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A Traditional Rice-Prawn Rotation Culture System from Kerala state, India

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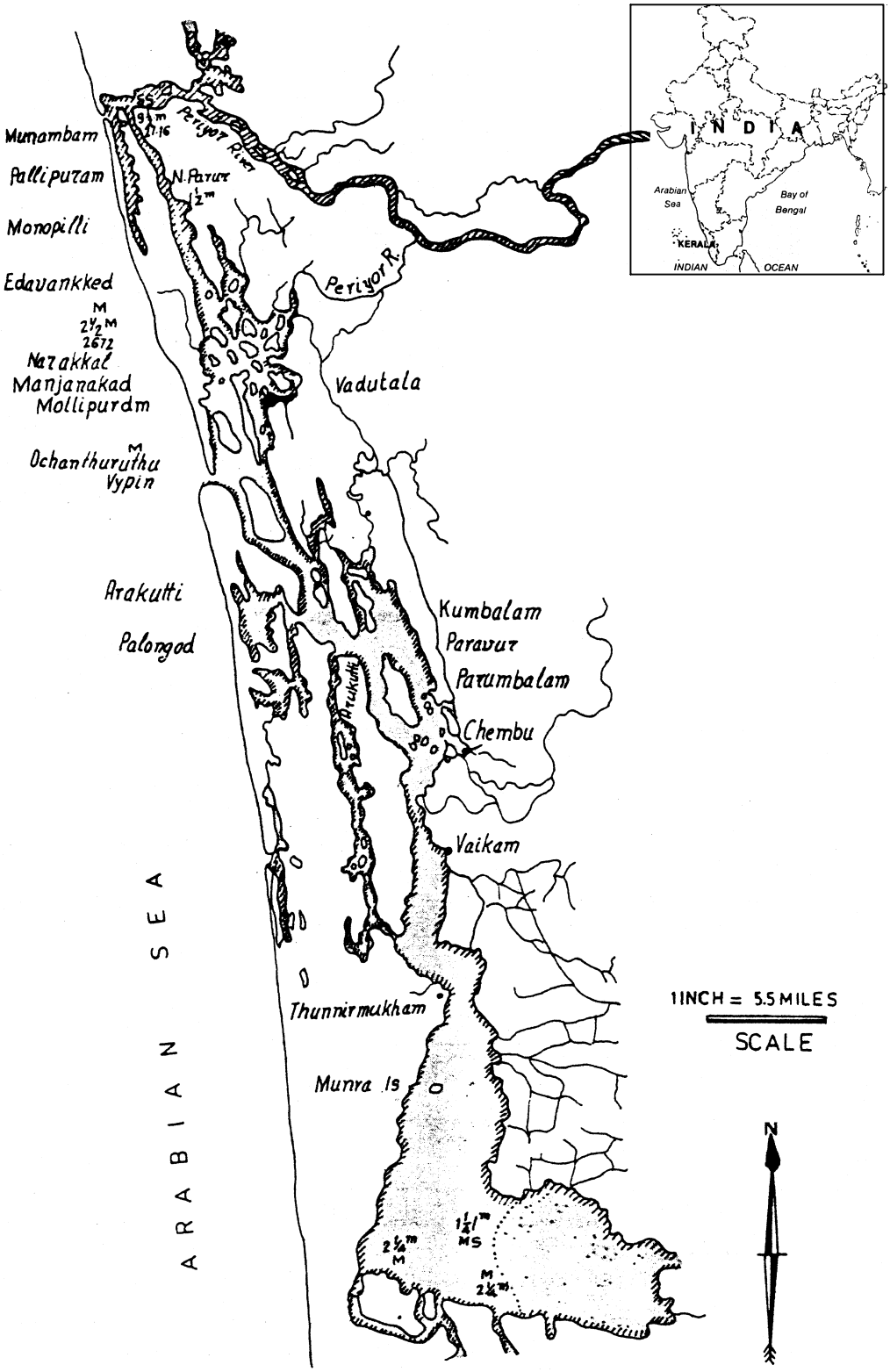
Abstract
A traditional method in which rice-prawn rotation culture is practised in low lying paddy fields surrounding the Vembanad estuary in the south-western coast of India is described. A long stemmed salinity tolerant variety of rice is cultivated from June to September. During harvest most of the straw is left in the field. The fields are then leased out to prawn farmers for a period of 5 months from mid-November to mid-April next year. Prawn larvae coming in from the sea, probably attracted by the comparatively lower salinity and the plentiful availability of food in the fields, are trapped. Harvesting starts from about mid December and continues till the middle of April. Prawns form about 80% of the catch. This system continues to survive and be profitable even with the generally declining trend in rice cultivation in Kerala state. A thorough study into the various aspects of the production dynamics of this unique and highly efficient culture system could provide valuable information; particularly for other regions with similar conditions.

