

Traditional and Improved Traditional Shrimp Farming in the Pokkali Fields of Kerala

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Shrimp production from two traditional Pokkali fields (P1 and P2) were studied during 1996-97. In 1997-98, in addition to the two Pokkali fields (P1 and P3), improved traditional culture of *Penaeus monodon* conducted in another Pokkali field (P4) was also monitored. The Pokkali fields were additionally stocked with wild seed of *Penaeus indicus* over and above the autostocking process. *P. indicus*, *P. monodon*, *Metapenaeus dobsoni* and *M. monoceros* were represented in the catches of the four fields during the two years of observations.

The total shrimp catch was 5572.6 kg in P1 (14 ha) and 3311.15 kg in P2 (6.4 ha) during 1996-97, and the respective productions were 398.042 kg ha⁻¹ and 517.367 kg ha⁻¹, respectively in 1997-98; the total catch dropped to 1507 kg and production to 107.643 kg ha⁻¹ in P1. In P3 (2.2 ha) the catch and production recorded were 1352.5 kg and 614.773 kg ha⁻¹, respectively.

The field P4 (3.2 ha) was stocked with PL 20 of *P. monodon* @ 37500 per ha. In 90 days culture, the shrimps attained final size of 179.0 mm per 42.2g and recorded survival rate of 31.4%. The total quantity of 835 kg *P. monodon* obtained works out to a production rate of 260.938 kg per ha in 3 months.

Analysis of cost and returns of traditional shrimp farming *vis-a-vis* modified traditional shrimp culture revealed that while the farmer of field P3 incurred loss of Rs. 34,000.00 in 5 months of shrimp filtration, the farmer of field P4 received profit of Rs. 72,986.00 in 3 months from the culture of *P. monodon* in 1997-98. The advantages of improved traditional shrimp farming is discussed in relation to traditional shrimp filtration practice.

(Key words: Brackishwater shrimp farming, Traditional and improved farming in coastal and backwaters, Pokkali fields)

Traditional system of brackishwater aquaculture practised in the seasonal Pokkali fields and the perennial fields lying adjacent to the coastal and backwater areas of Kerala has a very long history. In these fields seed shrimps and fishes are allowed to enter through tidal water and then trapped. After short duration of growth, they were periodically harvested during full and new moon periods. A number of workers have described the different aspects of these filtration system (Panikkar, 1937, 1952, Menon, 1954, Gopinath, 1956, Kestevan and Job, 1957, Raman and Menon, 1963, George

et al., 1968, George, 1974, George, 1975, Gopalan *et al.*, 1980, 1982, Verghese *et al.*, 1982, Purushan, 1988, 1996, Pillai *et al.*, 1997, Pillai and Krishnan, 1998).

With the emphasis on production of quality shrimps which are in great demand for export and also fetch substantial income, farmers have, of late, realised the importance of culture of *Penaeus monodon* and *P. indicus* in the Pokkali fields. The prospects of culture of these species have been demonstrated by Anon. (1992, 1995), George *et al.* (1968), George (1975), Gopalan *et al.* (1980, 1982), Verghese *et al.* (1982) and Purushan (1988).

The present study was undertaken to understand the current status of shrimp production from selected seasonal pokkali fields and to demonstrate the potentialities of these fields in augmenting the production of quality shrimps like *P. monodon* during the normal filtration season itself and also its economic advantage over the traditional system.

MATERIALS AND METHODS

Traditional Pokkali fields

Three Pokkali fields located in Vypeen Island, Ernakulam District were selected for collection of data on various aspects of the biology and production of shrimps (Fig.1). The two fields selected for observations in 1996-97 were situated at Elamkunnappuzha (P1) and Nayarambalam (P2). While P1 is 14.0 ha in area, P2 is 6.4 ha only. In 1997-98, in addition to P1 another field (P3) at Edavanakkad having an area of 2.2 ha was also monitored. All these fields receive tidal waters from the Cochin backwater system.

