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Economics of Prawn Culture in Vypeen, Kerala, with Emphasis on Some Little-known Facts

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Prawn culture in the seasonal and perennial fields of Vypeen in Kerala, famous for their productivity, is practised even today by the age-old method of filtration except for resorting to occasional selective stocking in low density and providing supplementary artificial feed. An economic analysis of the perennial fields is made in this paper with due consideration to hitherto unaccounted loss by predation and diseases such as soft prawn. Softness in prawns reduces its price. Problems faced by the farmers and suggestions to overcome them are given.

With the increasing demand for prawns in export market, extensive culture practices have given way to semi-intensive or intensive systems in many parts of the country. The perennial and most of the seasonal ponds of Vypeen Island near Kochi are still of extensive nature with little or no management. Although, some studies on economics of prawn farming in seasonal ponds are available (George, 1974, 1980; Purushan, 1987; Sathiadhas *et al.*, 1989), such information on the perennial fields is almost lacking. Diseases, parasites, predators and competitors cause concern in culture systems (Shang, 1981). Yet, it seems to be ignored in economic analysis except on a very few occasions, as for instance by Mammen *et al.* (1980) and Beynon *et al.* (1981). The present paper, therefore, reports the economics of the perennial prawn culture fields in Vypeen pointing out what harm predation and disease cause in production. Some observations on the seasonal system are also made for comparison.

Ownership

The prawn and fish culture practices in the perennial and seasonal ponds of Vypeen Island are well known. While small holdings belong to single individuals, larger ones (generally 4 ha and above) are owned by groups of people forming a *samajam*. For example, two perennial ponds (Ponds A and B) selected for

the study, at Edavanakad where most of such ponds exist, belonged respectively to 80 persons with holdings that range between 0.12 and 6.00 ha per head and 30 persons from 0.04 to 0.80 ha. A seasonal pond (Pond C) also included in this investigation for comparison was owned by a family of 5. The members of a *samajam* meet once a year and nominate a President, Secretary and Treasurer by consensus from among themselves as the Executive Committee to auction the pond, attend to annual maintenance and formally hand the pond over to the highest bidder, known as "contractor". The contractors are also groups of usually 8 to 10 persons who take up the culture operation and divide the income equally. But in the case of larger fields like Pond A, two of them are selected as managers and paid additional monthly salary. With respect to Pond B, where the area is less, the management was entrusted to a foreman whose normal duty was to arrange the watch and ward, supervise the workers and monitor the catch.

Immediately after the auction, the executive committee and the contractors inspect the pond, assess the condition of dykes and sluices, and jointly attend to repairs before handing over. Maintenance after handing over has to be met fully by the contractors. During the tenure of lease, the *samajam* will have no right on the pond. The lease amount is divided among members of the *samajam* proportionate to the area of their holdings. In a year, when the bid falls short of expectation, culture operations are undertaken by a group of 7 to 10 members of the *samajam* itself by offering a price reasonably above the bid but within the limits. If the owners themselves undertake culture operations in the following year/ years also, the responsibility is offered to different groups in the *samajam* even if they quote less, as a gesture to inculcate active participation as well as to gain experience in farming.

The lease in the case of Pond A is for a year starting from 1 November to 30 October and for Pond B for 11 months from 10 July to 10 June. In seasonal ponds, the lease is for a period of 5 months from 15 November to 15 April, as these fields are used for paddy cultivation at other times by the owners.

General Characteristics

Though majority of perennial ponds are on the seaward side of the island, they have connections only to the Kochi Backwaters on the eastern side through a system of canals by which seed enter the ponds. Wild stocking at high tide and harvesting at low tide are continuous processes that take place depending on the tide. In recent years, supplementary stocking of seed at an annual rate of 1,500 to 2,000 no./ha is practised if and when the natural stock is found deficient, subject to availability of seed from other areas. Seed are generally collected from the upper reaches of the backwater system, where the culture practices are not prevalent on a large scale due to influence of freshwater. Harvesting of seed from feeder canals and backwaters at Vypeen itself is not allowed as it is feared to deplete chances of natural stocking.

