

Wendy Pyper outlines efforts to improve the sustainability of prawn farming in Vietnam's Mekong Delta.

# Prawns in the p a d i



**I**n the coastal farming villages of southern Vietnam's Mekong Delta, prawn farming can be a ticket to a full stomach and a better life.

Farmed prawns sell for US\$2–\$10 a kilogram, depending on the species, and a good harvest can boost the average annual incomes of farmers from US\$800, to US\$2000–\$6000.

These returns have sparked a 'prawn rush', with some farmers giving up rice farming altogether. Others produce rice during the wet season and prawns during the dry, a season that in some areas is otherwise unproductive due to high salinity.

But the long-term future of prawn farming in the Mekong Delta is constrained by several factors, chiefly the

siltation of growing ponds, a high incidence of disease, and shortages in the supply of quality young prawns.

Technologies and management strategies for addressing these issues have been developed during collaborative research by CSIRO Marine Research, Sydney University, Cantho University and three Vietnamese government organisations. The work began in 1997, with funding from the Australian Centre for International Agricultural Research.

## Prawns on rice

The Mekong Delta project focussed on two coastal areas: the southern district of Gia Rai in the province of Bac Lieu, and the more central district of My Xuyen in Soc Trang province.

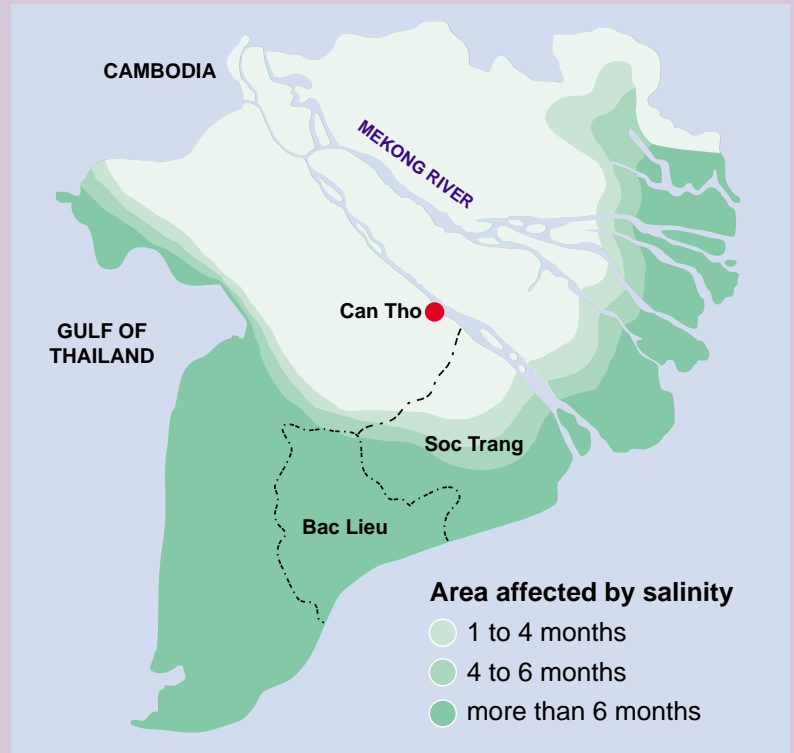
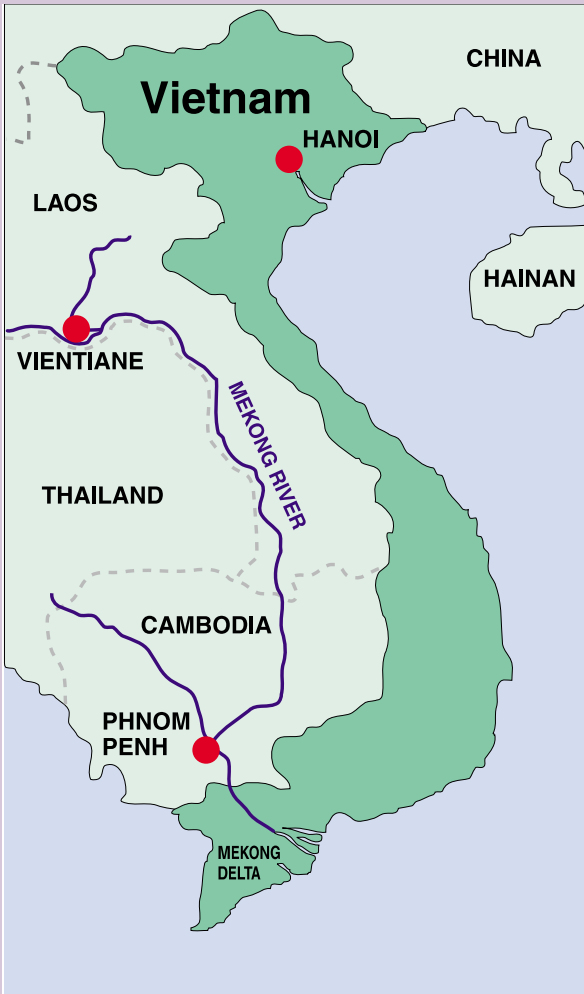
Above: Tiger prawns are so valuable, that at night, farmers guard their ponds from thieves from a purpose-built hut.