In Pokkali fields, shrimp filtration is carried out from 15 November to 14 April. After repairs and strengthening the outer *bunds*, digging channels inside the field leading to the sluice pit and refixing the sluice, tidal water is allowed to enter into the fields twice a day during high tides by regulating the flow rate with the help of the shutter planks of the wooden sluice. During night, hurricane lights are fixed on the outer mouth of the sluice during water intake. Seed shrimps attracted by the light enter in large numbers into the field. Depending on the tidal level, flow rate and water depth of the field, water is let out for 30 minutes to one hour before the onset of the next high tide. At this time the sluice net is fixed on the inner mouth region of the sluice to prevent escape of the shrimps and fishes from the field. Harvesting is always done with sluice nets from the lunar phase commencing from the second quarter of December. This periodical harvest continues upto March and the final harvest is done by cast netting followed by hand picking of the shrimps.

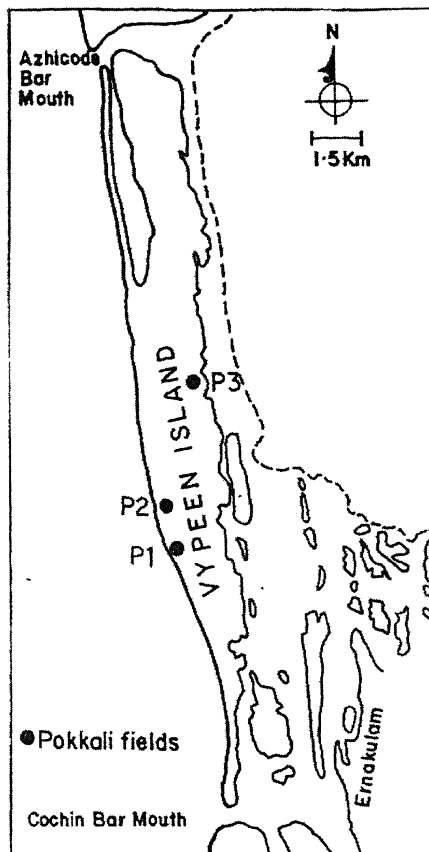


Fig. 1 Map of Vypeen Island showing location of Pokkali fields

The Pokkali fields are now-a-days additionally stocked with wild seed of *P. indicus* or hatchery seed of *P. monodon*, apart from the autostocking process. In 1996-97 season, P1 and P2 were additionally stocked with 5.0 lakhs and 8.5 lakhs, respectively with wild seed of *P. indicus*. In 1997-1998 P1 was supplementarily stocked with 5.0 lakhs wild *P. indicus* seed and P3 with 1.5 lakhs wild seed of *P. indicus* and 3000 nos PL 20 of *P. monodon* in addition to autostocking.

Samplings were carried out once in a fortnight from December to March. Catch data were obtained from the owners of the field during the field visits. Samples of *P. indicus*, *P. monodon*, *Metapenaeus dobsoni* and *M. monoceros* were analysed for their size distribution. Individual shrimps were measured from the tip of rostrum to the tip of telson for total length. For individual weight, a known quantity of shrimps was weighed and the average weight was then calculated.

Improved traditional culture

The 3.2 ha Pokkali field (P4) at Kottuvally was prepared for monoculture of *P. monodon*. This field has one wooden sluice for water exchange. Nearly 1/3 area of the field was deeper than the remaining part. The sluice pit has depth of 2.5 m. Both portions have been partitioned and connected by another wooden sluice to facilitate easy drainage of the field in a phased manner. The field was prepared by strengthening the outer *bund*, digging channels criss-crossing the field and also all along the inner periphery in its shallow portion for effective drainage and to provide deeper hiding places for the shrimps.

The field was prepared in December by reducing the water through sluice. By this method the shallow portion of the field was almost drained. In the deeper part, the water level was reduced by pumping. Eradication was then done with mohua cake @ 600 kg ha⁻¹. The next day, lime was applied @ 250

kg ha⁻¹. On the third day, water level was increased to 40cm. The water level was then raised to the maximum on the 10th day and the field was left undisturbed till stocking. By now rich plankton production was observed in the field.

