Integration of Freshwater Prawn Culture with Rice Farming in Kuttanad, India

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Abstract

The integration of paddy cultivation with prawn/fish culture can become a viable alternative to effectively utilize the vast area of derelict polders (embanked coastal flood plains) in Kuttanad, India. Nearly 55 000 ha of wetlands in Kuttanad are available for paddy cultivation year-round. Around 5 000 ha of the polders are utilized for *Macrobrachium rosenbergii* culture as a follow-up crop. Of the total area, about 250 ha of fallow polders are utilized for monoculture of *M. rosenbergii* from March to October, while in 4 750 ha polyculture with Indian and exotic carps is practiced from November to June. Stocking density is 15 000 to 60 000/ha for monoculture of *M. rosenbergii*, while in polyculture with carps, it is 5 000 to 20 000/ha of prawn and 5 000 to 10 000/ha of fish. Production from monoculture varies from 95 to 1 297 kg/ha whereas production from polyculture systems it is 70 to 500 kg/ha of prawn and 200-1 200 kg/ha of fish. Profits range from Rs. 5 000 to 20 000/ha. An evaluation is made of how the present polders of Kuttanad are best utilized for culture of *M. rosenbergii* following different systems of integrated farming and how the integration is useful in the aquaculture sustainability of Kuttanad, a tropical wetland ecosystem.

Introduction

In recent years in India, shrimp culture has faced a crisis due to rampant outbreaks of viral diseases. The situation has been further aggravated by the implementation of the Coastal Regulation Zone Act under the Environmental Protection Act of 1986 that imposed restrictions on setting up of industries including aquaculture activities within an area of 500 m from the high tide. The pursuit of alternate eco-friendly and sustainable freshwater aquaculture has led to the recognition of the giant freshwater prawn (*Macrobrachium rosenbergii*) as a prime candidate species for freshwater aquaculture. Considerable understanding of the biology of the species, its rapid growth, large size, greater disease resistance and good demand in both domestic and export markets has made it a prime species for freshwater aquaculture in India. Kerala state in India is endowed with large freshwater resources and low-lying paddy fields, which have been traditionally exploited for rice cultivation. The integration of rice farming in these polders (embanked coastal flood plains) with *M. rosenbergii* culture has given a new thrust to the economy of traditional farming in Kuttanad district. Rice and prawn/fish farming has turned out to be a viable alternative to effectively utilize the vast amount of fertile water available in Kuttanad.

Materials and Methods

Data on farming of *M. rosenbergii* under different culture systems in Kuttanad were collected from April 1998 to March 2001. The total area utilized for *M. rosenbergii* cultivation in Kuttanad was apportioned into five agronomic zones: Upper Kuttanad, Lower Kuttanad, North Kuttanad, Kayal lands (reclaimed part of the lake for rice cultivation) and Purakkad (an area characterized by peaty soil) (KWBSP 1990). Details on duration of rice cultivation, duration of prawn culture, type of farming, culture area, pre-stocking, stocking and post-stocking management practices, harvest details and net yield from the grow-outs were collected through a pre-tested questionnaire. The data compiled were analyzed for profitability and the feasibility of prawn farming in the polders. A comparative economic evaluation was made of rice and prawn farming following modified monoculture system on a rotational basis in Lower Kuttanad (Veliyanad) and polyculture in North Kuttanad for two years (November 1998 to August 2000). The production of *M. rosenbergii* from five polders in each of the areas following monoculture and polyculture was analyzed following Kurup et al. (1998). The stocking density of *M. rosenbergii* in all the ten polders were monitored and kept at 10 000 to 45 000/ha. Details of pond preparation, stocking and post-stocking management measures adopted are given by Kurup (1996). A successful integration of fish/prawn with other livestock was analyzed by Huat and Tan (1980).

Results and Discussion

Rice cultivation in Kuttanad

The total area of Kuttanad region is around 110 000 ha comprising 28%

dry land, 60% wetlands and 12% other water bodies such as lakes, rivers, channels, etc. Wetlands in Kuttanad are mainly used for rice cultivation with a total extent of 55 000 ha. Traditionally, rice is cultivated in two seasons: summer (November to February) and monsoon (July to October). Summer contributes to the bulk of the rice cultivated in this region. Of the total 55 000 ha utilized for rice cultivation in Kuttanad, nearly 35 000 ha is utilized during the summer season while only about 3 000 ha is used during the monsoon season. During recent years, farmers in Kuttanad have been inclined to abandon rice cultivation either partly during any of the two seasons or to fully leave the polders fallow. Diminishing returns from cultivation, acute labor shortage and severe crop loss due to flood and pest infestation etc. are the major reasons for this. As a result, nearly 36 000 ha of land remain fallow during the monsoon season.

