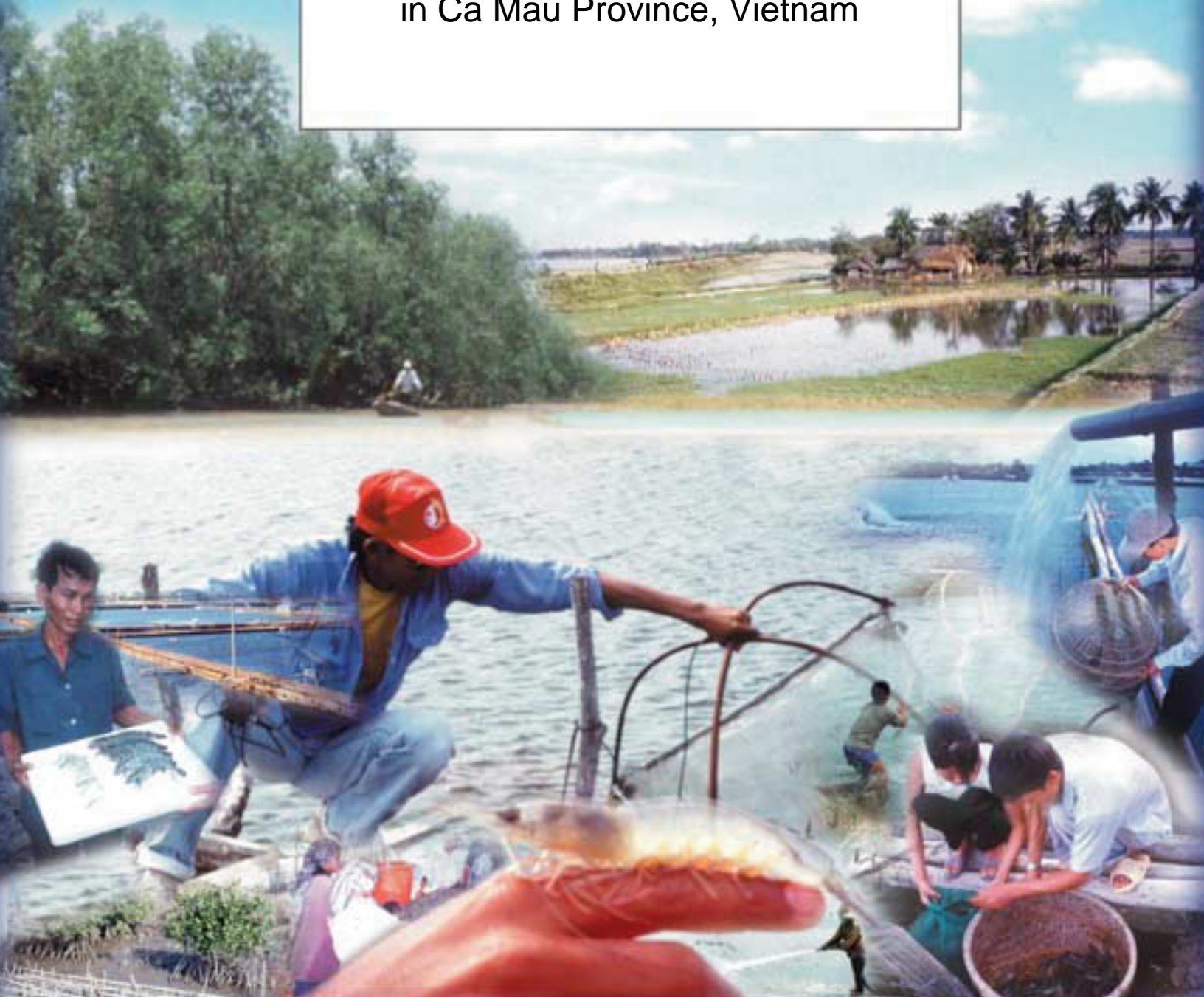


# Shrimp Farming and the Environment

Silvofishery Farming Systems  
in Ca Mau Province, Vietnam



A Consortium Program of:



# SILVOFISHERY FARMING SYSTEMS IN CA MAU PROVINCE, VIETNAM

## (1) A DESCRIPTION OF SYSTEMS AND MANAGEMENT PRACTICES

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Report Prepared for the

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Consortium Program on Shrimp Farming and the Environment

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### Preparation of this document

The research reported in this paper was prepared under the World Bank/NACA/WWF/FAO Consortium Program on Shrimp Farming and the Environment. Due to the strong interest globally in shrimp farming and issues that have arisen from its development, the consortium program was initiated to analyze and share experiences on the better management of shrimp aquaculture in coastal areas. It is based on the recommendations of the FAO Bangkok Technical Consultation on Policies for Sustainable Shrimp Culture<sup>1</sup>, a World Bank review on Shrimp Farming and the Environment<sup>2</sup>, and an April 1999 meeting on shrimp management practices hosted by NACA and WWF in Bangkok, Thailand. The objectives of the consortium program are: (a) Generate a better understanding of key issues involved in sustainable shrimp aquaculture; (b) Encourage a debate and discussion around these issues that leads to consensus among stakeholders regarding key issues; (c) Identify better management strategies for sustainable shrimp aquaculture; (d) Evaluate the cost for adoption of such strategies as well as other potential barriers to their adoption; (e) Create a framework to review and evaluate successes and failures in sustainable shrimp aquaculture which can inform policy debate on management strategies for sustainable shrimp aquaculture; and (f) Identify future development activities and assistance required for the implementation of better management strategies that would support the development of a more sustainable shrimp culture industry. This paper represents one of the case studies from the Consortium Program.

The program was initiated in August 1999 and comprises complementary case studies on different aspects of shrimp aquaculture. The case studies provide wide geographical coverage of major shrimp producing countries in Asia and Latin America, as well as Africa, and studies and reviews of a global nature. The subject matter is broad, from farm level management practice, poverty issues, integration of shrimp aquaculture into coastal area management, shrimp health management and policy and legal issues. The case studies together provide an unique and important insight into the global status of shrimp aquaculture and management practices. The reports from the Consortium Program are available as web versions (<http://www.enaca.org/shrimp>) or in a limited number of hard copies.

The funding for the Consortium Program is provided by the World Bank-Netherlands Partnership Program, World Wildlife Fund (WWF), the Network of Aquaculture Centres in Asia-Pacific (NACA) and Food and Agriculture Organization of the United Nations (FAO). The financial assistance of the Netherlands Government, MacArthur and AVINA Foundations in supporting the work is also gratefully acknowledged.

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### Reference:

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<sup>1</sup> FAO. 1998. Report of the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture. Bangkok, Thailand, 8-11 December 1997. FAO Fisheries Report No. 572. Rome. 31 p.

<sup>2</sup> World Bank. 1998. Report on Shrimp Farming and the Environment – Can Shrimp Farming be Undertaken Sustainably? A Discussion Paper designed to assist in the development of Sustainable Shrimp Aquaculture. World Bank (Available on [www.enaca.org/shrimp](http://www.enaca.org/shrimp)).