On occassions when growth is less than that expected, supplementary feeding with groundnut oil cake is resorted to. In the case of Pond B, one month holiday is allowed for growth and replenishment of stock by restricting the lease period to 11 months. During this month, while incursion of seed is facilitated, no harvest is carried out. This is to the advantage of the owner to bargain for higher price at the auction.

Pond A with water area of 54.8 ha is the biggest of the perennial fields here. The area of Pond B is 12.4 ha and that of Pond C, 17.6 ha. In perennial ponds, apart from regular filtration at the sluice, periodic harvests known as *veechel* are carried out, which in the case of Pond A occurs in the months of March, July and October and in Pond B in October and April. In *veechel,* around 100-200 small canoes, each having a minimum of two men, fish using cast nets, drift nets and drag nets. In spite of this, the regular harvest at the sluice gate continues from the very next day. In Pond C, towards the end of the lease, a total harvest known as *kettukalakkal* is invariably done. *Kettukalakkal,* like *veechel,* also

involves cast net, drift net and drag net operations, but includes subsequent hand picking known as *thappal* and *kalakkal* by women making the water muddy and causing the fish and prawn to surface from where they are sieved. Care is taken to have the *kettukalakkal* well before the expiry of lease for fear of mass invasion for plunder by local people. Though watch and ward are strengthened in the last leg of the lease, this invasion cannot be prevented. Though the field is open for gleaning by public after the lease period, this advantage is misused by trespassing in advance. On the day of *veechel*, apart from the regular and casual labourers, 30-100 persons are employed on special duty to ensure that no pilfering of the catch takes place.

The contractors suggest *veechel* when large sized prawns in good quantities are available in regular harvest. It is also done when calamities threaten. For instance, in Pond A, *veechel* was recommended in the first week of July 1991 as high incidence of soft prawn was noticed. But it could take place only in the third week, resulting in 77% reduction in catch on account of the delay in fixing a day for *veechel*. The following reasons are found to hinder the decision regarding a date. The fishermen engaged in *veechel* invariably belong to a trade union and in a pond as in the case of Pond A, where more than one union were involved, it was difficult to get their representatives together at a time convenient to all. The existing conventions do not permit any union to be left out in the process. The fishermen are paid during *veechel* on the weight of prawn caught irrespective of the species involved. As the rates are fixed on prevailing market price, the union delays *veechel* for a time when it is high. There can also be loss of time in coming to a compromise between the contractors and the union representatives during bargain for a reasonable rate. Once the date is fixed, the contractors supply entry coupons to the representatives of the unions for distribution among the members. Only the coupon holders have the right to fish in the pond. The catch by each canoe is handed over to respective union representatives who deliver it to the contractor after proper accounting for the price already agreed upon. The money realised is distributed among the concerned fishermen depending on the quantity caught by them. The fish caught, on the other hand, is auctioned by the union itself and the proceeds are shared equally between the contractor and the fishermen.

The contractors and owners are also interested in getting high prices for prawns, for the former gets better return on investment and the latter a higher stake for the next auction. But they have the anxiety of losing a good catch by natural calamities as already stated, if the harvesting is not done in time. In *kettukalakkal*, the marketing men, on the other hand, cooperate with the contractors on account of impending invasion, for if it happens both stand to lose.

Economics

Expenditure

An account of the annual total expenditure incurred for the 3 ponds is presented in Table 1. In all the ponds, the lease amount is the major item. Converted into per hectare, it works out to Rs 8,017 for Pond A, Rs 24,464 for Pond B and Rs 12,500 for Pond C, and its percentage in total expenditure (Table 2) was very high. Next to this were the labour charges and wages. Labour charges were mainly for fixing of sluices and maintenance of dykes and also for other odd jobs. Watchmen, the sluice net operator and foreman were paid monthly salary. In the case of Pond A, they were eligible for benefits of provident fund and bonus also. In periodic harvesting, cost on *veechel* came next with respect to perennial ponds. For *kettukalakkal* in seasonal ponds, it was slightly more than the charges on labour and wages. The material costs in all the ponds compared to other items was the least (Table 1). Total expenditure computed per hectare was the highest with Rs 39,018 in Pond B. In Ponds A and C, it was almost equal, but was not comparable because the time involved in Pond A was one full year against just 5 months in Pond C.