Prawn culture in Kuttanad

Three types of grow-out systems are presently employed for *M. rosenbergii* culture: polders, homestead ponds and coconut plantation channels. Table 1 gives the total area of each grow-out system in the five zones of Kuttanad for the monoculture and polyculture of *M. rosenbergii*. The farming of *M. rosenbergii* is mostly carried out in the polders (65-75%), followed by coconut plantation channels (15-25%) and homestead ponds (10-15%). The water spread of each polder used for prawn culture varied from 0.6 to 125 ha where the culture of *M. rosenbergii* is done on a rotational basis after a crop of paddy mostly from November to August. Around 5 000 ha of polders are currently utilized for *M. rosenbergii* farming in Kuttanad, of which monoculture of *M. rosenbergii* is done in 250 ha while in 4 750 ha culture is done with carps. Among fallow polders utilized for prawn culture, the maximum area was in Upper Kuttanad (1 351 ha) followed by Lower Kuttanad (1 298 ha), North Kuttanad (818 ha), Kayal lands (695 ha), while it was least in Purakkad (537 ha).

Integrated culture practices of *M. rosenbergii*

In 122 farms surveyed in 1998-2001, 75 farmers used polders for *M. rosenbergii* culture alternating with rice. Monoculture was practiced in 20 farms with a total area of 248 ha. North Kuttanad accounted for a maximum number of farmers (8) who switched to monoculture of *M. rosenbergii*. The water spread of farms used for monoculture was 1 to 25 ha each with stocking density varying from 15 000 to 60 000/ha postlarvae. Production of *M. rosenbergii* from these polders ranged from 95 to 1 300 kg/ha. About 4 750 ha are utilized for polyculture comprising Indian major carps such as catla (*Catla catla*) and rohu (*Labeo rohita*) and grass carp (*Ctenopharyngodon idella*) and *M. rosenbergii*. The polders, which were utilized only once a year for the paddy cultivation, were the major sites for the polyculture of *M. rosenbergii*. Such polders ranged from 5 to 230 ha each and the stocking density of *M. rosenbergii* was 2 000 to 15 000/ha postlarvae while that of fish was in the range of 1 000 to 5 000 fingerlings/ha. The culture period extended from 6 to 8 months and the production from such a system was 70 to 500 kg/ha of *M. rosenbergii*, and 200 to 1 200 kg/ha of fish. Apart from this, small areas are utilized for other types of integration: pig/fish in 10 ha, poultry/fish in 22 ha, duck/fish in 48 ha and livestock/fish in 28 ha.

Comparison of production from mono and polyculture

Table 2 shows information on farming and production of five polders where mono and polyculture were practiced in the summer season. Stocking density in the monoculture polders was 14 000 to 45 000/ha and production was 95 to 1 297 kg/ha. Similarly, in the polders where polyculture was adopted, production was 70 to 492 kg/ha of prawns and 200 to 1 200 kg/ha of fish. Results of the present study are complementary to Huat and Tan (1980) who reported an average production of 800 kg from polyculture ponds in Southeast Asia where *M. rosenbergii* and carps were cultured. The survival rate in all the

Table 1. Details of monoculture and polyculture of* M. rosenbergii *in different agronomic zones of Kuttanad.

Nature of the culture area	Upper Kuttanad		Lower Kuttanad		North Kuttanad		Kayal lands		Purakkad		Total	
	Mono-culture	Poly-culture	Mono-culture	Poly-culture	Mono-culture	Poly-culture	Mono-culture	Poly-culture	Mono-culture	Poly-culture	Mono-culture	Poly-culture
Polders	3 (26)	11 (1 325)	3 (48)	14 (1 250)	8 (110)	8 (550)	4 (36)	16 (625)	2 (28)	6 (450)	20 (248)	55 (4 200)
Homestead ponds	2 (2)	6 (4)	1 (1)	4 (6)	1 (2)	2 (4)	0	3 (6)	1 (1)	8 (22)	5 (6)	23 (42)
Coconut plantation channels	1 (12)	3 (125)	1 (8)	2 (23)	4 (90)	3 (62)	0	2 (28)	1 (6)	2 (30)	7 (116)	12 (268)
Total	6 (40)	20 (1 454)	5 (57)	20 (1 279)	13 (202)	13 (616)	4 (36)	21 (659)	4 (35)	16 (502)	32 (370)	90 (4 510)

Number in parenthesis is area of land in ha.

ten polders was higher under lower stocking densities and was comparable to the retrieval rates reported by Jhingran and Sharma (1980) in the paddy fields. The net returns from the polders were basically governed by the size structure of *M. rosenbergii* at the end of the culture. The present study shows that revenue and production from monoculture ponds were perceptibly higher compared to polyculture ponds supporting the promotion of monoculture of *M. rosenbergii* as a rotational crop in the rice fields of Kuttanad.