## **Abstract**

The present case study is divided into two parts: (1) a description of the farming systems and management practices for mixed shrimp aquaculture-mangrove farming systems in the Mekong delta of Vietnam; and (2) the findings from a detailed socio-economic study of these farming systems. The case study describes and builds on experiences of the ACIAR/RIA-2/NACA Project (PN 9412) “Mixed shrimp farming-mangrove forestry models in the Mekong delta”. The project was carried out in two State Fishery-Forestry Enterprises (SFFE), Tam Giang III (TGIII) and SFFE 184, both located in the Ngoc Hien District, Ca Mau Province, Vietnam.

The first phase of the project (1996-98) achieved its two technical objectives of investigating the main factors limiting shrimp and wood production, and identifying improved culture options and management practices for these mixed farming systems. The project was extended into a second phase (until September 2000), to assist in achieving the other objective of assisting national and provincial authorities to transfer project results and recommendations to coastal farming communities in the lower Mekong Delta. In this regard, an in-depth socio-economic study of sample farmer communities in the two Enterprises was carried out to assess the benefits and constraints relating to the implementation of the management recommendations by farmers, and to recommend appropriate institutional framework that would enable effective adoption of these recommendations.

The findings provide important insight into the social and economic status of farmers involved in mixed aquaculture-mangrove farming, and the constraints associated with the adoption of management recommendations, with special consideration of the problems faced by poor farmers.

In addition, the information on socio-economic conditions of farmers practising silvo-aquaculture, gathered through this study, may be of use to a number of other projects currently on-going or planned in the Mekong Delta, including the World Bank-Government of Vietnam project for the Rehabilitation and Development of Coastal Wetlands. The findings are also of more general concern to the World Bank/NACA/WWF/FAO Consortium Program on Shrimp Farming and the Environment, providing management practices relevant to mixed farming systems, and wider understanding of the constraints faced by poor farmers in adopting better management practices.

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## Abbreviations and Acronyms

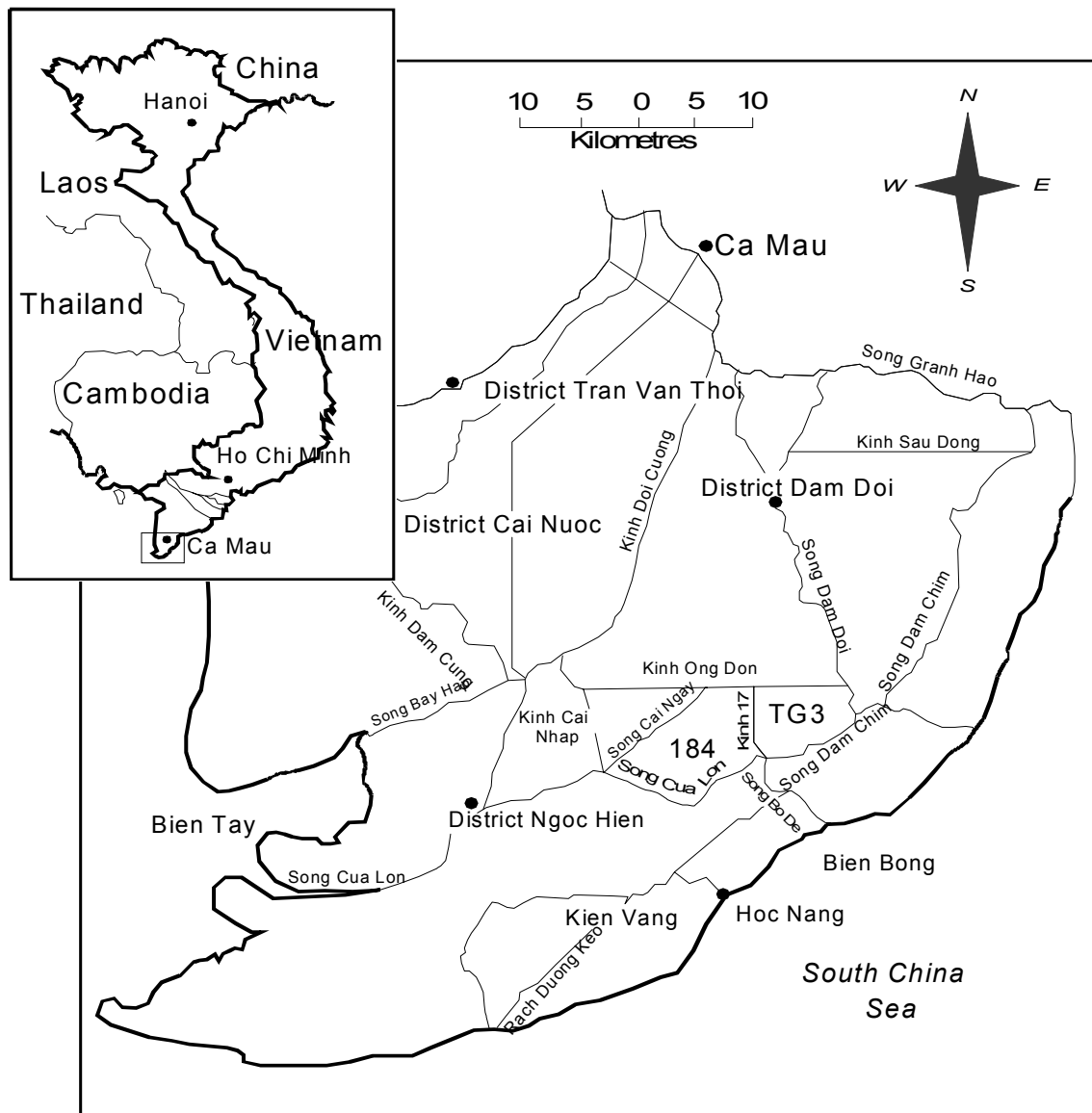
ACIAR	Australian Centre for International Agricultural Research
BZ	Buffer Zone
CWPDP	Coastal Wetlands Protection and Development Project
DARD	Department of Agriculture and Rural Development
FAO	Food and Agriculture Organization of the United Nations
FPZ	Full Protection Zone
SFFE 184	State Fisheries-Forestry Enterprise 184 (Name of study area)
NACA	Network of Aquaculture Centres in Asia-Pacific
PL	Post Larvae
ppm	Parts per million
RMFP	Rehabilitation of Mangrove Forest Project
SFFE	State Fisheries Forestry Enterprises
TGIII	Tam Giang 3 (Name of study area)
VBP	Vietnam Bank for the Poor
VND	Vietnamese Dong (1 US\$ = 14,000 VND in 1999)
WB	World Bank
WWF	World Wildlife Fund



# Description of Systems and Management of Mixed Shrimp Aquaculture-Mangrove Farms in the Mekong delta of Vietnam

## Background

Ca Mau Province (8° 34' to 8° 57' N, 104° 43' to 105° 25' E) is part of the lower Mekong Delta region land area, and the southernmost province of Vietnam (Figure 1). In common with most of the Mekong Delta, the province is relatively flat topographically, much of the lying within the intertidal zone between about MSL + 1 m and MSL - 1 m. Prior to the Vietnam–American war Ca Mau was covered extensively by mangrove forests, most of which were destroyed by defoliants sprayed during the war. During this period about 80% of the 44,900 ha of mature *Rhizophora* forest in Ca Mau was destroyed by herbicides (Hong and San 1993) Following the reunification in 1975, natural regeneration and extensive replanting, mainly with monocultures of *Rhizophora apiculata*, led to the partial recovery of mangrove vegetation. More recently, however, rapid expansion of coastal shrimp aquaculture has contributed to, but is not entirely responsible for the loss of more than half the mangrove forest that existed in Ca Mau and Bac Lieu provinces in 1982. In the 10 year period



**Figure 1.** Map of Ca Mau Province, showing the location of Tam Giang III (TG3) and SFFE 184 Enterprises.

from 1982 to 1992, the area of mangroves decreased by about 40,000 ha (48%) in Ngoc Hien district of Ca Mau Province, while the area of shrimp ponds increased to more than 30,000 ha (Binh 1994).