Income

The harvested prawns were sold at the farm-gate on existing prices. Fishes such as *Tachysurus maculatus* occurring in daily harvests were also sold at market rates. On the other hand, fish such as *Elops* sp., *Megalops* sp., mullets, *Lates* sp., *Epinephelus* sp., rays, *Sillago* sp., *Anabas* sp. and sciaenids were auctioned. The income from the three ponds from sale proceeds are given in Table 3.

Profit

Expenses other than investment on lease, payment of licence fee and purchase of non-consumables were met from income arising out of daily harvest. The above initial investments were met either from own resources or by way of loan. Accordingly, 14% interest in the case of the former and 18% in the latter were also accounted towards expenditure. The profit rates calculated by taking these into consideration are given in Table 4.

The income was calculated accounting for the loss due to soft prawn syndrome. The presence of predatory fishes in large number in the perennial pond greatly reduced the prawn catch. The extent of predation by these fishes was difficult to quantify. Observations on the gut contents of the major predators indicated a minimum loss of 8% of the total prawn catch. Estimated loss due to frogs was about 2%.

Discussion

Prawn production per hectare per month was higher in seasonal than in perennial ponds (Table 6). Absence of predatory fishes and rare occurrence of soft prawn disease in seasonal fields add to its high production. According to Menon (1954) it is also due to the rich organic matter left behind as paddy stumps after harvest. This emphasises the need for supplementary feeding in perennial ponds. At present, feeding is rarely carried out and even if attempted, no schedule is followed. Dietary manipulations, in fact, is one of the recommendations to overcome soft prawn problem (Purushan and Rajendran, 1984; Baticados *et al.*, 1986). Soni (1986) while studying the soft prawn syndrome at Vypeen attributed it to adverse ecological conditions and stated that it often results in considerable material and economic loss to the farmers. As mentioned earlier, soft prawns fetch a lower price. Random samples examined from Pond A during June-July of the years under observation showed occurrence of 150 to 375 g of soft prawn in a kilogramme as against the accepted level of 75 g. Kwei Lin (1989) attributed the collapse of prawn culture industry in Taiwan to virulent diseases arising from ecosystem mismanagement. Although ecological studies of prawn culture fields of Kochi area have received wide attention (Sankaranarayanan *et al.*, 1982; Gopinathan *et al.*, 1982; Nasser, 1986; Nair *et al.*, 1988), how it could be related to overcome diseases and resultant losses needs consideration.

Traditional practice has rightly been called as filtration (George *et al.*, 1968) rather than culture as it does not involve selective stocking. In this system, prawn seed from wild are allowed to enter the ponds at high tide and get naturally stocked. Gathering seed from backwaters for stocking in ponds is costly. As a result, selective stocking is limited and there are no hatcheries nearby to supply seed. The farmers are ready to set up hatcheries either as joint venture or as small-scale backyard units if technology is provided. Selective stocking of seed of prawns which fetch high prices together with supplementary feeding will augment production from perennial ponds.

In scientific system, eradication of predators is recommended before stocking. *Veechel* to an extent helps elimination of predators. As weeding out is impractical in perennial ponds, menace by predators is unavoidable. At present, in selective stocking, seed is released directly into the pond. Hatchery-bred

seed and to an extent those that are collected from the wild are smaller in size than the ones which enter the ponds on their own. They, hence, suffer heavy mortalities. If nursery facilities are provided, as recommended by Unnithan (1985) and Kungvankij *et al.* (1986) survival rate will increase. In natural stocking, along with prawn seed, eggs and larvae of predatory fishes also enter the ponds. According to Djajadiredja (1957), tiny larvae of *Elops* sp., *Megalops* sp., *Lates* sp. and *Therapon* spp. squeeze through the filtering screens and gain entry. Pillai (1972) in his review on the important pests and predators in coastal aquaculture systems of the Indo-Pacific Region, listed reptiles, birds and mammals along with a number of predatory fishes and discussed common methods for their control. In Ponds A and B, apart from the predators among quality fishes, freshwater snakehead was also observed in good numbers. Frogs inhabiting the dykes, especially along the canals leading to sluices, too feed on the prawns. Frogs as predators in nursery ponds were mentioned by Pillay (1990). Some of the frogs examined from Pond B in fact had as many as 4 medium sized prawns in their alimentary canals. If frog menace is eradicated, the prawn catch may go up by 2%.

