	32.5	18.45	3.70	7.47	1.24	—
G	,,	0.57	34.0	17.99	6.90	8.12	1.37	7.7
H	,,	0.55	35.5	0.09	4.47	7.08	0.86	—
I	June 1978	1.00	29.5	11.57	5.26	—	1.01	0.65
J	,,	0.80	30.0	10.03	6.75	—	—	1.20
K	,,	0.85	31.0	4.52	5.68	—	1.91	2.20

Euastrum, *Cosmarium* and *Desmidium* species and the micro-green algae and diatoms such as *Coscinodiscus*, *Pleurosigma* and *Rhizosolenia*. In general, the production at the secondary level was found to be high in all the ponds (the highest value of biomass (10.5 ml/100 l of water) was recorded in pond C). On the whole the adults and larvae of copepods dominated the zooplankton samples followed by rotifers, foraminifers, larvae of nematodes, bivalves and crustaceans.

STOCKING

The ponds were cleared of predators and other fishes by total fishing and by pumping out the water completely. Thereafter the water was allowed into the ponds through the nylon netting provided at the sluice gate. After filling with water, the ponds were left free for 2 to 3 days and after which they were stocked with seeds of *P. indicus*. At no stage of the culture operations the tidal waters were controlled unless some adverse blooms were seen in the lake waters.

The seeds of *P. indicus* required for stocking were collected from the Ashtamudi Lake from the nearby areas of the farm. The seeds were collected using a velon screen of 1.5 × 1.0 m which was manually operated by two persons by slowly dragging close to the bottom for short distances. The net was operated in shallow muddy areas from the very water fringe upto 0.5 m depth. The collections were carried out usually at the beginning of the high tide or towards the last phase of the ebb tide. Schools of *P. indicus* seeds were often observed in these grounds and in a single operation which covered about 6 m^2 more than 5,000 seeds were obtained. The seeds were transported from the collection site to the farm in plastic bins of 60 litre capacity. From the general collections the healthy ones of *P. indicus* of almost uniform size were sorted out, counted and released into the ponds after a brief acclimatization in the pond water.

The details of stocking of *P. indicus* seeds in the different ponds during the culture operations carried out in 1978 and 1979 are given in Table 2. The stocking rate varied from about 50,000 to 70,000/ha in 1978. However, in the experiments conducted in 1979, the stocking rate was relatively high, being about 56,000 to 252,000/ha. After stocking, the environmental parameters were monitored every fortnight. Along with this the growth rate of prawns was also checked. No supplementary feed was given during both the experiments.

GROWTH PATTERN OF PRAWNS

For studying the growth of *P. indicus* in the grow out ponds, data were regularly collected and analysed from ponds A, I, J, K in 1978 and from ponds I, J, K and N in 1979. The size range of the seeds and mean size stocked in the first three ponds in 1978 were 15-25 mm and 18.2 mm respectively. In pond K, the seeds with a size range of 20-46 mm and with a mean size of 31.2 mm were stocked. In 1979, the mean size of the seeds stocked in all the ponds was 18.9 mm. The rate of growth of prawns in the different ponds during the culture experiments of 1978 and 1979 are given in Figs. 3 and 4.

The rate of growth of prawns in the culture experiments of 1978 in the different ponds varied from 0.60 mm/day in pond A to 0.86 mm/day in pond J. However, relatively low growth rate (0.42 mm/day in pond K to 0.63 mm/day in pond I) was observed in the experiments carried out in 1979. The average growth per day was found to be 0.73 mm and 0.54 mm respectively in the culture experiments of 1978 and 1979. The difference observed in the growth rate was mainly due to the increased rate of stocking of seeds in 1979.

TABLE 2. *Details of stocking of* P. indicus *seeds in the ponds (A-N) in* 1978 *and* 1979

Ponds	Area in ha.	1978 Date of stocking	1978 No. of seeds stocked	1978 Estimated rate of stocking per ha.	1979 Date of stocking	1979 No. of seeds stocked	1979 Estimated rate of stocking per ha.
A*	0.153	26.6.78	10,726	70,105	—	—	—
B	0.153	5.8.78	8,200	53,595	—	—	—
C	0.128	10.8.78	7,400	57,813	20.2.79	11,000	85,938
D	0.151	11.8.78	7,525	49,834	10.2.79	21,500	142,384
E	0.187	3.9.78	9,700	51,872	20.2.79	22,000	117,647
F	0.210	3.9.78	11,840	56,381	13.2.79	12,800	60,952
G	0.220	20.8.78	11,050	50,227	7.2.79	12,800	58,182
H	0.220	16.8.78	11,450	52,045	6.2.79	12,300	55,909
I*+	0.139	21.6.78	7,393	53,187	29.1.79	17,100	123,022
J*+	0.124	7.7.78	6,359	51,282	28.1.79	11,100	89,516
K*+	0.101	7.7.78	5,050	50,000	1.2.79	12,100	110,802
L	0.101	14.8.78	5,650	55,941	5.2.79	11,000	108,912
M	0.101	20.8.78	5,150	50,990	15.2.79	25,500	252,475
N+	0.101	8.8.78	5,050	50,000	25.1.79	10,300	101,980

* Ponds monitored regularly for the study of growth pattern in 1978.