Keywords: Rice-prawn rotation culture, efficiency

1. Introduction

'Prawn filtration' is a traditional method in which rice-prawn rotation culture practised in low lying paddy fields surrounding the Vembanad estuary in the south western coast of India (figure 1). This system is practised in an approximate area of 4,500 hectares. The size of individual farms vary from less than 0.5 ha to more than 10 ha (George, 1983). These low lying paddy fields are confluent with the Vembanad lake through canals and are subjected to tidal influence. The farming system involves entrapment of juvenile prawns brought in by the tidal water into the fields after the rice harvest, allowing them to grow there and catching them by 'filtration' at regular intervals.

Figure 1. The Vembanad backwater system around which the low lying fields where rice – prawn rotation culture is practised



2. Culture practise

2. 1 *Rice cultivation*

During the rainy season (June to September) the south west monsoon brings fresh water into these fields making them almost salt free. A long stemmed verity of rice ('Pokkali') which can tolerate salinity of up to 6 – 8 ppt and is highly disease resistant, is sown after the onset of the rains in June. About 75 kg of seeds are required for 1 ha of paddy field in this region. The rice matures in about 90 to 100 days and is harvested in September; one hectare of paddy field normally yield about 1.5 tonnes of rice in this area; during harvest most of the straw is left in the field. This decay in course of time and form a good manure which support rich organic production in the fields.

2. 2 *Preparation for prawn farming*

Soon after the paddy harvest, the fields are leased out to prawn farmers for a period of 5 months starting from mid November to the middle of April next year. The person or group of persons who lease the land for prawn farming are required to be registered with the Department of Fisheries, Government of Kerala which issues a license for this purpose. The lease amount varies from place to place depending on the location and the proximity of the field to the bar mouth and also on the productivity of the field. They immediately make preparations for letting in the prawns. The outer bunds round the fields are strengthened as the first step; this is done by scooping out earth from the field just inside the outer bund and depositing this on top of the bund. This results in a deepened channel just inside the outer bund, which is used for navigation inside the field. All breaches like holes made by crabs etc. are closed so that water flow in and out from the field is possible only through the sluice gate. A semicircular shaped area just inside the main sluice gate is then deepened so that the depth is maximum at the middle. Channels varying in width from 1 to 2 metres and about 1 meter in depth connecting this deepened area with other parts of the field are dug out with a slope towards the sluice gate. Unlike in the case of paddy cultivation, farming of prawns is done in large fields; small farms of different ownership are collectively auctioned as a unit and the lease amount is proportionally divided among land holders. The existing mud boundaries separating the small fields are cut open at various points so that movement across them are freely possible. This temporary merging of small fields make prawn culture easier and reduces the cost of preparation of the field.

The wooden sluice gate is then fixed at a predetermined place in the outer bund. The size and position of the sluice gate depend on the general layout and extend of the fields and the width of the outer bund. Nowadays already fully built sluice gates are installed into the outer bund. After placing the structure in the mud workmen trample on it to entrench it firmly in the mud. Strong poles are erected very close to the sides of the sluice gate inside and outside the pond. These poles are joined together across and length wise with other wooden support. This structure and the sluice gate are then firmly tied together to avoid further sinking or shifting of the sluice gate. During the first few days after fixing the sluice gate, the top frame is loaded with weights in order to stabilise the gate to the maximum possible extent in the ground. Shutter planks, the removal of which allows flow of water through the sluice gate are subsequently introduced into the grooves provided for the purpose. Sluice gates are generally made of local timber.

A shed is then put up on the outer bund near the sluice gate to house a watchman and also to keep the fishing implements like sluice nets, bamboo or betel nut screens, hurricane lamps etc. To prevent any large influxes of aquatic weeds such as *Salvinia* sp. into the fields, two bamboo poles or betel nut tree trunks are tied together at one end and floated in a triangular pattern inside and outside the sluice gate while letting in and letting out water. The outer bunds lying immediately close to the sides of the sluice gate are then further strengthened. The outer bunds are periodically checked throughout the culture period for any breaches. The salinity of the water rises as fresh water inflow caused by the monsoon rains decrease.

2. 3 *Entrapment of prawn*

Larvae of several species of marine prawns enter brackish water systems and lead 5 to 6 months of the following period of their lives there. These prawn seed from the surrounding backwaters are let into the fields at high tide. They are possibly attracted by the comparatively lower salinity and the plentiful availability of food in the fields. It is also sought to attract them by hanging a kerosene oil lamp above the sluice gate during the night. During low tide water from the fields is filtered out through a conical bag net having a rectangular frame fixed in the sluice gate, or a closely tied screen made of bamboo or betel nut tree, to prevent the escape of already entered prawns. This sort of entrapment is continued at every high tide throughout the period of operation.

2.4 *Culture of prawn*

The entrapped prawns are allowed to grow in the field. The prawns feed on the abundant natural food present in the field. No artificial supplementary feed is given to the prawns. There is thus no input of potentially eutrophicating substances during the entire period of culture. Birds are sought to be kept away by tying long strings across the field, to which empty polyethylene bags are tied. These flutter in the wind producing sound and thus repelling the birds.

