Integration of Crustacean Aquaculture with Coastal Rice Farming in Vietnam

LE THANH HUNG

Introduction

Rice-based farming systems in Vietnam include the cultivation of local rice varieties in the rainy season (from June/July to November/December) in coastal areas when the salinity is low enough (<5 ppt). Tidal fluctuation supplies the ricefield floodwater. The annual rice yields are low (2.5-3.0 t/ha) compared to inland areas. This paper gives some examples of integration of crustacean aquaculture into coastal rice farming.

Freshwater Prawn and Marine Shrimp Culture Integrated with Coastal Rice Farming

The giant freshwater prawn *(Macrobrachium rosenbergii)* migrates to estuaries to reproduce. There are two peaks for the subsequent appearance of juveniles in rivers: June-July and October-November. Juveniles can be grown to 25-35 g in four to five months in coastal ricefields. Some enter the ricefields on spring tides. Farmers trap others in the rivers and stock them. The ricefields used for prawn culture range from 1,000 to 3,000 m² for 72% of farmers. They have a peripheral ditch: a refuge for the prawns at low tide. They forage in the fields at high tide. The ditch is made by removing earth to construct dikes. These prevent complete flooding on spring tides. The ditch surface area varies from 10 to 40% of the total area of the ricefield. The water level is maintained from 15 cm to 1.2 m. The dikes are 2.5-3.0 m wide at the bottom and 0.5-0.6 m wide at the surface (Fig. 1). Water inlet and outlet gates are screened to keep out predators. Water is exchanged daily.

Juvenile prawns are stocked 15-20 days after rice transplanting. They are harvested one month after the rice harvest. Due to dependence on natural seed, several stockings may be needed to reach the desired density: 10,000-20,000 of 4-5 g juveniles/ha. Although prawns are fed occasionally with rice bran, cassava roots, coconut (copra and copra meal), shrimp-head waste, trash fish, and fiddler crab (*Uca* sp.), natural food is very important to compensate for the low stocking density and irregular feeding regime. Farmers apply little or no pesticides. Rice losses due to the brown planthopper *(Nilaparvata lugens)* are minimized by keeping young ducklings and high water levels. If the salinity remains lower than 10 ppt in the dry season, the farmers can raise a second crop of prawns without rice, but this is not common because of seed shortage and water constraints.

Table 1. Freshwater prawns *(Macrobrachium rosenbergii)* harvested from ricefields after four to five months in 55 farms in Duyen Hai district, Ho Chi Minh City, Vietnam. (Crop I: rainy season with rice; Crop II: dry season without rice).

	Yields in kg/ha					
	<100		100-300		>300	
Item	Crop I	Crop II	Crop I	Crop II	Crop I	Crop II
% of total farmers	22	19	55	76	23	5
Prawn weight in g/head (%)						
>30	13.6	27.6	21.9	20.4	23.8	20.0
15-30	43.4	53.9	57.6	54.7	56.5	55.0
<15	42.0	18.5	20.5	24.9	20.7	25.0
Survival (%)	30	N/A	64	58	65	50
Return rate*	1.05	N/A	2.87	2.58	3.47	2.83

*Return rate: harvested weight over released weight.
N/A = Not available.

Data collected from 55 farms (Table 1) shows that 22% produced less than 100 kg prawns/ha/crop. The reasons for low yields were poor management, including failure in excluding predators, poor feeding and low pH water. After four to five months, 75-80% of the prawns were bigger than 15 g, except on farms with yields lower than 100 kg/ha/crop.