Stocking was done on 1-1-1998 with 1.2 lakh PL 20 of *P. monodon*. The stocking density was 37,500 per ha. Feeding was done with Higashi PL for the initial 10 days and thereafter with starter for 20 days. Subsequently the shrimps were fed with clam meat @ 3% body weight, twice in a day. After 90 days culture, the shrimps were harvested by pumping out water and cast netting followed by hand picking.

Soil and water parameters of the fields were studied following standard analytical procedures (Jackson, 1967, APHA, 1971).

RESULTS

Traditional Pokkali fields

Species composition

The shrimp fishery of the Pokkali fields was largely contributed by four species of penaeids, *P. indicus*, *P. monodon*, *M. dobsoni* and *M. monoceros*.

Size composition

The size groups of the four species of shrimps cultured in the Pokkali fields are shown in Table 1. In P1, the size of *P. indicus* ranged from 62-128 mm in 1996-97 and 88-123 mm in 1997-98. In P2 and P3, the size

Table 1. Size range of shrimps from Pokkali fields during 1996-97 and 1997-98

Species	Size range in 1996-97 (mm)		Size range in 1997-98 (mm)	
	P1	P2	P1	P3
<i>P. indicus</i>	62 - 128	67 - 125	88 - 123	92 - 120
<i>P. monodon</i>	160 - 210	-	150 - 202	170 - 185
<i>M. dobsoni</i>	30 - 70	40 - 72	36 - 63	40 - 62
<i>M. monoceros</i>	65 - 97	68 - 100	60 - 88	60 - 85

Table 2. Catch, catch composition and production of shrimps from Pokkali fields during 1996-97

Species	P1 (14.0 ha) ¹			P2 (6.4 ha)		
	Catch (kg)	Catch composition (%)	Production (kg ha ⁻¹)	Catch (kg)	Catch composition (%)	Production (kg ha ⁻¹)
<i>P. indicus</i>	3287.70	59.0	234.835	1118.75	33.8	174.805
<i>P. monodon</i>	25.55	0.5	1.825	-	-	-
<i>M. dobsoni</i>	1595.85	28.6	113.989	1477.90	44.6	230.922
<i>M. monoceros</i>	663.50	11.9	47.393	714.50	21.6	111.640
Total	5572.60	100.0	398.042	3311.15	100.0	517.367

1. This field was studied during 1996-97 also

Table 3. Catch, catch composition and production of shrimps from Pokkali fields during 1997-98

Species	P1 (14.0 ha) ¹			P3 (2.2 ha)		
	Catch (kg)	Catch composition (%)	Production (kg ha ⁻¹)	Catch (kg)	Catch composition (%)	Production (kg ha ⁻¹)
<i>P. indicus</i>	463.0	30.7	33.071	367.0	27.1	166.818
<i>P. monodon</i>	4.0	0.3	0.286	22.5	1.7	10.227
<i>M. dobsoni</i>	571.0	37.9	40.786	771.0	57.0	350.455
<i>M. monoceros</i>	469.0	31.1	33.500	192.0	14.2	87.273
Total	1507.0	100.0	107.643	1352.5	100.0	614.773

1. This field was studied during 1996-97 also

varied from 67-125 mm and 92-120 mm, respectively. *P. monodon* was absent in P2, but available in few numbers in P1 and P3. It was found in the size range of 160-210 mm in 1996-97 and 150-202 mm in 1997-98 in P1. In P3, it showed size variation of 170-185 mm (Table 1).

The total length of *M. dobsoni* fluctuated from 30-70 mm and 36-63 mm in P1 during 1996-1997 and 1997-1998, respectively. In P2 and P3 they were noticed in the respective size range of 40-72 mm and 40-62 mm, respectively. In P1, while the size of *M. monoceros* varied from 65-97 mm in 1996-97, it was 60-88 mm in 1997-98. The size of this species was in the order of 68-100 mm in P2 and 60-85 mm in P3 (Table 1).