One of the major bottlenecks for the successful farming of *M. rosenbergii* is the size disparity seen particularly in male populations. This results in a diverse population structure at the time of harvest that classifies the prawns into different morphotypes based on their weight. The harvested prawns are marketed under different weight classes and the price that each weight class fetches is different. Two market structures are prevalent in Kuttanad (two-grade and six-grade) that divide the final catch into two or six different weight groups (see Table 2). A definite marketing system does not exist in Kuttanad. Hence, the tariff employed for each grade of prawn is different from time to time and is decided by the procuring companies. The percentage of weight group <50 g was found to adversely affect the final profit. In lesser-stocked ponds, the average weight and survival of prawns were comparatively higher. Moreover, the positive shift in the predominance of larger weight group prawns in these ponds yielded better results. These findings are in full agreement with Siddiqui et al. (1997) in Saudi Arabia. Based on the trend noticed in the production in the ten polders, it can be inferred that biomass, marketable yield structure and profit from these polders can be improved by optimizing stocking density, improving post-stocking management measures and adopting an innovative system of culture of *M. rosenbergii* (Karplus et al. 1986, 1987).

Conclusion

In Kuttanad, double cropping of rice may not always be feasible due to floods during the monsoon and this combined with low returns from rice cultivation due to the high cost of land lease and labour has tempted the farmers to abandon one crop of rice and instead culture fish and /or prawn during the season, leading to increased benefits. Utilization of polders for fish and/or prawn culture will not only be helpful in improving the revenue for the farmer but will also provide additional employment. Integration increases benefits by reducing the cost for pond fertilization, maintains soil fertility, avoids accumulation of waste products, enhances better pest control from the agricultural viewpoint and enables farmers to continue with their traditional norms of livelihood. Since rice and fish/prawn are grown in different seasons, the deleterious effects of pesticide accumulation, seen as a result of simultaneous culture of rice-prawn, can be reduced. The ideal season for rearing fish and prawns in the ricefields of Kuttanad appears to be March to October. According to Nair (1994), production from such a system on an average would be 1 000 kg/ha of fish and around 750 kg/ha of prawn. This arrangement also reduces the production cost of rice since the soil is soft and clean after the fish/prawn harvest and allows immediate seeding and transplanting. It appears that the polders of Kuttanad can be utilized for culture of *M. rosenbergii* and that rotational farming of rice and *M. rosenbergii* can be popularized in suitable polders when they are fallow for six months.

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Table 2. Summer season production of* M. rosenbergii *under different management strategies.

Polders	1	2	3	4	5	6	7	8	9	10
Type of culture	Mono	Mono	Mono	Mono	Mono	Poly	Poly	Poly	Poly	Poly
Area of polder (ha)	1.1	2.5	2	2.1	2.1	42	2.5	1.3	35	20
Stocking density (/ha)	14 000	25 000	30 000	40 000	45 000	10 000	12 000	20 000	15 000	10 000
Survival (%)	25	38	26	38	35	22	42	31	37	52
Duration of culture(months)	8	8	6	6	8	8	8	8	8	8
Total yield(kg/ha)	95	186	177	1297	1250	70	180	492	450	143
Market yield structure	6 grade <50g (8%) 60g -(16%) 80g -(20%) 120g (32%) 230g (14%) 230g +(10%)	6 grade <50g (11%) 60g (15%) 80g (18%) 120g (25%) 230g (22%) 230g +(9%)	6 grade <50g (12%) 60g (17%) 80g (19%) 120g (22%) 230g (16%) 230g +(14%)	2 grade <50g (52%) >50g (48%)	2 grade <50g (58%) >50g (42%)	6 grade <50g (7%) 60g (12%) 80g (32%) 120g (28%) 230g (11%) 230g+(10%)	2 grade <50g (32%) >50g (68%)	6 grade <50g (12%) 60g (15%) 80g (32%) 120g (28%) 230g (12%) 230g +(9%)	6 grade <50g (9%) 60g (17%) 80g (21%) 120g (26%) 230g (13%) 230g +(14%)	2 grade <50g (29%) >50g (71%)

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