In addition to supporting coastal capture fisheries and providing protection from storms, mangrove forests currently supply much of the material used for rural housing and most of the firewood needs for domestic heating in the province. In response to these resource and land use issues, 22 State Fisheries Forestry Enterprises (SFFE) were established in 1986, where both shrimp and mangrove wood are produced by individual farmers on small holdings. While these enterprises appeared initially to offer a partial solution to the problems of conflicting land use and environmental quality, farm production and income has declined in recent years.

The central Government is responsible for overall policy with respect to mangrove and other coastal resources in Vietnam. Within this overall policy framework, provincial Governments have some degree of independence in formulating and implementing more specific policies and management strategies relating to provincial land use options. Provincial Forestry and Fisheries Departments, together with Enterprise Managers are responsible for year-to-year and day-to-day management of forestry and fisheries activities. In practice, the lines of responsibility and decision making often overlap between national and local government agencies, leading to some conflict in goals, policy and management issues between forestry and fishery sectors.

In 1991, the Provincial People's Committee of the then Minh Hai Province (Now subdivided into the two provinces of Ca Mau and Bac Lieu) took the decision to classify mangrove forestlands into three types, and to implement a participatory forestry policy (Decree No. 64-QD/UB on 28 March 1991). This was supplemented by a further decision to decentralise forest management to the private sector and to organisations (Decree No. 02/CP on 15 January 1994). In practice there have been difficulties in implementing these policies, resulting in a continuing loss of mangroves through illegal cutting by both landholders and itinerant workers. This resulted in the imposition of a total ban on the cutting of mangroves in Ngoc Hien District in 1996 (The ban was removed in mid-year 1999).

This case study describes a collaborative research study to assess the main factors affecting the yield of shrimp and mangrove wood in mixed shrimp culture-mangrove forestry farming enterprises in Ngoc Hien District, Ca Mau province, southern Vietnam (Figure 1), and to evaluate options for improving farm production and income sustainably within existing environmental and socio-economic constraints. Much of the description of the farming systems and practices has been taken from a published article by the same authors (Johnston et al. 1999).

## **General Description of the Site**

The two State Fisheries-Forestry Enterprises (SFFE) covered by this case study, LNT 184 (abbr. 184) and Tam Giang III (abbr. TG3) are situated in the Ngoc Hien District of Ca Mau Province (Figure 1). Both enterprises border the Cua Lon River, which transects the province from the South China Sea to the east, and the Gulf of Thailand to the west (Figure 1). Both enterprises are situated on relatively flat, low-lying, swampy land, most of which is flooded by tides for 180–360 days per year. Mangroves are the dominant vegetation on the tidally flooded land.

Soils in both enterprises are predominantly medium to heavy clays consisting of about 50% clay (< 4 µm in size) and 50% fine silt (4–17 µm in size) down to a depth of at least 50 cm. Soil salinity ranges from about 20‰ up to 35‰. Wet soil pH ranges from about pH5 to pH7, with dry soil pH in the range of pH4.5 to pH6.5. Consequently these soils are mildly acidic, and there is evidence of potential acid sulphate conditions in some areas.

The area experiences a pronounced wet season from May to November, and a dry season from December to April, with an annual average rainfall of about 2400 mm (Table 1).

**Table 1.** Mean annual values for climatic parameters, based on records from the Ca Mau weather station for the years 1971 - 1998.

Parameter	Value
Average temperature (°C)	27
Minimum temperature (°C)	19.6
Maximum temperature (°C)	35.5
Relative humidity (%)	83
Precipitation (mm)	2,366
Evaporation (mm)	836
P/E ratio	2.8

There has been a rapid increase in the human population in Ngoc Hien District since the early 1980s. From 1983 to 1992 the population of Ngoc Hien almost doubled in size (Hong and San 1993), so that by 1993 an estimated 9,600 households had settled on former mangrove forest land, of which about 6,800 had settled illegally, encroaching on more than 30,000 ha of mangroves to build shrimp ponds (Binh 1994). In 1996, SFFE 184 was estimated to have 1,018 farming households, with a total population of about 7,000 people, while the smaller Tam Giang III enterprise had 236 farming households representing 1,007 people. Most farming households are relatively recent immigrants from elsewhere, the average residence time in both enterprises being about 5 years (as of 1996).

### Land Use Policy and Planning Issues

Mixed shrimp - mangrove forestry farms in Ca Mau Province generally range in size from 2 -17 ha of which, under the original government policy, 70% was allocated for mangrove forest, 20% for ponds, and 10% for housing and other domestic purposes. However, the provincial government has recently proposed changes to these guidelines to increase the proportion used for aquaculture, housing and other domestic purposes to 40% of the farm area. In practice, this will probably result in more than 40% of household land being used for aquaculture and domestic purposes, as past experience suggests that farmers tend to stretch the limits set by local authorities.

This decision is in line with a policy to increase provincial aquaculture exports from US\$ 145 million in 1999 to US\$ 500 million by 2005. This is expected to be met in part by switching about 50,000 ha of land in Dam Doi, Cai Nuoc and a part of Tran Van Thoi districts to mixed rice (wet season) - shrimp (dry season) farming systems from the present rice only production cycle.

Provincial forestry policy has traditionally focussed predominantly on the production of timber and fuel from mangroves in Ngoc Hien District and, to a lesser extent from, Melaleuca forests which are extensive in the western part of the province. However, rising land levels in some parts of Ngoc Hien District are likely to require a re-thinking on forestry and land use policies.

All waterways in Ngoc Hien District carry high levels of suspended sediment. These suspended sediments are very small in size, about 50% being clay of less than 4 microns in size and the remaining 50% being fine silt of 4 microns to 17 microns in size. Historically, these sediments presumably originated in the catchment of the Mekong and its tributaries, and were carried south by currents in the South China Sea, the heavier sand and coarse silt particles settling out before reaching the Ca Mau Peninsula. Locally, fine sediment in waterways also comes from erosion of the eastern coastline, and erosion along the edges of waterways caused by tidal flows and boat traffic, both of which are also sufficient to keep most of the fine material in suspension. Under the relatively static conditions in ponds, a proportion of this sediment settles out on the bottom of the pond. Ponds need to be cleaned at least annually to maintain an appropriate water depth for shrimp culture. Provincial regulations forbid this material to be pumped back into the waterways (though this is often done surreptitiously) and so legally this sediment has to be deposited somewhere on the farm. In the large extensive mixed farming systems of Ca Mau it is usually deposited in adjacent mangrove areas.