Inset: Farm children in the Mekong Delta.

To integrate rice and prawns, farmers in these regions must redesign their rice fields with a trench around the periphery and dykes to manage water levels.

The trenches and dykes reduce the area available to rice, but provide a refuge for prawns away from the more extreme environment of the flooded rice field. At the start of the dry season (January), when water in the local canal system becomes saline, a flapgate is opened and the trenches and fields are flooded with saline water.

The flooded trenches and fields are stocked with wild prawns (*Penaeus* and



The Mekong Delta is the largest river delta in Vietnam, extending more than million hectares, of which 2.3 million hectares is cropped. The region consists of 12 provinces with 14.2 million inhabitants of Vietnamese, Cambodian and Chinese origin. The delta is sub-tropical with distinct wet and dry seasons and an average temperature variation of between 25 and 28°C. These conditions have made the Mekong Delta the 'rice bowl' of Vietnam, responsible for 45-50% of the country's total rice production.

Right: A rice-prawn farm under rice cultivation. The farm family lives in huts made of nipa palm leaves, bamboo or mangrove timber.

Below: In the coastal areas of the Mekong Delta, the dry season brings saline water to the local canal system, preventing rice cultivation. Prawn farming provides farmers with an important source of income during this normally unproductive time.





*Metapenaeus* species) or tiger prawn postlarvae (*Penaeus monodon*) from hatcheries.

The prawns are harvested two to four months later, and when the wet season arrives, rainfall and fresh water from the river are used to flush the fields of residual salinity. This readies the fields for rice.

CSIRO's Dr Nigel Preston says a major advantage of the rice-prawn system is that it allows the use of otherwise unproductive land in the dry season.

'For farmers practising rice monoculture in the coastal regions of the Mekong Delta, the influx of saline water into the fresh water canals during the dry season limits the availability of land for rice cultivation,' Preston says.

'Depending on the severity of the saline intrusion, the farmer is limited to a single or double rice crop, compared with a three crop cycle in fresh water areas. So the production of prawns in the dry season provides an important source of farm cash income.'

### Setting priorities

In Gia Rai, integrated rice-prawn farming has been practised since the 1970s, but poor soil fertility and sediment build-up from influent water has contributed to declining yields of rice and prawns. In My Xuyen, soil and water conditions are more favourable for rice production and the siltation of fields is less pronounced.

To evaluate the sustainability of different farming systems in both regions, and identify areas for further research, Dr Nigel Preston of CSIRO Marine Research and Dr Donna Brennan of the University of Sydney began a study of the economic, social, environmental and biological factors influencing farm productivity.

Brennan and a Vietnamese team led by Tran Thanh Be of Cantho University surveyed 425 households in Gia Rai and My Xuyen practising a range of different farming systems, including rice monoculture, prawn monoculture and rice-prawn farming.

'To improve the economic performance of farms, we needed to understand the economic and social background we were working in,' Brennan says.

'So we had to understand how important different farming activities were to the total income, what constraints there were and what aspirations or incentives farmers had.

'Once we understood these, we could use bio-economic models to simulate what happened if something changed. For example, what happened if rice or prawn yields improved and how important would that be to farm income?

'This allowed us to speculate in a more structured way about potential improvements.'

The survey found that in both districts, prawns were the most important single



Left: Many farmers feed their prawns on home-made feed, comprised of rice, rice bran, cornmeal and fishmeal. Here the motor from a boat is attached to a grinder, which mixes and grinds the feed into spaghetti-like strands. These are then left in the sun to dry. Research has shown that home-made feed contributes little to the protein requirement of the prawns and more nutritionally balanced commercial feeds were recommended.