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Lowering of salinity from the maximum of 13.29‰ in June to 4.45‰ in September was noticed during the first set of experiments and the lowest salinity value observed during 1979 experiments was 18.70‰ in June and the same showed an increase upto 39.18‰ in April. The extremely low and high saline conditions in which the prawns were grown in the two years become all the more significant when the results obtained in respect of growth rate in two seasons are considered. The results obtained during the present experiments indicate that in both the seasons, even under extreme salinity conditions steady growth rate was maintained as it would be seen from the Figs. 3 and 4. Same was the case with temperature also. It was found that temperature as high as 38°C recorded in April 1979 did not have any adverse effect on the growth of the prawns. Thus it becomes evident that a range in salinity between 4.45‰ and 39.16‰ and a temperature maximum upto 38°C would in no way affect the survival and growth of *P. indicus*.

The pattern of growth rate of the species in the initial 20 days after stocking and the subsequent 20 days was analysed and the results are presented in Table 3. In spite of the highly varying densities of stocking (50,000 to 70,000/ha in 1978 and 56,000 to 252,000/ha in 1979), the average growth rate during the first 20 days after stocking in both the years was regis-

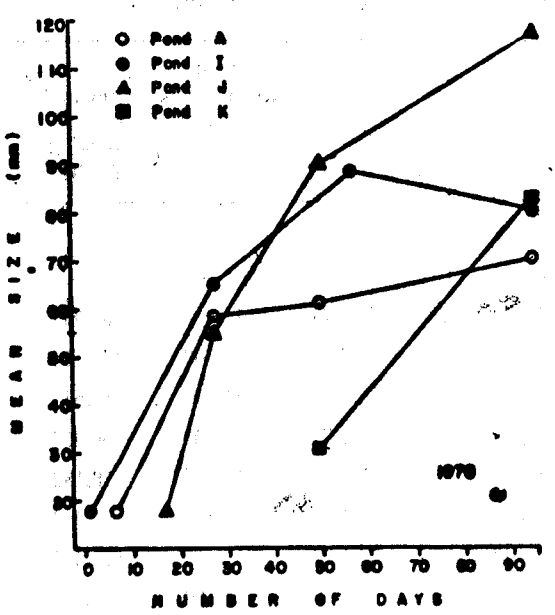

Fig. 3. Growth rate of *P. indicus* in different ponds in 1978.

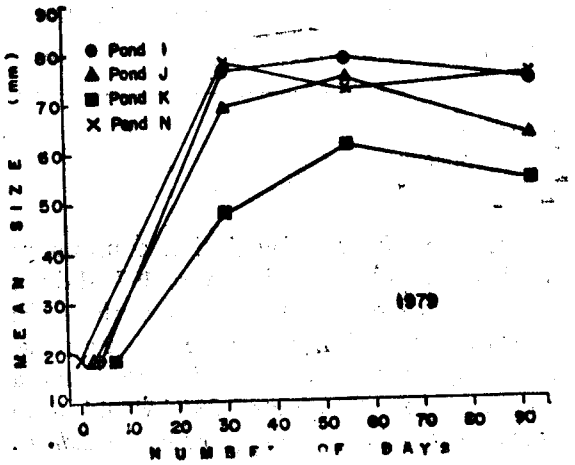

Fig. 4. Growth rate of *P. indicus* in different ponds in 1979.

tered at 1.86 mm/day. During the subsequent 20 days of the 1978 experiments, in ponds where the stocking rate was between 50,000 53,000/ha the average growth rate was observed to be 1.17 mm, whereas in one pond where the stocking rate was 70,000/ha the growth rate was found to be much less being 0.13 mm/day. In the experiments conducted during 1979, concomitant with the increased stocking rate, the growth per day was low, being 0.78 mm only.