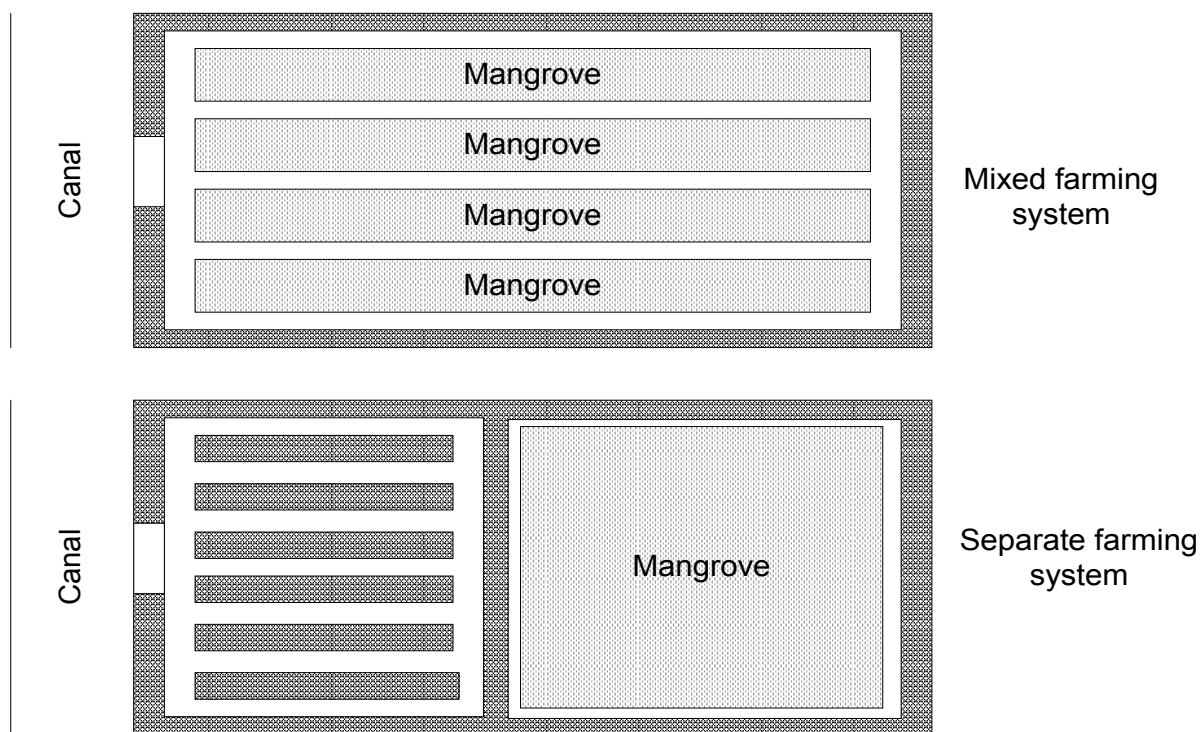
This, together with the processes described in the preceding sections of this case study, suggest that land levels overall are rising in mixed shrimp farming-mangrove forestry enterprises in the south-eastern parts of Ca Mau province. The consequences of this can be seen elsewhere further inland in the province, where mangroves have almost entirely disappeared or have been reduced to a thin veneer of a few metres in width adjacent to waterways. To some extent these changes are inevitable, because they form part of the pattern of landbuilding that occurs naturally in many mangrove dominated estuaries. However, the speed with which they have taken place, and are continuing to take place in Ca Mau, has accelerated as a result of the development that has occurred in the province over the past two to three decades, of which aquaculture is a significant part.

The impact of these changes are likely to be felt within two to three decades, and will have far reaching impacts on farming and other land use practices in Ca Mau province, and on related policies. Changes likely to occur within the next 20 years include:

- A decline in wood production from mangrove forest.
- A shift from traditional and extensive aquaculture to improved extensive and semi-intensive aquaculture. This will involve the gradual disappearance of the present mixed farming system, which will not be economically or environmentally sustainable under the joint influence of declining mangrove forest yields and the management requirements for improved extensive or semi-intensive aquaculture. Intensive aquaculture in Ca Mau may not be an option owing to poor water quality, unless new, more cost effective, environmentally sustainable technologies for managing this become available.
- Diversification of farm outputs, which increasingly are likely to include terrestrial forestry, horticulture and cash crops, along with polyculture or the concurrent culture of aquatic species other than shrimp.

### **Farming Systems and Practices**

There are two main farming systems, which for present purposes will be called 'mixed' and 'separate'. Ponds in both systems consist of a series of long (250-800m), narrow (3-4m wide) parallel channels dug either through (mixed) or adjacent (separate) to forest and separated by levees. In mixed systems, the levees are vegetated by mangroves and are similar in principle to the tambak aquaculture systems used in Indonesia. In the separate system, pond levees are bare with the ponds located near waterways at the front of the farm, while mangroves are usually grown on a separate area at the back of the farm (Figure 2). Ponds are generally shallow, ranging from 30 cm to 1 m water depth, with a mean of 50 +/- 11.5cm. Each pond is connected to the waterway by one or sometimes two sluice gates. Those farmers with access to investment tend to use cement sluice gates, usually about 1 m in width, whereas poorer farmers use wooden sluice gates of about 0.8 m in width.

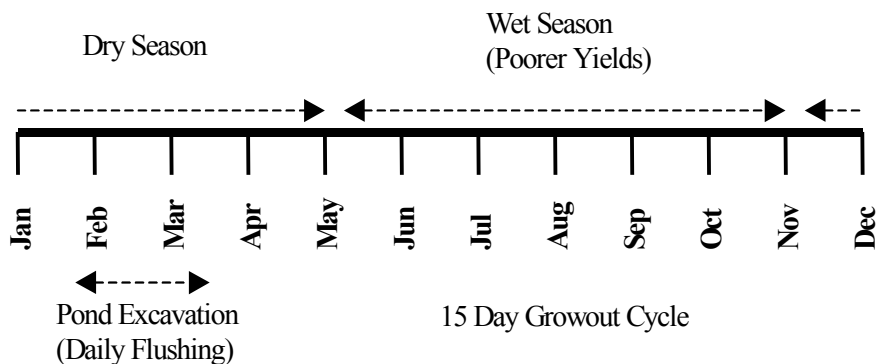


**Figure 2.** Schematic diagram of mixed and separate farms.

Traditionally, shrimp culture in Ca Mau Province has been primarily extensive, based on the tidal recruitment and harvest of wild penaeid and metapenaeid shrimp from local waterways, with little or no supplementary feeding, aeration, water pumping or soil treatment. The predominant species cultured are *Metapenaeus ensis* and *M. lysianassa* (>80% harvest) with *Penaeus indicus* the next most important species (7-10%). Stocking densities are generally low, between 1 and 5 post larvae/m<sup>2</sup>. This is reflected in annual shrimp production, which is low and highly variable ranging between 100 and 400 kg/ha/yr, with mean shrimp yields of 286 +/- 106 kg/ha/yr. Some farmers stock part of their pond with hatchery reared postlarvae of *Penaeus monodon*, but most have had variable success owing to the poor quality of hatchery reared postlarvae, widespread mortality from shrimp viral diseases, and inappropriate management practices (AIMS, RIA-2, NACA. 1999a and 199b).