Above left: Regular water exchange between prawn ponds and the Mekong Delta - to bring in free wild prawns - causes large amounts of sediment to be deposited on the pond bottom. This sediment must be removed before rice is planted. Monetary and technical limitations prevent farmers returning the silt to the river, so it is piled up on dykes and around the farm house. This practice is unsustainable and causes a gradual loss of land available for crop production. Senior experimental scientist, Chris Jackson, from CSIRO Marine Research, gives some perspective to the quantity of sediment deposited.

crop in terms of income. Rice also provided a good income for farmers in My Xuyen, while crab culture supplemented incomes in Gia Rai. To a lesser degree, vegetables, coconuts and off-farm employment, provided alternative sources of cash.

This generally high level of income diversification meant that households did have food and alternative sources of income in the event of prawn deaths from disease. But the importance of prawns to their total incomes meant that such a failure would be a serious setback.

The survey revealed that rice-prawn farming was expanding at the expense of other crops despite low survival rates of tiger prawns and desperate shortage of both wild and hatchery reared postlarvae. In addition, farmers practising natural recruitment of wild prawns were degrading their land faster than those investing in the more expensive tiger prawn stocks.

For poor farmers, however, the benefits of acquiring wild prawns for free, through frequent tidal water exchange, outweighed future production losses caused by land loss through siltation.

'Farmers exchange pond water at every possible high tide to maximise the recruitment of free prawns. But every free prawn brings in kilograms of sediment,' Preston says.

'Land degradation is a rational choice for them, because they don't have secure tenure of their land, they're poor, and they need money today.'

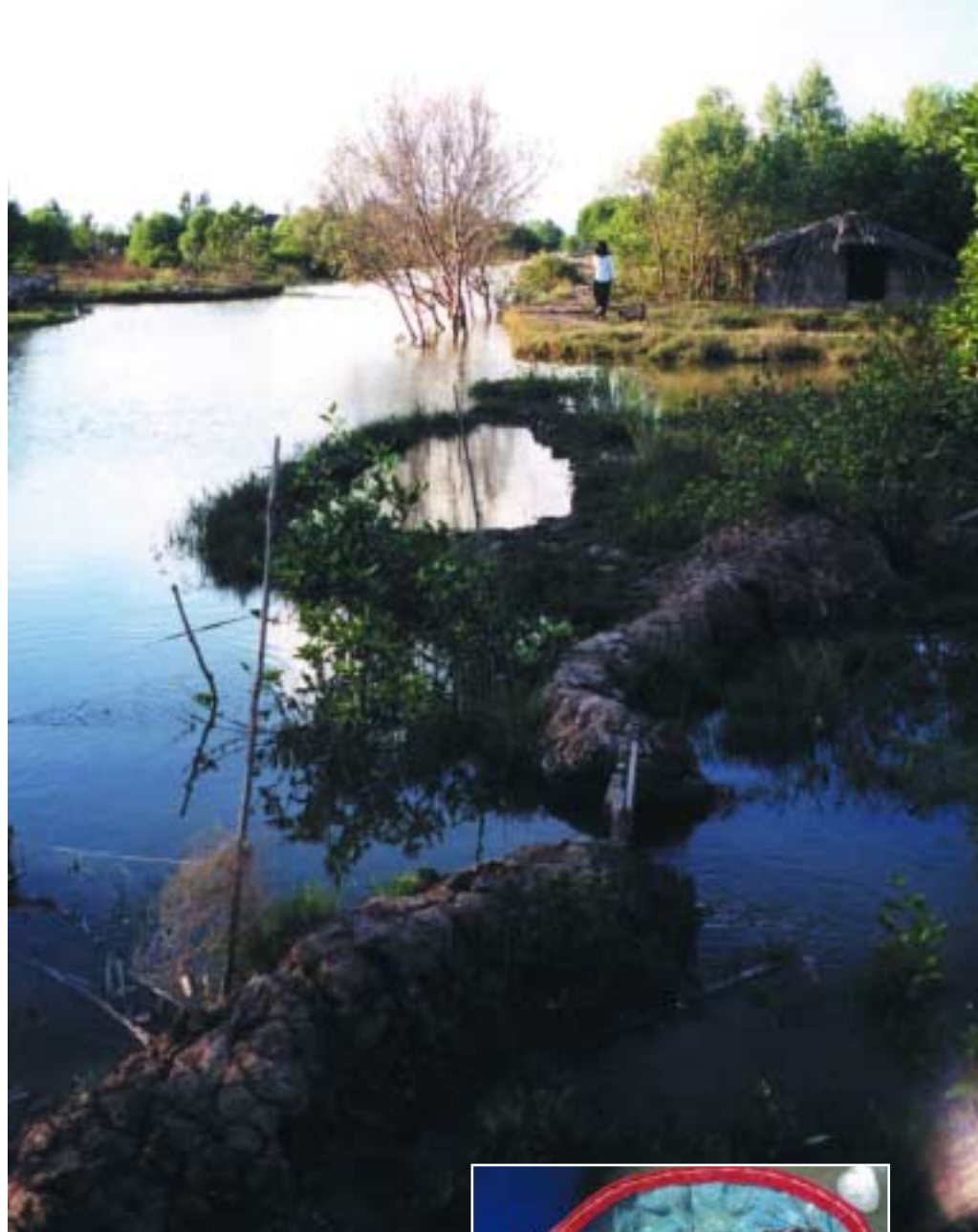
The survey highlighted the need for appropriate technologies to limit or avoid sedimentation, enhance hatchery-reared prawn survival rates and improve postlarval supply.