2.5 *Harvesting of prawn*

Harvesting starts from about mid December and is carried out every 3 or 4 days before and after full moon and new moon during which period maximum tidal amplitude is experienced. It continues till the middle of April. It is done using a long conical net with a float at the end. During low tide by fixing a conical net at the outer mouth of the sluice gate so that the prawns and other fish are entrapped when the water rushes out. A kerosene lamp is hung at the sluice gate to attract the prawns from the field. After some time a fisherman goes out on a country boat to collect the harvest. The end of the net is located by the float on the surface of water. The tip of the net is tied using a rope. The harvest is emptied into the boat after hauling the net up and then untying the rope. Prawns form about 80% of the catch and belong to different species (Table I). The remaining part is made up of fish like *Etroplus maculatus*, *Mugil* sp. and *Tilapia mossambica* and some species of crabs (Jhingran, 1991). The total yield of all these together may be around 700 kg per hectare.

Table I Composition of catch and average returns
(Total catch = 700kg per hectare)

Type	Percentage	Price(Rs per kg) (DM 1 = Rs 24)	Average returns (Rs per species)
Prawns			
Penaeus monodon	0.5-1	250	1.750
Penaeus indicus	28-34	150	32.550
Metapenaeus monoceros	42-46	50	15.400
Metapenaeus dobsoni	3-5	50	1.400
Fish			
Etroplus sp.	6-12	70	4.410
Mugil sp.	4-6	65	2.275
Tilapia mossambica	4-6	35	1.225
Crabs	<1	50	350
		Total	59.360

3. Advantages of the system

This traditional system maximises the resource utilisation by appropriately exploiting the ecological cycle taking place in these fields. There is a complete absence of costly inputs such as fertilisers and pesticides for the rice crop and use of supplementary feed for the prawns. The culture system is thus totally environment friendly. That the productivity has been largely maintained with minimal energy subsidies over the years show the complimentarity of the two crops. This system continues to be profitable (Table II) even with the ever increasing labour charges; more so given the fact that the area is very near the city of Cochin. It's survival over the years is particularly commendable, given the fact that rice cultivation has been generally on the decline in Kerala state, because of high labour charges coupled with stagnant product price (rice being the staple food, its prices are subject to indirect government control). Furthermore alternative options like cocoa, rubber etc. are proving to be less labour intensive and more profitable.

Table II. Comparison of the profitability of the rice-prawn rotation culture system (system I) as compared to the rice monoculture (system II) in other parts of the state (all figures Rupees per hectare; DM 1 = Rs 24)

	System I				System II	
	Land owner		Prawn farmer			
	expenses	income	expenses	income	expenses	income
Cost of rice seed	650				800	
Labour charges	15.400		6.000		12.000	
Fertiliser and pesticide charges	nil		nil		2.750	
Sale proceeds of rice		9.800				19.600
Sale proceeds of straw		nil				1.000
Number of crops per year	one		one		two	
Lease amount		37.500	37.500			
Total cost	16.050		43.500		31.100	
Total income		47.300		59.360		41, 200
Net profit		31.250		15.860		10.100

4. Socio-economic relevance, problems and future prospects

The prawn industry also supports a large labour population, particularly women labourers who are employed in the pealing sheds, ice factories and processing centres. After the period of lease in mid April the fields are open for the public for fishing, providing the local population with a large area where capturing fish is easier than in the open waters. This culture system provides fish items both for export and for the local market. Prawn species like P. indicus and P. monodon which costs DM 6 – 11 per kilogram (Table I) are almost totally exported while the other smaller species of prawns serve as a valuable protein supplement to the diet of the local population (farm labourers in this region earn about DM 4 per day)

Of late however several problems have affected the productivity of this unique farming system. Unscientific and ill planned constructions at the sea mouth, and along the routes of inward movement of prawn larvae, are thought to be the cause of reduced arrivals of the same in some regions. Discharge of effluents by some of the neighbouring chemical companies is also believed to interfere with the movement of the larvae. Even though the rice cultivation part is currently compulsory as per local law in this region, there is an increasing pressure from the farmers to allow them to substitute this apparently uneconomical part by another prawn crop.

As compared to the system described above intensive prawn monoculture has proved to be non sustainable and environmentally disastrous in other regions. It is also often resented by the local population as it is largely non-participatory and caters only to the export market. During culture period all other species are removed (often using chemicals) and the field

stocked with one or two high value species. The growth of the culture species has to be almost completely supported by artificial feeding. To prevent the outbreak of infectious diseases antibiotics will have to be used. The culture system is capital intensive and hence the small farmers often get excluded. Intensive monoculture does not provide the protein rich food source that the conventional system provides for the local market at affordable prices. In general, as against the capital intensive, unsustainable and environmentally damaging intensive culture system the rice-prawn rotation culture system is a sustainable, eco-friendly and harmonious and at the same time highly profitable traditional culture practise. There is need for a thorough study into the various aspects of the production dynamics of this unique and highly efficient system.

5. Literature cited.

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