In the seasonal ponds there was predation by both resident and migratory birds. Mammen *et al.* (1980) explained the negative returns from a pond in Kochi area due to the low water level and consequent predation by cranes. Beynon *et al.* (1981) reported from Texas a 75% decrease in prawn production due to gulls. In Pond C when the predation was high, the birds were driven away by rattling empty tins. South of Vypeen, they are scared off by the sound made by wind on fine nylon monofilaments tightly tied across poles erected along the periphery of the pond. This can be tried at Vypeen also.

Among mammals, otters are the most destructive predators and they kill much more than they can actually eat (Pillai, 1972). Predation by otters, although reported to have been a problem in ponds here in the past, was not noticed during the present study. Similarly, predation by snakes also was virtually nil. Possibly, the increase in human habitation and better lighting facilities have driven them off.

Another important problem in culture ponds is the invasion by clams. A cursory survey in Pond A indicated 20 clams of 30-35 mm size in a square metre. In the case of "baby clams" of 15-25 mm size, this number may be as high as 1,500/m2. According to the farmers, the invasion at present is not high. This may be true as Saji Chacko (1987) studying the occurrence of clams in prawn culture fields at Vypeen reported 224 numbers of the bigger sizes. In one case, it was told by farmers that 11 t of clams were gathered from a 0.6 ha pond in 1986. The feeling of farmers that clams affect prawn culture is also corroborated by Saji Chacko's (1987) finding that it retards the growth of prawn. Invasion by clams, like predators, cannot be avoided. However, the farmers while weeding them out make an income when large quantities are present by selling the shells for which there is demand. In clam infested fields, both farmers and experts feel that the size prawns attain is less than those growing in clam-free ponds. Biologically, though there appears to be no direct competition between prawns and clams for food, the eddy each clam creates with siphons while feeding, denies the prawns a calm substratum to hunt for their food and also a resting place especially during moulting. Over and above the retardation of growth and forced postponement of moulting, it causes to an extent mortality of the moulted ones also. However, these aspects should be worked out and scientifically proved.

The system of *samajam* in the perennial ponds is of advantage to the owners in preventing the contractors from underquoting the lease amounts in a year and exploiting them. This system, therefore, can be recommended for other fields under joint ownership in areas such as Kaithara near Vypeen where it is not practised. At Kaithara, the owners are individually approached by contractors and confidentially fix the lease amount. As a result its rate in the same pond varies from person to person. Consequently, cooperation and coordination among the owners are lacking. Also, absence of concensus among them hampers opportunity to undertake culture by themselves.

The rights resting with the union of fishermen and the delaying tactics they adopt in fixing a day for *veechel* result in loss of prawns in the field. The owners, as also the contractors, therefore, feel that they should have the onus of selecting the day for *veechel*. The loss in prawns is a loss to the nation. Therefore, the Government should intervene and impose policy regarding the fixing of date for *veechel* at the right time to prevent loss.

Table 6 gives the summary of the economics worked out for prawn culture in Vypeen Island. While George (1974) obtained a very high return on expenditure, Gopalan *et al.* (1980) found the traditional culture practice a loss. The price of prawn has shown an increasing trend over the years, but it is comparatively low when the catch is dominated (75.4% in Pond C) by less priced species such as *Metapenaeus dobsoni.* George (1980) reported 61.2% of *M. dobsoni* in the catch, while Sathiadhas *et al.* (1989) recorded 62.9%. This explains the low price per kilogramme of prawn in Pond C, and in the studies by George (1980) and Sathiadhas *et al.* (1989).