Post-stocking Monitoring of the Environmental Parameters

During 1978 experiments, the water temperature in the ponds ranged between 30.18°C in June and 34.63°C in October. Similarly, salinity values showed a minimum of 5.34‰ in August to a maximum of 11.90‰ in June. The low salinity even in the month of September was due to the heavy rains and subsequent flooding that occurred on account of very active north-east monsoon. The oxygen values varied from 3.64 ml/l in July to 5.80 ml/l in September. The monthly average values of salinity, temperature and oxygen for ponds A, I, J and K are presented in Table 4.

The results of the post-stocking monitoring of the environmental parameters conducted in 1979 are presented in Fig. 5. The ambient water temperature recorded a minimum of 30°C in January and a maximum of 38°C in March. During the period January-February and May-June, the temperature was comparatively low, but during the summer months of March-April, the temperature values were quite high. There was a marked variation in the salinity which showed a minimum of 18.7‰ in June and a maximum of 39.18‰ in April, thus recording more than 100% increase during the course of the experiment. Though the ponds were connected by canals, it was obvious that the salt content in the mud also influenced the salinity of the water. However, the sudden lowering of the salinity due to the monsoon rains had greatly influenced the environmental conditions. It was observed that the prawns could withstand such extreme variations in salinity probably due to the interstitial chlorides available in the area (Fig. 5).

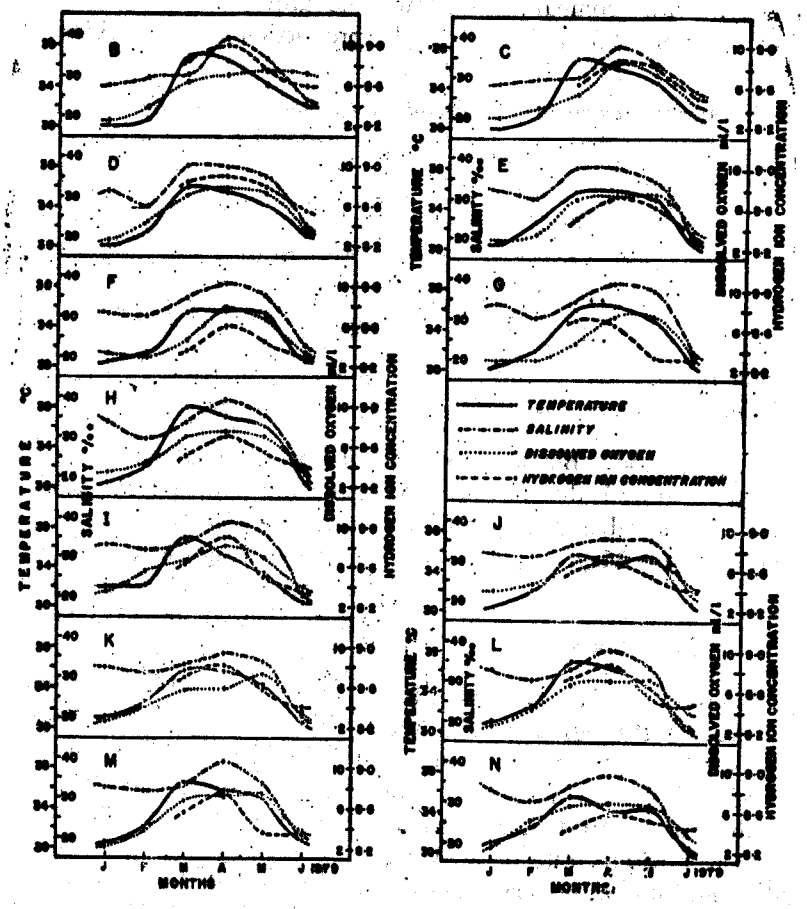

Fig. 5. Post-stocking environmental features in different ponds in 1979.

TABLE 3. *Average growth rate per day (mm) of* P. indicus *during the first* 40 *days in* 1978 *and* 1979

Ponds	1978 Duration		1979 Duration	
	1st 20 days	21-40 days	1st 20 days	21-40 days
A ..	2.00	0.13	—	—
I ..	1.72	1.15	2.23	0.75
J ..	2.62	1.20	1.90	0.83
K ..	1.14	1.15	1.30	0.65
N ..	—	—	2.00	0.88

The dissolved oxygen content showed substantial variations, with comparatively low values ranging between 2.3 and 8.58 ml/l during the first half period. But no apparent adverse effect was noticed due to the low oxygen content. The pH values ranged between 8.3 in July and 8.75 in May.