#### *Production Schedule*

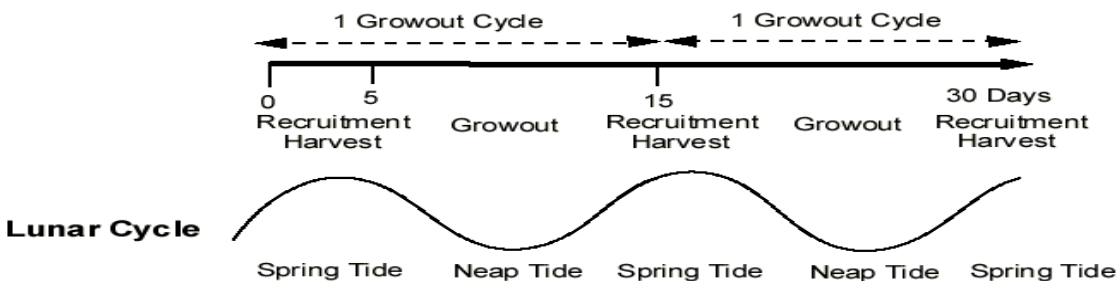
Most farmers follow a similar aquaculture management protocol (Figure 3). During February and March the ponds are drained and sludge that has accumulated on the pond bottom (about 20-30 cm annually) is removed and placed on adjacent levee banks. Placement on levees causes leaching of acid sulphate soil into ponds during the wet season. This problem is continuing due to lack of appropriate land on which to place the excavated mud. Costs vary depending on whether the pond bottom is cleaned manually (16,000 – 20,000 VND per 3 x 36 m channel), or with a dredge (100, 000 – 120,000 VND per channel) (14,000 VND ~1USD in March 1999). The majority of farmers excavate the ponds themselves and although the benefits of cleaning the pond bottom annually are well known (some farmers clean their ponds twice a year), most farmers clean their ponds only every few years owing to their lack of financial capital.



**Figure 3.** Shrimp culture management practices throughout a typical year. Some farmers will also excavate ponds between June and September if money is available

After cleaning the pond bottom, the ponds are either allowed to dry out, or are flushed daily by leaving the sluice gate open. This free flushing is believed to be linked with good yields for those farmers who practice it. During free flushing, a wide mesh net is placed at the sluice gate to capture fish and large shrimp from the river during the flood tide whilst allowing shrimp post larvae and juveniles into the pond. On the following ebb tide shrimp from the ponds are also harvested in the net. Hence a double harvest and single recruitment occurs per day. Following excavation, ponds are filled during the first spring tide in late March - early April and a 15 day grow out cycle is initiated. However, some successful farmers leave the shrimp to grow for 1.5 months with regular recruitment every 15 days. The resultant harvest is one of the biggest for the year.

During each 15 day growout cycle, recruitment and harvest occurs on consecutive flood and ebb tides for 3 - 5 days of the spring tide period (Figure 4). During recruitment the sluice gate is opened to allow shrimp to enter the pond on the flood tide. A mesh screen is placed at the front of the sluice gate to prevent predators from entering the pond. After recruitment the sluice gate is closed and a conical bag net up to 7m long, is placed at the front of the gate with its mouth facing into the pond. The gate is re-opened on the ebb tide and shrimp/fish/crabs are harvested in the net. Ponds are drained to approximately 20 cm depth after which the sluice gate is closed and then reopened for the next recruitment. This continues day and night until spring tides have passed. The sluice gate is then closed for a 10-12 day growout period during the neap tides. Water exchange is limited during this time, although the first two boards may be removed to allow approximately 20



**Figure 4.** Schematic diagram of the 15 day grow out cycle for shrimp culture in Ca Mau province. During a single growout cycle recruitment and harvest occurs concurrently over 3-5 days of spring tides followed by approximately 10-12 days growout during the neap tides. Recruitment and harvest is then repeated on the next spring tide. This 15-day cycle is repeated throughout the year.

cm water exchange. Recruitment and harvest is repeated during the next spring tide period. This 15 day cycle continues for the remainder of the year (Figure 4).

#### *Recruitment and Harvesting Technique*

Although recruitment for the majority of farmers is just an opening of the sluice gate on the flood spring tide, successful farmers have optimised the recruitment potential and survival of wild seed by adopting techniques based on their behaviour. Prior to the tide turning, these farmers open the sluice gate on the ebb tide which concentrates post larvae at the entrance of the sluice gate due to the water turbulence. When the water level in the canal rises to nearly equal that inside the pond, the post larvae swim against the gentle out-flowing current and into the pond. This gentle current prevents any damage and at the same time the turbulence attracts larvae to the gate. Hence a greater number of larvae are recruited and a higher proportion survives once in the ponds.

The traditional harvesting technique used by farmers involves capturing shrimp and fish exiting the pond on the ebb tide in a bag net which extends into the canal from a frame within the sluice gate.

### **Mangrove Forestry**

Mangroves are a major source of timber and thatching for houses and other buildings throughout much of the Ca Mau Peninsula. They are also the main source of fuel, providing local communities with both fuelwood and charcoal for cooking. Based on the projected demand for firewood of 954,000 m<sup>3</sup> in Ca Mau and Bac Lieu Provinces in year 2000 and timber yields from mangrove forests of about 12 m<sup>3</sup> ha<sup>-1</sup> y<sup>-1</sup> (Hong and San 1993), it is estimated that about 80,000 ha of mangrove forest will be required to meet just the fuelwood demands in these provinces by the end of this century. The remaining area of mangroves in Ca Mau and Bac Lieu Provinces is not known accurately, but is probably in the vicinity of 50,000 ha or less (Hong and San 1993). Typhoon Linda damaged much of this remaining forest, particularly older stands, in October 1997.

Depending on the size of their farm, most farmers have 4-8 ha of mangrove forest, which they are required by provincial policy to manage for wood and fuel production. Failure to meet this requirement may result in the lease being revoked before it expires, or not renewed after 20 years. However, financial returns to farmers from aquaculture are much higher than those from mangrove forestry. Hence, most farmers are keen to expand their ponds into areas presently set aside for forestry.

Under the current forest management policy, *Rhizophora apiculata* is planted at an initial density of 20,000 ha<sup>-1</sup>, with thinnings by 20-30% at 5, 10 and 15 years, and the final harvest at 20 years. Stands planted at 20,000 ha<sup>-1</sup> begin to self-thin at about 5 years of age, so the timing of the first thinning is most appropriate. However, a thinning rate of 20-30% is much too low. Stands thinned manually by only 30% at 5 years of age begin to self-thin again at about 8 y of age, two years before the next scheduled manual thinning at 10 years of age. Trees lost through self-thinning represent a substantial loss in potential wood production unless they are removed immediately after death. This cycle is repeated at each of the subsequent thinning at 10 and 15 years of age, in each case self-thinning commencing about 2 years after the previous manual thinning.