### Wild stocks and sediments

High rates of sediment deposition during the prawn production cycle in rice-prawn ponds has caused a significant loss of production area, particularly in Gia Rai.

Sediment must be removed to enable effective water management for the rice crop. But as the silt generally cannot be returned to the river, due to economic and technical constraints, most of it is piled on the farmers' land, gradually reducing the area available for production.

'The farmers in Gia Rai are really scratching out a living because the land is



not really suitable for agriculture,' Brennan says.

'The soil is naturally salty and rice farming is not very successful. The average pond area now lost to sediment is about 24%.'

The research team began a field study with five farms in Gia Rai to see whether reducing water exchange rates could be adopted as a management practice without decreasing prawn production rates.

Although low water exchange reduces the recruitment on wild prawns, it creates a more stable pond environment, enhancing the survival and growth of artificially stocked prawns.

Instead of allowing water to enter the ponds at each high tide (two tides per month), one farmer filled his ponds once, while the others either reduced their intake or continued business as usual.

'The highest production – 132 kg of prawns compared to a mean of 40 kg –



Above: Natural biota that enters the ponds with influent canal water can be caught with a beam trawl. The biota, which includes fish, snapping prawns and glass prawns, are a major source of nutrition in the second half of the prawn growth season.

Top: A sluice is opened to allow saline water from the Mekong Delta to flow in through tidal flow (gravity fed) into the farm ponds. In other places, such as this farm in Bac Lieu, a flapgate (in foreground) can be opened to allow water in. This is the most common practice.

was achieved on the farm that had maintained the lowest water exchange. It also had the lowest level of deposited sediment,' Preston says.

'This indicates that low water exchange may be a viable strategy for significantly reducing sediment deposition, without compromising production. But its success will depend on obtaining supplies of hatchery-reared postlarvae.'

### The road to domestication

Encouraging poor farmers to switch from the natural recruitment of wild prawns to hatchery-reared tiger prawn postlarvae is difficult, because the poorest farmers do not have the money to buy these postlarvae or 'seedstock' as they are otherwise known.

Borrowing money is a risky proposition because there are no funds to repay loans

in the event of prawn crop failure. Seedstock supply constraints exacerbate this problem because they have led to the sale of high-priced, low quality post-larvae that have low survival rates.

About 87% (1.7 billion) of postlarvae used in the rice-prawn system come from hatcheries around Nha Trang in central Vietnam, more than 600 km away. Because the post-larvae have to be transported such long distances and are not well acclimatised to conditions in the Delta, survival rates are only about 9% in Gia Rai and 18% in My Xuyen. Farm trials by the research group have shown many of these postlarvae are infected with viral diseases, which emerge when the prawns are under stress.

To improve survival and reduce disease, Preston says future projects could look at building hatcheries within the Mekong Delta. A move away from wild broodstock, (taken from trawlers), to domesticated broodstock would also limit the spread of disease and allow selective breeding for beneficial traits. Disease-free broodstock, and the technology for domestication, are available in Australia. (see *Ecos 104*).

Domestication should also resolve a major bottleneck in rice-prawn farming: the supply of sufficient quantities of tiger prawn postlarvae to farms.