TABLE 4. *Average monthly values of hydrological parameters during the culture period in* 1978 *(for ponds A, I, J and K)*

Parameters	June	July	August	September	October
Temperature (°C) ..	30.18	31.3	31.0	30.87	34.63
Salinity (‰) ..	11.90	6.41	5.34	6.14	—
Dissolved oxygen (ml/l) ..	5.59	3.64	5.28	5.80	—

DISCUSSION

In recent years several workers have recorded the rate of growth of *Penaeus indicus* in the culture systems as well as in the natural environment. The rates of growth recorded were found to vary due to several factors such as size of the seed at stocking, rate of stocking, environmental conditions of the fields and the method of culture operations followed. George (1975) made some observations on the growth rate of *P. indicus* in a paddy field in Cochin area where non-selective stocking was done and recorded a growth rate of 0.498 mm per day for a period of 89 days. Growth rate was studied by Suseelan (1975) on prawns in the natural ecosystem and he reported that *P. indicus* grew at the rate of 1.00 mm per day for a period of 89 days. The present observation of 1.5 mm per day during the first 40 days of culture is found to be comparable with those recorded by Sultan *et al.* (1973), Mammen *et al.* (1980) and Muthu *et al.* (MS).

Muthu *et al.* (MS) conducted studies on the growth rate of prawns in the experimental ponds at Narakkal, Cochin and showed that the growth rate of *P. indicus* was inversely proportional to stocking density. However the present studies revealed that even in higher stocking densities *P. indicus* grew at a faster rate to attain an average size of 55 mm (growth per day being 1.86 mm) during the first 20 days of stocking. Thus the present experience suggests that about 123,000 seeds of *P. indicus* could be stocked in a reasonably productive field of 1 ha and reared upto a size of 55 mm without any supplementary feeding; further retention of the stock necessitates either thinning of the stock or intensive feeding to obtain sustained growth rate.

In view of the lack of information on the behaviour of prawns in culture ponds under extreme environmental conditions such as low salinity and high temperature, the present culture experiments were also aimed at understanding the impact of the above conditions on the growth and survival of prawns in confinement. Therefore the two sets of farming were carried out in two different seasons, one during the south west monsoon period which was characterised by extremely low salinity and the other during the pre-monsoon summer months when the temperature of the water rose to higher levels.

It has been observed that in the initial 20 days after stocking the prawns grow at a faster rate and this would encourage adoption of the

practice of nursery farming. The seeds can be densely stocked in one or two ponds and after 20 days they can be transferred to various grow out ponds. This would minimise the mortality rates and difficulties connected with the handling of the seeds.

The causative factors for the low growth rate during the second twenty days other than the stocking density have also been investigated. It was observed that extreme fluctuations in the environmental parameters like water temperature and salinity have influenced the growth to a great extent. Inadequate water circulation due to weak flow into the feeder canals and resultant stagnation of water in some of the ponds might have added to this problem. Further, it was observed that in certain shallow ponds there was accumulation of dead bivalve shells in the substratum. It is possible that in the shallow ponds the increase in water temperature might have affected the dissolution of calcium carbonate and resulted in an increase in the pH of the water. However, further investigations are required to corroborate this view.

As far as mariculture practice is concerned, the Quilon-Neendakara area is a virgin ground. The main prospects are the availability of plenty of unused water area. The problem of water contamination in this area is the result of widespread practice of coconut husk retting which produces lot of hydrogen-sulphide and high rate of oxygen demand. These areas have to be avoided when the question of site selection is considered. Although, other species are available, considering the demand and monetory returns, *P. indicus* can be given priority in prawn farming. Availability of plenty of seeds in the area makes the task easy for the farmers in collecting adequate number of seeds. Neendakara is one of the main marketing centres for seafood in the State. This added facility for preservation and marketing the harvest is of great advantage to the farmers in this area.

Quilon is one among the very few districts in the State bestowed with the benefit of having financing agencies like Small Farmers Development Agency (SFDA) and Integrated Rural Development Programme (IRDP) which give subsidised loans to agricultural farmers on easy repayment instalments. Considering the awareness among the people of the potentialities of aquaculture, of late, these agencies have come forward to help the fish farmers with financial assistance. The SFDA has already drawn up a scheme (involving Rs. two lakhs at the first stage) to take up prawn culture in the low lying coastal saline tract of Quilon District by the small and marginal farmers.

The encouraging results obtained on the growth rate of prawns during the present experiments proved beyond doubt that Ashtamudi Lake area is one where faster growth rate for prawns could be expected. Subsequent to the present study, several farmers have taken up prawn culture in this area and promising results are being reported. Besides, under the Lab-to-Land programme, the Central Marine Fisheries Research Institute has successfully carried out intensive prawn culture operations in the farms of 14 adopted farmers. Hence, the present attempt was successful in two spheres ; in identifying new areas for prawn culture as well as in popularising and transferring scientific know-how in mariculture.

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