At 10 years of age, when the second thinning is carried out, trees have an average stem diameter of 6 cm. With a nominal 30% thinning rate, thinnings yield about 30 m<sup>3</sup> of wood ha<sup>-1</sup>. Wood removed at the second thinning is used for smaller poles (valued in June 1998 at about US\$ 30-40 m<sup>-3</sup>), firewood (US\$ 6.40 m<sup>-3</sup>) and charcoal production (US\$ 115 per metric tonne). At 15 years of age, when the third manual thinning is carried out, the trees have an average stem diameter of 8-9 cm. With a nominal 30% thinning rate, thinnings yield about 44 m<sup>3</sup> of wood ha<sup>-1</sup>. Wood removed at the third thinning is used for larger poles (valued in June 1998 at about US\$ 50 m<sup>-3</sup>), firewood (US\$ 6.40 m<sup>-3</sup>) and charcoal production (US\$ 115 per metric tonne).

By 20 years of age, when the final harvest is carried out, stand density has fallen to about 1,500 ha<sup>-1</sup> as a result of natural self-thinning, because stands that have been thinned manually by 30% at 15 years of age begin to self-thin again at 18-19 years of age. Trees harvested at 20 years of age have an average stem diameter of 11-12 cm, the final harvest yielding about 180 m<sup>3</sup> of wood ha<sup>-1</sup>.

### **Impact of Aquaculture on Mangroves**

Aquaculture development in Ca Mau Province has had a significant impact on the hydrology of mangrove areas. Many of the remaining mangroves are surrounded by levee banks, or situated in areas where tidal access is hindered. In mixed farms, where mangroves are enclosed within a levee surrounding the farm, normal tidal flooding and flushing is prevented by the more or less constant water level in the pond. Flooding and flushing of mangroves in these farms is further hindered by the usual practice of placing soil excavated during pond construction along the edge of the adjacent mangrove areas. Reliable estimates of the frequency and duration of flooding for mangrove areas in Tam Giang III and LNT 184 enterprises are not available. However, based on general field observations it is probable mangrove areas within the ponds of mixed farms are rarely flooded. The situation for mangrove areas located outside the pond on farms using the separate farming system is less clear, but field observations again suggest that many areas are flooded for not more than about 2-3 days per month.

### **Impact of Mangroves on Aquaculture**

Farmers who use the mixed mangrove-pond farming system report that shrimp yields decrease when mangroves within the ponds reach 8-10 years of age. This is attributed by farmers to a lack of light through shading of the pond canals by the forest canopy. However, shading by mangrove canopies is probably not significant, given that the water in the pond is already highly turbid, and the water transparency is usually less than 20 cm. Mangrove leaves have a very high tannin content, and a more likely explanation is that the decomposition of leaves that have fallen into the pond canals leads to relatively high levels of tannin, particularly near the pond bottom where shrimp usually feed. Regardless of the mechanisms involved, most farmers respond to the decline in pond production by cutting back the mangroves along the edge of the pond channels.

It is clear from the foregoing that extensive mixed farming systems in Ngoc Hien District present a number of environmental and production problems, and that they require management compromises to be made that are not optimal for either shrimp culture or mangroves. These problems will become even more serious as farmers shift from extensive culture of wild shrimp to improved extensive and semi-intensive culture of *P. monodon* in response to government policy for the aquaculture sector, and to socio-economic pressures.

### **Management Interventions to Improve Farm Production and Income**

#### *Improved Extensive Wild Shrimp Culture*

A number of factors are responsible for low yields from traditional extensive culture of wild shrimp. Some common problems and simple, common sense, inexpensive practices to address them include:

- Many ponds are too shallow and have high rates of leakage, resulting in water levels of less than 50-60 cm between lunar cycles. Narrow, poorly maintained channels inside the pond often compound this. As a consequence, the water volume in the pond is too small to buffer changes in water quality between topping up on lunar spring tides. This can lead to excessive diurnal changes in water temperatures and oxygen levels during period of high insulation in the dry season, and to rapid changes in salinity and pH during heavy rain in the wet season (Johnston et al. 1999). Re-digging the pond to an average water depth of 1 m, reducing leakage where possible, and careful attention to regular cleaning of the pond bottom and other general pond maintenance activities between crops,



would improve water quality management overall and contribute significantly to better conditions for shrimp health in the ponds.

- Poor recruitment of wild seed, leading to low stocking densities. This is partly a result of declining wild seed stocks in local waterways, especially of higher value Penaeid species like *P. merguensis* and *P. indicus*. Hence, smaller, lower value metapenaeid species like *M. ensis* and *M. lysianassa* make up more than 80% of the harvest (Johnston et al. 2000). However, the almost universal practice of recruiting wild seed on the flood tide every 15-day lunar cycle, followed by harvesting on the ebb tide of the same tidal cycle, also leads to a significant loss of recent recruits (Johnston et al. 2000).

Furthermore, harvesting every 15 days means that a significant proportion of the shrimp harvested are relatively small, and therefore of low value. This harvesting schedule is carried out chiefly to provide farmers with a regular source of income and reduce the perceived risk of high mortality when shrimp are allowed to growout for longer. In practice this management technique represents little more than subsistence capture fisheries.

While little can be done to redress the harvest imbalance between metapenaeids and penaeids, a change in the recruitment and harvest cycle to improve recruitment and extend the growout period is suggested. This involves topping up the pond and recruiting on flood tides every 15 days, coupled with harvesting larger shrimp using 'tom te' or 'against water current' techniques (Johnston et al. 1999). This would minimise large losses of recently recruited juveniles from bagnet harvests on ebb tides, and increase the size (and value) of the harvested shrimp. In practice, it has proven to be difficult to change farmer perceptions of the benefits of changing to this management strategy.

#### *Improved Extensive and Semi-intensive Culture of P. monodon*

Prior to 1994, improved extensive culture of hatchery reared *P. monodon* post larvae was widely practised, but since then most farmers have experienced severe financial losses from *P. monodon* culture. This has been due to a combination of poor water quality, unhealthy or poor quality post larvae from local hatcheries, poor handling techniques during transport and at stocking, poor management during growout, and a significant increase in the incidence of shrimp diseases.

However, intensification of shrimp culture forms a major part of national and local government policy for aquaculture development in the lower Mekong delta. Several small-scale experimental trials of semi-intensive culture of *P. monodon* in Ngoc Hien district have given encouraging yields (1-2 t ha<sup>-1</sup> y<sup>-1</sup>). However, it is not yet clear whether such yields (or higher yields) will be sustainable in all parts of the district over the longer term, and the environmental implications for widespread adoption of semi-intensive shrimp culture have yet to be assessed. In addition, there are several other constraints on the widespread, rapid and successful shift to semi-intensive shrimp culture in Ngoc Hien district:

Semi-intensive culture is much more capital intensive than the present extensive culture system, and carries with it a significantly higher risk of severe financial loss if a crop fails. Most existing small-scale farmers in Ngoc Hien district have limited capital to invest in the changes to their farms that will be needed to carry out semi-intensive culture successfully and would be seriously affected financially by a failure over the first few crops. Furthermore, the ability of most farmers to borrow capital at reasonable rates of interest is severely restricted by their lack of collateral, due in part to the lack of land tenure and the short term nature of their farm lease (20 years).