'At the moment, many farms cannot buy any postlarvae,' Preston says. 'But those farms that do are likely to receive

infected stocks. Both issues can be resolved by domestication, but it will take a while to convince the farmers and funding agencies of these benefits.'

In the meantime, Preston and his colleagues have tried to introduce some simple techniques to improve prawn survival in both tiger prawn and wild prawn systems. These include improving the quality of feed and feed management practises, improving water quality, and 'nursing' postlarvae in smaller, more environmentally controlled areas before release into the larger pond.

Importantly, Brennan and Preston found that the relatively low input costs of the rice-prawn system, (compared with the intensive prawn monoculture systems in Thailand and Australia), meant that survival did not have to be very high to break even.

'Even though the risks involved in prawn farming are high, farmers can still make money if survival is above 8% in the natural system and above 17% in the hatchery-reared system,' Preston says.

'However, the risk of crop failure is high in the region and more than 30% of farmers surveyed in Gia Rai experienced complete crop failure. So research and extension focused on improving survival is likely to have a high pay-off.'

### Wiser investment

The Vietnamese government aims to expand prawn farming in coastal provinces from 226 000 to 330 000 hectares during the next five years. The expanded production would contribute 55% of Vietnam's total aquaculture harvest.

But the industry will not achieve environmental or economic sustainability until the problems of siltation, high prawn mortality and inadequate postlarval supplies have been addressed.

According to Preston, there should be no more expansion until the quality and quantity of postlarvae improves. Enforcing such a policy is difficult, but targeting banks and moneylenders may expedite its adoption. Brennan and Preston believe the only way to bring in such a policy is through banks and moneylenders.



Left: Researchers filter water samples to investigate nutrient and phytoplankton.

Above left: Pole bridges were built to allow scientists access to the centre of the pond.



'We have to show them that until the bottlenecks in prawn farming are overcome, lending money for expansion is as risky for them as it is for prawn farmers,' they say.

Brennan says banks will be involved in the development of best management practices.

'In the next 12 months we'll be talking to government authorities about their aspirations and we'll encourage more

discussion about problems of regulation, science and extension,' Brennan says.

'We'll also ensure banks have access to this information, as they already provide information to farmers about farm management practices. This could help reduce the risk of crop failure and loan default.'

In the meantime, Preston and Brennan say there are two good management strategies that farmers can employ to reduce economic risks.

'Income diversification can help spread risk, so it's important that farmers produce rice or vegetables, or have some other form of employment,' Brennan says.

'Farmers practising the rice-prawn farming system have, in general, managed to achieve financial sustainability and this project may help authorities and banks promote rice-prawn as a safer option than prawn monoculture.'

The second strategy is wise investment.

'We're trying to highlight in our management practice suggestions that if farmers make money, they need to invest it safely, not put all of it into prawns the next year,' Brennan says.

'Many households we surveyed had some cash, gold or household assets and this practice could be encouraged through extension and improved financial institutions that provide good returns on savings.'



Top: Can Tho, capital of the Mekong Delta.

Above: Farmers and scientists travel by boat along the canal systems in the delta. At Vinh Loi town, scientists and their supplies await a boat to take them to their research farms.

The ongoing exchange of information between Australia and Vietnam, and further research by three Vietnamese post-graduate students (Tran Thanh Be, Le Xuan Sinh and Tran Thi Tuyet Hoa) into prawn farming problems and technologies, should help overcome any cultural barriers to change, and eventually, the bottlenecks to sustainability identified in the study.

**Abstract:** Farmers in parts of the Mekong Delta in southern Vietnam are turning to integrated rice-prawn farming in a bid to boost income. A study into the economic and environmental sustainability of rice-prawn farming found that, prawn farming practices unsustainable. Farmers relying on natural recruitment of wild prawns were losing valuable land to sediment. Alternatively, farmers stocking ponds with tiger prawn postlarvae from hatcheries risked losing their crop to disease. Encouraging farmers to reduce water exchange between their ponds and the delta, and to stock ponds with hatchery reared 'seedstock', will improve environmental sustainability. Until appropriate technology can be developed, simple pond management and financial management strategies have been introduced to reduce farmers' exposure to income risk from prawn production.

**Keywords:** prawns, prawn farming, aquaculture, agricultural systems, sustainable agriculture, farm management Mekong Delta, Vietnam.