Table 2 summarizes the costs and benefits. Farmers with prawn yields lower than 100 kg/ha had net benefits less than US$400/ha/crop. Those with yields higher than 300 kg/ha had net benefits higher than

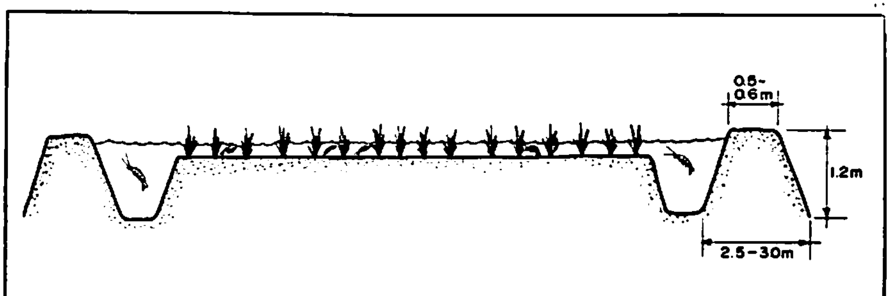


Fig. 1. *Cross section of a ricefield with a peripheral ditch for rice and prawn culture.*

Table 2. Economic revenues (in US$) per hectare from prawns and rice culture in ricefields of 55 farmers in Crop I in Nha Be and Duyen Hai districts, Ho Chi Minh City, Vietnam.

	Income range (US$)		
Item	<400	400-1,000	>1,000
Prawn yield (kg/ha)	<100	100-300	>300
Operating costs (US$)	690.32	640.16	816.56
Labor*	287.24	271.86	273.08
Rice seed	12.90	13.30	12.40
Prawn seed	329.74	242.25	363.50
Fertilizer	21.26	20.50	20.88
Sluice gate	6.88	7.23	7.74
Feed	25.13	76.28	125.96
Miscellaneous	7.17	8.74	13.00
Gross returns (US$)	866.49	1,346.30	2,008.95
Rice	411.82	440.42	464.45
Prawn	422.26	894.86	1536.56
Others**	32.41	11.02	7.94
Net benefit (US$)	176.17	706.14	1,192.39

*Includes dike construction and management.
**Includes wild fish.

US$1,000/ha/crop. Gross returns from rice production and operating costs were similar for all 55 farmers. The return from prawns was the decisive factor determining the net benefit.

Marine shrimps (Penaeidae) at spring tides migrate on to tidal flats where the salinity is above 10 ppt. Farmers use fallow ricefields to trap and grow shrimps. Sub-adult shrimps also migrate to the sea at spring tides and farmers catch them in trap nets at outflow gates. This is very common in the lower Mekong Delta.

Despite the economic benefits of rice-prawn and rice-shrimp integrated farming, their adoption is constrained by:

- Lack of natural seed supply for *Macrobrachium* and marine shrimps and low quality (poor survival) of hatchery-reared *Macrobrachium* postlarvae.
- Water management difficulties both in quantity (distance of ricefields from water sources) and quality (inappropriate pH, salinity, etc.).
- Lack of extension services. Lack of credit for farmers.
- Time needed to recover costs, especially for dike construction and seed (cannot be recovered from a single crop).

These systems of crustacean culture in coastal areas could be much improved by the establishment of nurseries to nurse *Macrobrachium* postlarvae to 4-5 g. With good seed supply, extension services and credit, the system could be very successful both for producing *Macrobrachium* in fallow ricefields in freshwater and penaeid shrimps where salinities exceed 10 ppt.

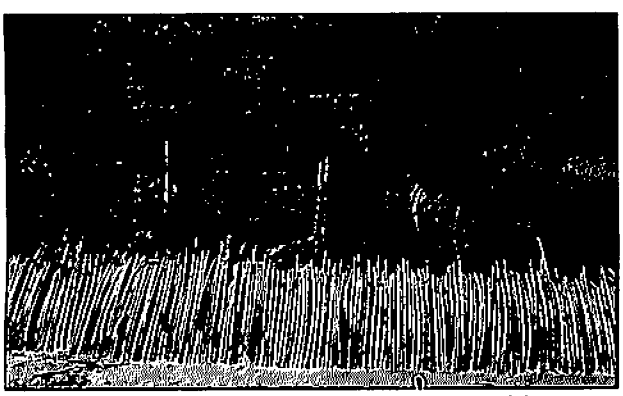
Crab Culture in Backyard Ponds and Ricefields

Mangrove crabs *(Scylla serrata)* are quite abundant on tidal flats. Farmers collect juveniles and culture them in small backyard ponds or fallow ricefields. There are two systems of crab culture in South Vietnam: moulting crab and fattening crab culture.