Many farmers already manage their extensive farms poorly, few have had experience of *culturing P. monodon* successfully, and even fewer have had any experience in semi-intensive culture of *P. monodon*. With the low educational level of most farmers, and the general lack of fisheries extension support in Ngoc Hien District, it

will probably take some time for many farmers to acquire the new skills and experience needed to carry out semi-intensive aquaculture successfully.

It is already clear that in Ngoc Hien District, *P. monodon* will grow to about 40-50 g in weight over a three-month growout period. Thus the key to improving the yield from this species is to increase the overall survival rate, which is commonly about 1%, and seldom greater than 10% in Ngoc Hien District. Small-scale trials, working with several farmer groups in Ngoc Hien District, are presently underway to improve the survival rate. These involve the following:

- Re-digging ponds, or parts of them, to a water depth of 1 m.
- Training farmers in selecting high quality seed.
- Implementing sound nursery management practices, including feeding.
- Conducting trials on feeding during growout.
- Training farmers how to manage water quality within existing environmental, infrastructure and economic constraints.
- Training farmers how to monitor shrimp health and growth.
- Advising farmers on how to implement step by step improvements to pond design and management based on household economic circumstances.

Semi-intensive culture using hatchery-reared post larvae at low stocking densities is considered to be a viable option for farms with good pond design and good management practices. For many farms, however, attention would need to be given to improving pond design and management skills before they shift to semi-intensive culture of *P. monodon* or *P. indicus*. A sensible approach would be to start semi-intensive culture in a small, improved section of the pond and then for the farmer, after having gained success and experience, to gradually increase the area of pond given over to semi-intensive culture. However, caution should be exercised in shifting farms entirely to semi-intensive culture because of the ever present risk of losing a crop from disease or from uncontrollable changes in water quality, particularly given the highly variable and often poor quality of hatchery reared postlarvae. A sensible risk management strategy would be to maintain part of the pond area under extensive culture of wild shrimp with improved pond design and better management.

### *Forestry*

Clearly, there are a number of problems with current silvicultural practices. Firstly, the initial planting density is too high, leading to self-thinning of the forest at an early age of around five years. Secondly, the timing and degree of manual thinning are inappropriate, because stands begin to self-thin again within 2-4 years after having been thinned manually. It is estimated that a reduction in planting density to 10,000 ha<sup>-1</sup>, and a thinning strategy designed to avoid stands undergoing self-thinning, together would increase average annual wood production from mangroves by between 10% and 30%.

In addition to lower economic returns from mangrove forestry compared with aquaculture, two other issues also contribute significantly to farmer perceptions about the value of mangrove forestry. Firstly, few farmers have security of land tenure, because land ownership by farmers in Ca Mau Province is rare; most farmers are granted a 20 year lease that may or may not be renewed. With the current 20 year forestry rotation, those farmers who plant mangroves in the first year of their lease can expect to harvest within the period of their lease, whereas those who do not plant in the first year of their lease can benefit from the final harvest only if their lease is renewed. This is a strong disincentive for farmers to manage their allocated area of mangrove forest for maximum production.

Secondly, most of the forestry profit currently comes from the final harvest. In order to gain a regular annual income from mangrove forestry, farmers need to harvest a proportion of their mangroves annually, ideally this proportion being equal to 1/rotation length (in the present case 1/20). This requires that each farm have stands

of mangroves with a range of ages up to the maximum age at harvest, presently 20 years. However, with only 4-6 ha of mangroves, most farms are too small for this approach to work well, and in most cases the mangrove stands on any particular farm are of similar age. Based on current production estimates and prices, individual farming households would need at least 200 ha of mangrove to earn an annual net income of US\$ 1,000 from mangrove forestry alone.

It is clear from the foregoing discussion that the participatory mangrove forestry programme and mixed mangrove-shrimp farming systems have not worked well for small-scale farmers in Ngoc Hien District, and have not arrested the continuing loss of mangroves in the province. This contrasts remarkably with the Matang mangrove forest in the state of Perak in Peninsular Malaysia, where the original mangrove forest area gazetted for forest production at the end of last century, about 40,000 ha, has decreased by only about 250 ha (Gang 1985). In 1985, the annual tangible produce from forest products and associated fisheries in Matang was estimated to be about 152.4 million MYR (equivalent to 40.1 million US\$) (Awang, in Gang 1985). Less tangible benefits to environmental quality, employment and social equity have not been quantified, but are likely to be very significant (White and Cruz-Trinidad 1998). Part of the success of Matang can be attributed to three key factors:

- The Matang mangrove forest is essentially a single intact entity comprising 19 independently gazetted more or less contiguous forest reserves, not a series of very small forest areas scattered over a much wider area.
- The Matang forest is controlled by the State of Perak. Forest management policies, and day-to-day management and regulatory control is the responsibility of a single authority, in this case the Perak Forestry Department.
- The whole area has been mapped and divided into smaller working compartments, for which there are detailed inventories that form the basis for the overall management plan.

Tam Giang III Enterprise in Ngoc Hien District and the Bai Boi (coastal) area on the south-western tip of Ca Mau Peninsula still have some relatively large contiguous areas of mangrove forest. However, aquaculture ponds have made significant inroads into the mangrove forest in both areas, particularly in Tam Giang III Enterprise, where mixed shrimp-mangrove farming systems are common. It is suggested that shrimp ponds be progressively removed from the inner parts of both Tam Giang III Enterprise and the Bai Boi area, and these areas returned to mangroves. It is also suggested that mangrove forests in these areas be returned to the enterprise or other local institution, which should be given full responsibility for the management of forestry activities. There may also be opportunities to restore larger contiguous tracts of mangrove forest on land with a suitable tidal regime in some other enterprises. Shrimp ponds should not be permitted within mangrove areas that are designated for forestry production.

Extensive replanting of mangroves along the south-eastern coastline of Ca Mau Province as part of the World Bank Coastal Wetlands Protection and Development project may improve coastal protection and overall environmental quality. However, most of the replanting will be carried out in the coastal protection zone, within which forestry activities will not be permitted.

It is not certain that Ca Mau Province will be able to meet its projected timber and fuelwood needs from mangrove and *Melaleuca* forests even if larger contiguous areas of mangrove forest are established. Furthermore, the topographic changes outlined above suggest that an increasing proportion of these requirements will have to be met by terrestrial forestry in the future. A number of exotic hardwood species, notably *Eucalyptus*, as well as softwood species like *Acacia*, grow quite well in Ca Mau Province on moderately saline soils that are rarely flooded by tidal waters. There may well be other indigenous and exotic tree species that are equally, or more suitable for timber and fuelwood production under local conditions.