The declining prawn fishery and the need for culture in our vast potential areas have recieved wide attention (Verghese, 1980; Sakthivel, 1985; Noble, 1990). Further, the advantages of converting extensive systems into semi-intensive ones have also been highlighted (Anonymous, 1978; Mammen *et al.*, 1980; Gopalan *et al.*, 1980; Hirasawa, 1985, Felx and Jegatheesan, 1988; Purushan, 1989). Factor-product relationship studies in prawn culture (Chiang *et al.*, 1986; Ajith Kumar, 1990) also indicate that a more manageable system is better in increasing production. Despite owners' high rate of income on investment, overall prawn production in perennial and seasonal ponds is low when compared to semi-intensive system. Production per hectare per month is high in seasonal ponds than in perennial system (Table 6). Converting the extensive systems into smaller semi-intensive ones, though costly, will add to the economy of the country by increasing the overall prawn production and providing employment opportunities. But semi-intensive system means much higher investment and operational cost (Surendran *et al.*, 1991). In extensive system, the natural exchange of water by tidal amplitude is enough. Stocking of seed and supplementary feeding in semi-intensive system will require water exchange more frequently. This requires periodic pumping of water. The owners and contractors are not in favour of converting their fields as returns on investment are not commensurate with the existing system. Srivastava *et al.* (1983) while comparing the different systems of culture observed that the return on investment in filtration is higher (72.5%) than that in extensive (40.5%) and intensive (15.2%) culture practices. The ponds in the present study, as regular harvesting by filtration was also involved, can be compared only with the filtration system mentioned by Srivastava *et al.* (1983) in which case the returns were not as high as reported by them. As the tendency to migrate back from the pond is observed only at harvestable sizes, undersized prawns generally do not get filtered. Moreover, the farmers appear to resort to partial stocking and hence these ponds are comparable to the extensive culture system mentioned by Srivastava *et al.* (1983). The rate of return on investment from these ponds are comparable with their findings for the extensive system. As they have stated in the case of converting filter fields into intensive culture systems, any effort to motivate extensive field owners to take up even semi-intensive culture is not likely to succeed. This, therefore, has to be handled at the level of cooperatives with aid from the Government.

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Table I. Annual expenditure (Rs) on culture ponds

	Perennial		Seasonal
	Pond A	Pond B	Pond C
Lease amount	739,333	303,334	220,000
.Operational cost			
Licence fee	10,482	465	660
Cost of non-consumables			
Coconut tree used as piles at sluice	4,500	900	--
Shed for watchmen, and its maintenance and repair	27,000	3,500	3,000
Canoes	12,000	4,500	--
Weighing balance	300	--	--
Cycle	700	--	--
Torch	2,000	500	500
Petromax lanterns and lamps	5,100	288	750
Cost of consumables			
Harvesting nets	7,500	2,500	4,500
Inlet nets	2,250	750	--
Net frame	600	300	--
Nylon screen	1,500	800	1,500
Kerosene	6,840	855	925
Battery	6,000	1,900	1,000
Raincoat, gumboots, gloves, umbrellas and towels for watchmen	1,700	875	--
Feed	--	1,000	--
Seed	46,250	5,000	--
Hire charges for harvest boats	12,000	3,000	4,500
Miscellaneous	--	--	645
Labour charges and wages			
Fixing of sluice and maintenance of dykes	20,000	4,800	6,880
Salary to watchman	108,000	54,000	21,000
Salary to lady workers	11,700	--	--
Salary to foreman	8,400	10,200	--
Salary to manager	24,000	--	--
Salary to sluice net operator	7,800	10,200	4,000
Wages for non-permanent staff	42,000	9,750	--
Provident fund and bonus to permanent staff	25,476	--	--
Cost of periodic/total harvest			
Harvest charges	165,250	63,360	34,800
Hire of persons on special duty	4,500	1,050	--
Total	1,003,181	483,827	304,660
Expenditure/ha	18,306	39,018	17,310

Table 2. Percentage contribution of expenditure under major heads

	Lease amount	Other operational cost	Labour and wages	Periodic/total harvest
Pond A	44	14	25	17
Pond B	63	6	18	13
Pond C	72	6	11	11