Catch, catch composition and production

Species-wise catch, catch composition and production of shrimps from P1 and P2 during 1996-97 are presented in Table 2 and that of P1 and P3 during 1997-98 in Table 3.

In P1, the total catch was 5572.6 kg in 1996-97. The major share (59%) was contributed by *P. indicus* followed by *M. dobsoni* (28.6%), *M. monoceros* (11.9%) and *P. Monodon* (0.5%) in their order of dominance. The production is 398.042 kg ha⁻¹ (Table 2). However, in 1997-98 the total catch dropped to 1507 kg in P1. The production was as low as 107.643 kg ha⁻¹. *M. dobsoni* dominated the catch (37.9%) followed by *M. monoceros* (31.1%) and *P. indicus* (30.7%). *P. monodon* contributed only 0.3% to the total catch (Table 3).

The total shrimp production from P2 was 3311.15 kg and the average production was 517.367 kg ha⁻¹. The fishery was dominated by *M. dobsoni* (44.6%). The next dominant species was *P. indicus* (33.8%) and then *M. Monoceros* (21.6%) (Table 2). In P3, the total catch was 1352.5 kg and it was largely contributed by *M. dobsoni* (57%). The shares of *P. indicus*, *M. monoceros* and *P. monodon* to the total fishery were 27.1%, 14.2% and 1.7%, respectively. The production was 614.773 kg ha⁻¹ (Table 3).

Improved traditional culture of *P. monodon*

The details of the culture of *P. monodon* in Kottuvally Pokkali field (P4) are given in Table 4. The shrimps registered faster growth and attained final size of 179 mm per 42.2g in 90 days of culture. The total quantity of 835 kg shrimps harvested from this field accounted a production of 260.938 kg ha⁻¹. The survival was 31.4%. However, all the harvested shrimps were in the grades of 20 to 30 counts. The percentage contribution of the harvested shrimps to the different grades were 20 counts - 46.3%, 23 counts - 29.6%, 25 counts - 16.2% and 30 counts - 7.9%.

Table 4. Details of *P. monodon* culture in the Kottuvally Pokkali fields (P4)

Area of the field (ha)	3.2
Date of stocking	1-1-1998
Stocking size	PL 20
Total seed stocked (nos)	1,20,000
Stocking density (no/ha)	37500
Date of harvest	31-3-1998
Total rearing period (days)	90
Final size (mm g ⁻¹)	179.0/42.2
Total quantity harvested (kg)	835.0
Production (kg/ha ⁻¹)	260.938
Survival (%)	31.4

During the culture period, the pond depth varied from 40-100 cm (Table 5). The salinity from 6.0 ppt at the time of stocking gradually increased to reach 15.0 ppt in March. Water was always alkaline. However, soil showed slight acidity initially (pH 6.8), but corrected to alkaline side by lime application (pH 7.8). DO was maintained above 3.0 ml l⁻¹ with effective water exchange mechanism. The soil was always found in reduced condition (Table 5).

Physico-chemical parameters of Pokkali fields

Water and soil parameters of the two Pokkali fields, P1 and P3 during 1997-1998 are presented in Table 5.

Both the fields were shallow and the depth varied from 40 to 90 cm. Soil and water of P1 and P3 were alkaline in nature. The salinity which was 7ppt at the beginning of the season raised to 20 ppt in P1 and 25 ppt in P3 by March. DO was very low in both the ponds indicating very poor water exchange and heavy microbial decomposition of organic wastes. Electrical conductivity was low at the start of the season and thereafter it increased to 10 dSm⁻¹ by March in both the fields (Table 5).

Economics of improved traditional and traditional farming of shrimps in Pokkali fields during 1997-1998.