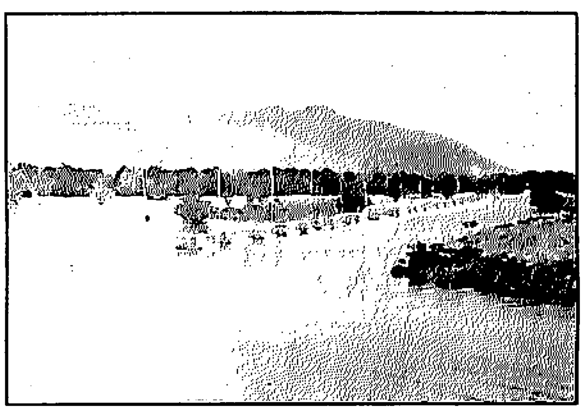
Moulting crab culture was developed about five years ago. Small wild-caught crabs (<100 g) have low value and were previously used as livestock feed or manure in coastal areas. Farmers catch small crabs migrating upstream from estuaries (January to August) using conical fixed nets. The farmers induce moulting by removal of the four pairs of walking legs. The crabs are held in small backyard ponds or ricefields. Each pond is 300-500 m^2 in area and have outlet and inlet water gates for better tidal exchange. The water depth in ponds range from 0.7 to 1.0 m and in ricefields' peripheral ditches from 0.3 to 0.5 m. The stocking density is 100 kg per 300-500-m^2 pond. The crabs are fed with trash fish and crustaceans (mainly *Uca* sp.) at 3-5% body weight/day. The appropriate salinity range is 8-25 ppt. Lower salinities reduce survival. Thus, farmers practise moulting crab culture mainly in the dry season.

Crabs moult on the 13th to 25th day after leg removal, the majority after 14-20 days. Farmers drain ponds daily at low tide to collect premoulting crabs. These are transferred to net *hapas* (1.0 x 2.0 x 0.8 m) to make it easy to recognize moulting and remove moulting crabs from the water. If not, their soft shells harden within a few hours. Soft shell crabs are kept on a humid substrate (such as moist weed or paper) and transferred to traders for subsequent freezing and export.

Moulting crabs are worth five to ten times more than hard shell small crabs. Their survival varies from 20 to 50% depending on water exchange, water quality parameters and feeding. Farmers can get 50-70 kg of soft shell crabs from 100 kg of seed crabs. The net benefit from a 300-500-m^2 pond can reach US$50-70/month.

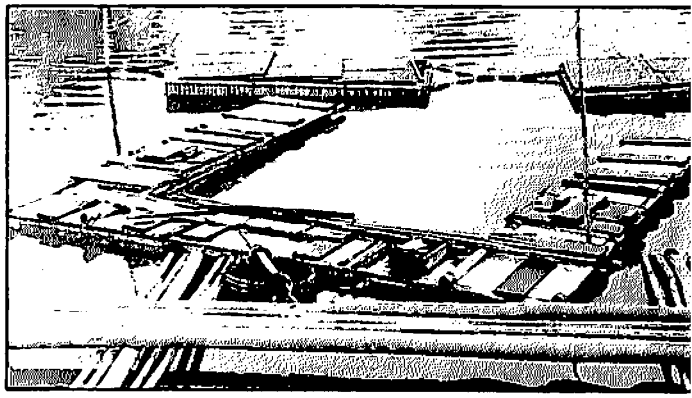


An experiment to fatten crabs (Scylla serrata) in a mangrove forest without clearing trees, Duyen Hai district, Vietnam.



Crab (Scylla serrata) culture cages located in mangrove forest, Dong Hai province, Vietnam.