Table 3. Income from culture ponds

Item	Pond A		Pond B		Pond C	
	Quantity (kg)	Value (Rs)	Quantity (Kg)	Value (Rs)	Quantity (Kg)	Value (Rs)
Sale from regular harvest						
Penaeus indicus @ Rs 65/kg	8,872	576,680	4,356	283,140	1,700	110,500
Soft *P. indicus* @ Rs 52/kg	1,621	84,292	558	29,016	--	--
Metapenaeus dobsoni @ Rs 18/kg	8,431	151,758	3,956	71,208	9,500	171,000
Penaeus monodon @ Rs 150/kg	180	27,000	97	14,550	--	--
Fishes @ Rs 10/kg	600	6,000	180	1,800	--	--
Sale from periodic/complete harvest						
P. indicus @ Rs 65/kg	4,600	299,000	2,276	147,940	1,500	97,500
Soft *P. indicus* @ Rs 52/kg	750	39,000	324	16,848	--	--
M. dobsoni @ Rs 18/kg	400	7,200	--	--	300	5,400
P. monodon @ Rs 150/kg	100	15,000	40	6,000	--	--
Fishes @ Rs 20/kg	500	10,000	200	4,000	--	--
Total	26,054	1,215,930	11,987	574,502	13,000	384,400
Prawn production	24,954	1,199,930	11,607	568,702	13,000	384,400
Gross income/ha	--	22,189	--	46,331	--	21,841

Table 4. Return on initial investment

	Pond A	Pond B	Pond C
Lease amount (Rs)	439,333	303,334	220,000
Operational cost (Rs)	146,722	27,133	17,980
Total initial investment (Rs)	586,055	330,467	237,980
Total annual expenditure (Rs)	1,003,181	484,827	304,660
Gross income (Rs)	1,215,930	574,502	384,400
Net income (Rs)	212,749	90,675	79,740
ROI assuming that other expenses are met from the daily sale of catch (%)	36.3	27.4	33.5
ROI after deducting interest @ 14% (%)	22.2	13.4	19.5
ROI if initial investment is a loan and repaid @ 18% interest (%)	18.3	9.4	15.5

ROI - Return on total initial investment

Table 5. Anticipated income and profit in perennial ponds when loss due to predation and soft prawn is not accounted

	Pond A	Pond B
Total initial investment (Rs)	586,055	330,467
Gross income (Rs)	1,346,553	632,408
Total annual expenditure (Rs)	1,003,181	483,827
Net income (Rs)	343,372	148,581
ROI assuming that other expenses are met from the daily sale of catch (%)	58.6	45.0
ROI after deducting interest @ 14% (%)	44.6	31.0
ROI if initial investment is a loan and repaid @ 18% interest (%)	40.6	27.0

Table 6. Comparative statement on expenditure, income, profit, prawn production and price in culture ponds in Vypeen Island

Location	Area (ha)	Culture Period (mo)	Expenditure /ha (Rs)	Gross income/ ha (Rs)	Profit on expenditure (%)	Prawn production/ ha (kg)	Price of prawn (Rs/kg)	Reference
Edavanakad	60.70	12	14,474	2,871	95.0	811	3.54	George, 1974
			(123)	(239)		(68)		
Edavanakad	54.80	12	18,306	22,189	21.2	455	48.87	Present study
			(1,526)	(1,849)		(38)		
Edavanakad	12.40	12	39,018	46,331	18.7	936	49.50	Present study
			(3,252)	(3,861)		(78)		
Vypeen	16.00	5	6,238	6,889	10.4	735	9.36	George, 1980
			(1,248)	(1,379)		(147)		
Narakkal	3.03	5	8,074	6,665	--	638	10.45	Gopalan *et al.*, 1980
			(1,615)	(1,333)		(128)		
Narakkal	8.00	5	16,520	17,675.	7.0	665	26.58	Purushan, 1987
			(3,304)	(3,535)		(133)		
Vypeen	84.21	5	5,461	7,423	35.9	591	12.56	Sathiadhas *et al.*, 1989
			(1,092)	(1,485)		(118)		
Edavanakad	17.60	5	17,310	21,841	26.2	739	29.56	Present study
			(3,462)	(4,368)		(148		

Figures in parentheses indicate values/ha/mo.