The item-wise expenditure of capital and operational costs and the income from improved traditional culture of *P. monodon* carried out in Kottuvally field (P4) are presented in Table 6. During the culture, the farmer incurred total expenditure of Rs. 2,92,835.00 and obtained an income of Rs. 3,65,821.00. From this short duration culture, the farmer received net profit of Rs. 72,986.00 in 3 months.

The details of expenditure and income from traditional shrimp farming in Edavanakkad field (P3) are shown in Table 7. The total operational cost including the

Table 5. Physicochemical parameters of Pokkali fields during 1997-98

Parameter	Elamkunnappuzha (P1)	Edavanakkad (P3)	Kottuvally (P4)
Water			
Depth (cm)	40.0 - 90.0	40.0 - 80.0	40.0 - 100
Transparency (cm)	27.0 - 45.0	Clear	Nil - 46.5
Temperature (°C)	32.0 - 34.0	29.0 - 31.0	30.0 - 35.0
pH	7.0 - 7.4	7.0 - 7.8	7.2 - 7.8
Salinity (ppt)	7.0 - 20.0	7.0 - 25.0	6.0 - 15.0
DO (ml l ⁻¹)	2.8 - 4.0	2.0 - 3.0	3.0 - 4.2
Soil			
Temperature (°C)	31.0 - 32.0	29.0 - 30.0	32.0 - 34.0
pH	7.0 - 7.8	7.0 - 7.8	6.8 - 7.8
Redox potential (mV)	-20 to -31	-30 to -90	-46.5 to -60.0
Electrical conductivity (dSm ⁻¹)	3.0 - 10.0	4.1 - 10.0	5.2 - 9.0

cost of seed additionally stocked in the field was Rs. 1,34,900.00. The total earnings from this operation was Rs. 1,00,900.00 and the farmer incurred net loss of Rs. 34,000.00 in 5 months.

DISCUSSION

The spectrum of shrimp species which constitute the fishery of Pokkali fields were *P. indicus*, *M. dobsoni*, *M. monoceros* and *P. monodon*. The size composition of these species vary from catch to catch due to their constant immigration and regular fishing, and thereby making it difficult to estimate their growth rate from these fields. Percentage composition of the four species revealed that while *P. indicus* showed declining trend in P1 during the two seasons of study, *M. dobsoni* and *M. monoceros* increased their contribution to the fishery during the same period (Tables 2 and 3). This may be due to poor recruitment of *P. indicus* compared to the other two species. A similar trend was noticed in P3 also wherein the fishery was mainly supported by *M. dobsoni* (Table 3).

George (1974) reported declining trend of the fishery of *M. dobsoni* and *M. monoceros* and the increased contribution of *P. indicus*

in Pokkali fields. Studies conducted by Pillai *et al.* (1997) indicated the dominance of *P. indicus* over *M. dobsoni* in a Pokkali field. George *et al.* (1968), George (1974) and George (1975) stated that more than 50% of the catch has been represented by *M. dobsoni*. A gradual shift from this trend has been noticed in the catches as the practice of supplementary stocking of the Pokkali fields with *P. indicus* seed caught up with the farmers in the late 1980s. At present more than 95% of the Pokkali fields of Vypeen Island have been additionally stocked with either wild or hatchery seed of *P. indicus* and to a limited scale with *P. monodon* (personal observations). The increased catch of *P. indicus* noticed during 1996-1997 in P1 and P2 in the present study may be due to the additional stocking of *P. indicus*. However, in P1 and P3, irrespective of supplementary stocking, the yield of *P. indicus* was less during 1997-98. A general survey conducted in Vypeen island revealed that production of *P. indicus* was low in majority of the fields during 1997-98.