*Leg removal to stimulate moulting in crab (*Scylla serrata*) culture, Dong Hai province, Vietnam.*



*Instrument used to lift cages of cultured crabs (*Scylla serrata*), Dong Hai province, Vietnam.*

Fattening crab culture is different. Large (>100 g) crabs are often thin-bodied and command low prices. They are fattened in earthen ponds fenced with nipa palm fronds or bamboo to prevent escapes. The pond structure is similar to that for moulting crab culture. In some places, farmers fatten crabs in bamboo cages (1.0 x 2.0 x 1.0 m) floating in ponds or rivers. Thin crabs are fattened for 15-20 days, fed with trash fish and crustaceans (fiddler crabs) at 5-10% body weight/day. The stocking density is about 100 kg per 300-m² pond or 10 kg for a 2-m³ cage. The survival rate is high, 70-90%. Fattened crabs are worth three times more than thin crabs. The net benefit from a 300-m² pond is US$100-150/month. Fattening crab culture can be practised year-round but is mainly done from August to November.

From October to December, farmers prefer to trap and culture female crabs because their eggs are a high-priced export item. Ripe females are held in ponds for 15-20 days during which the eggs develop to fill 70% of body cavity. Female crabs are fed with fiddler crabs at 10% body weight/day. The stocking density is 50-100 kg per 300-m² pond. The net benefit from female crab culture can reach US$200/month from a 300-m² pond.

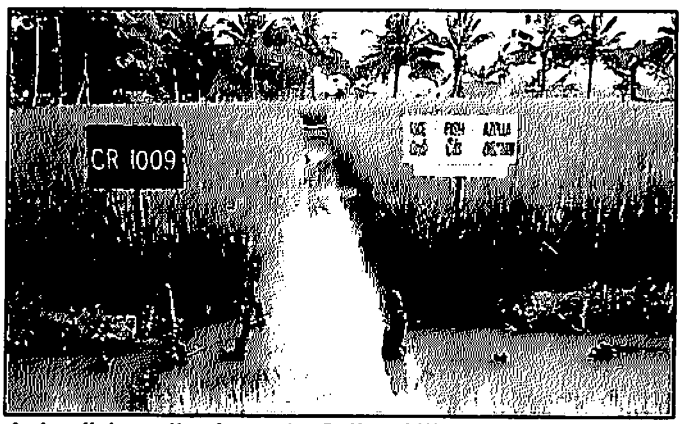
These types of crab culture are attractive to farmers with limited holdings of coastal land. They are excellent cash crops. The main constraints are the cash required to purchase or catch seed and seed supply shortages. Poor farmers find it difficult to raise the financial resources to start crab culture. Overharvesting of ripening females is likely to worsen the seed supply situation.

LE THANH HUNG *is a lecturer and the Deputy Dean of the Faculty of Fisheries, University of Agriculture and Forestry, Ho Chi Minh City, Vietnam.*

News Items

Rice-Fish-Azolla Integration

RICE-FISH-AZOLLA culture is being investigated in low lying ricefields in the Tanjore Deltaic Zone, Tamil Nadu, India. A 0.2-ha ricefield has been provided with trenches (0.5 m deep, 0.5 m wide) connected to a 1.0-m deep, 1.5-m wide main channel (see photo). The fish (*Oreochromis niloticus*, stocked at 4-cm fingerlings weighing 19 g each at 6,000 pieces/ha) are raised mainly in these water spaces. Rice (CR 1009, maturity period of 150 days) is planted using normal spacing (20 x 10 cm). Azolla (*Azolla microphylla*) is applied for nitrogen fixation and as a feed for foraging fish. Dried azolla is also incorporated in a supplemental fish feed (dried azolla, 50%; rice bran, 15%; chicken manure, 10%; corn meal, 5%; sorghum meal, 5%; broken rice, 2.5%; groundnut cake, 2.5%) applied at 5% of the fish body weight.



*A rice-fish-azolla plot at the Soil and Water Management Institute, Kattuthottam, Tamil Nadu, India. The fish (*Oreochromis niloticus*) are mainly in the trenches.*

The concurrent rice and fish culture system yields a net income per hectare of Rs7,215/crop (US$1= Rs28.01), compared to Rs5,800/crop for rice alone. The provision of water space for the fish lowers rice yields by about 300 kg/ha but the fish harvest more than compensates for this. *(Source: V.S. Shanmugasundaram and K. Ravi, Soil and Water Management Institute, Kattuthottam, Tanjore 7, Tamil Nadu, India.)*