Wide variations in the production of shrimps from Pokkali fields were observed during the two seasons. The average shrimp production of 398.042 kg ha⁻¹ registered in

Table 7. Details of expenditure and income of shrimp filtration in Edavanakkad Pokkali field - P3 (2.2ha)

A. Operational cost	B. Income	C. Profit/Loss
1. Lease amount	Rs. 1,00,000.00	
2. Watchmen shed	3,000.00	22,929.00
3. Labour charges for sluice erection, bund repairs, digging channels, etc.	8,000.00	Loss : Rs 34,000.00
4. Fuel charges	1,400.00	74,878.00
5. Cost of <i>P. monodon</i> @ Rs. 500 per 1000 PL 20 for 3000 seed Cost of 1.5 lakh wild seed of <i>P. indicus</i> @ Rs. 40 per 1000 nos	1,500.00 6,000.00	600.00 2,493.00
6. Wages for a watchman @ Rs. 2000 per month for 5 months	10,000.00	
7. Miscellaneous cost	5,000.00	
Total	Rs. 1,34,900.00	Rs. 1,00,900.00
		Rs. 34,000.00

P1 during 1996-97 dropped to a low of 107.643 kg ha⁻¹ in 1997-98. The productions recorded for P2 and P3 were 517.367 kg ha⁻¹ and 614.773 kg ha⁻¹, respectively. The relative poor production noticed in P1 may be due to less recruitment of seed shrimps since this field is located much away from the main backwater system compared to P2 and P3. Pillai *et al.* (1997) have stated that shrimp production in Pokkali fields from a level of 1100 kg ha⁻¹ in 1950s has dropped to 500-800 kg ha⁻¹ in 1970s and declined further to 350-500 kg ha⁻¹ in 1990s. The different production rates reported from Pokkali fields by the earlier workers were 1079 kg ha⁻¹ (Menon, 1954); 1184 kg ha⁻¹ (Gopinath, 1956), 574 kg ha⁻¹ (George *et al.*, 1968), 903 kg ha⁻¹ (George, 1974), 784 kg ha⁻¹ (Gopalan *et al.*, 1980), 968 kg ha⁻¹ (Purushan, 1988) and 353.8 kg ha⁻¹ (Pillai *et al.*, 1997). Inadequate recruitment of seed shrimps, low saline conditions extending upto January, siltation of the fields and canal systems, indiscriminate collection of seed shrimps, over-exploitation of the marine and backwater fishery, etc. might have resulted in low production of shrimps from Pokkali fields.

Culture of *P. monodon* in Pokkali fields has shown promising results. Although the production obtained was only 260.938 kg ha⁻¹ from improved traditional culture of this species in P4, all the harvested shrimps were in the grades of 20 to 30 counts. The species registered faster growth to attain 179 mm per 42.2 g in 3 months. The monthly growth rate of 59.6 mm recorded in the present study was much greater than the growth rates of 39.6 mm, 40.6 mm and 41.0 mm reported by Chakraborti *et al.* (1986) from three tide-fed ponds in lower Sundarbans area of West Bengal. Sevastian *et al.* (1978) reported a growth rate of 38.4 mm per month from a perennial field. From a tide-fed pond, Sundararajan *et al.* (1979) observed monthly growth rate of 47.7 mm.

In the present observation, *P. monodon* attained final weight of 42.2 g in 90 days. Thampy *et al.* (1998) recorded 30.0 g in 72 days for this species from a mixed culture experiment conducted in a perennial field. From a perennial field at Narakkal, this species reached 30.0 g in 120 days (Anon., 1995). The relative fast growth registered by this species in Pokkali fields suggests its suitability as a candidate species in monoculture operations in these fields.

A comparison of the economics of traditional shrimp farming and improved culture of *P. monodon* in Pokkali fields conducted during 1997-98 revealed that even with the modest production of 835 kg obtained from 3.2 ha area, net return of Rs. 72,986.00 could be realised from this short term culture. Although the farmer of P3 lost Rs. 34000.00 from the filtration field, the profit margin from traditional shrimp culture is always governed by the success or failure of the fishery of one species, namely *P. indicus*. This is clearly evident from the catch data of this species in P1 and P3 (Table 3). The main motivating factor for additional stocking of the Pokkali fields with *P. indicus* seed is nothing but the aim to fetch more returns from this seasonal avocation.

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