### *Diversification and Risk Reduction*

The risk of shrimp mortality from disease and poor water quality is a major factor affecting income security for farmers. The risk of mortality from disease and other causes can be reduced, and income security improved, by the adoption of better pond design and management practices. Income security would also be improved dramatically by diversification of the cultured species (including mud crabs), and by growing appropriate fruit tree, vegetable and other cash crops on levee banks and other elevated areas.

### **Conclusions**

Coastal aquaculture and land use in Ca Mau Province are presently at a cross-road. Expansion of aquaculture production and a relatively rapid shift from extensive culture of wild shrimp to more intensive culture of *P. monodon* and perhaps other hatchery reared species may lead to a deterioration in environmental quality and increasing land use conflicts. Coupled with this, changes in population demography and land level will require a flexible land use policies and management based on social equity, sound predictions of changes in land levels with respect to sea level, and environmental considerations. The social and economic costs of developing and implementing land use policies that take account of expected future trends may now be high, but the costs will be immeasurably greater in the future if inappropriate land use options based on a short-term perspective are adopted.

# Socio-economic Study of the Mixed Shrimp Farming-Mangrove Farming Systems

## Objectives of the Study

Based on an understanding of the basic processes operating in these mixed farming systems, the ACIAR project has developed a set of management recommendations. The objective of this part of the case study was to assess the social and economic benefits of and constraints to implementing these technical management recommendations.

The specific objectives, based on the Terms of Reference (see Appendix 1) for the socio-economic study component, are as follows.

- To prepare a framework for carrying out an economic analysis of mixed farming system management practices, based on the technical recommendations developed by the ACIAR Project FIS/94/12.
- To identify social and economic benefits and constraints to implementation of these technical management recommendations.
- To assess institutional constraints to implementation of these management recommendations, and recommendations for overcoming such constraints where possible.
- To provide recommendations on the optimal institutional arrangement to support farmers in improving benefits from their mixed farming systems, and how this institutional structure(s) be developed, and to provide an analysis of the requirements to support and manage risk in poorer households.
- To provide recommendations on how to promote farmer Groups and improve local management of resources (including co-management possibilities).
- To identify strategies to ensure benefits from improved management strategies reach the poorer farm households and their members.

## Technical Management Recommendations

The technical management recommendations of the ACIAR project cover three areas: shrimp culture, mangrove silviculture and farm diversification. In addition, recommendations are made on economic, social and extension policy issues.

For shrimp culture improvement, the recommendations focus on improvements in water and sediment quality, stocking techniques for *Penaeus monodon* seed, and wild shrimp stocking and harvesting. The key recommendations to achieve these include:

- Maintaining high water level by digging the pond to a water depth of 1 m and reducing leakage. Where leakage is a major problem, about 30 percent of the pond area should be dug to a water depth of 1.5 m, including a channel to the sluice gate.
- Reducing water exchange during the wild shrimp harvests every 15 days around lunar spring tides, or preferably, adopting longer, 45-60-day harvest cycles, with spring tide water exchange to top up the pond and recruit wild seed. Larger shrimp can be harvested during the growout using the “against-the-water-current” or “*Tom Te*” techniques. The pond is completely drained for a full harvest at the end of the 45-60 day growout period.
- Minimizing the adverse effects of excavated pond sediments on the pond and mangrove environments; ideally, the pond spoil should be placed in one area to build up a larger area of land above the tidal limit for growing terrestrial plants and other crops.
- Stocking healthy *P. monodon* post-larvae, first in a nursery pond (covering 10-20 percent of the total pond area) for about 20-30 days, feeding daily with a boiled-fish-and-egg diet. Final stocking density in the growout pond should be 1-2 m<sup>2</sup> or 10,000-20,000 PL/ha. Monitor survival and growth in nursery pond weekly, and in growout pond every 10-15 days. Aim initially for 30-40 percent survival.

For mangrove management, the recommendations attempt to bring planting density and thinning in line with natural thinning regimes so as to achieve optimal benefits. Planting densities of 10,000 trees/ha or 7,000 trees/ha are suggested. For the former density, first thinning can be carried out at 7-8 years to 5,000/ha and to 2,000 /ha at 12 years. For the latter (7,000/ha), first thinning to 3,000/ha at 8-9 years and second to 5,000/ha at 13 years are suggested. Final harvest for both is at 18-20 years.

Current policy is to plant at 10,000/ha, with thinnings by 30 percent at 10 and 15 years. At this density, natural thinning occurs earlier at 7-8 years, depriving farmers of revenues at the first thinning. Some years ago, planting densities used to be even higher, at 15,000 to 20,000 trees/ha.

Mangrove management recommendations also include phasing in a staged planting schedule that allows farmers to have stands of different ages (5 or 10 ages with each age class covering 1/5 or 1/10 of the total area and separated by an interval of 4 or 2 years respectively). Equally importantly, the recommendations call for a change in forest policy to allow farmers the flexibility to implement the above recommendations.

Recommendations on farm diversification include planting of salt tolerant fruit and timber trees on levees and other areas above the tidal limit, planting of annual cash crops during the rainy season, diversification into crab culture as well as mixed shrimp fish farming or even fish farming. More importantly, however, the Project recommends development of a long term strategy for land use and resource allocation that takes into account expected changes in topography and land forms arising from sediment deposition and erosion in the Mekong Delta.

### **Case Study Methodology**

Two farmer groups were selected for the study, one each in TGIII and SFFE 184. The selection was made based on the ease of communication with the Group members during a preliminary field visit in November 1999 with the ACIAR project team, including Dr. Philip Hirsch (consultant and supervisor for the socio-economic study component), Dr. Barry Clough (Australian project leader) and Dr. Tran Thanh Xuan (Vietnamese project leader).

Three additional visits, each lasting 3 to 10 days, were made during November 1999 to January 2000. A total of 23 farmers (13 in 184 and 10 in TGIII) belonging to the two Groups participated in the study. The following techniques were used to gather information.

- Semi-structured interviews
- Group-based Participatory rural appraisal (PRA) exercises
- Interviews with key stakeholders

In addition, personal observations made during the visits were recorded and where possible, brought up during discussions with the farmers.

#### *Semi-Structured Interviews*

Of the 23 farmers, 11 (5 in the TGIII Group and 6 in the 184 Group) were interviewed individually using a semi-structured interview scheme containing a set of guideline questions (see Appendix 7).

In both the Groups, experimental trials were under way during 2000 to assess the effectiveness of the technical recommendations of the ACIAR project, conducted by a local staff of the Research Institute for Aquaculture No. 2 (RIA-2), through its Ca Mau-based sub-institute (Minh Hai Sub-Institute for Fisheries Research, MHSIFR) under the supervision of the Vietnamese and Australian project leaders.

Several Groups have been selected in the two enterprises for these trials. In each Group, two farmers are selected for the trials, one receiving full financial support (covering costs of pond deepening, seed, feed, and equipment for shrimp production and trial monitoring), and the other receiving partial support (covering all of the above except pond deepening). For the semistructured interviews, an attempt was made to target, in each Group, the full- and partial-trial participants<sup>3</sup> and three to five control farmers (non-participants) representing, respectively, an economically well-off, medium and less well-off farmer category.

The semi-structured interviews focused on the resources and demands in a farming environment and the farmer's perception. Resources, such as physical, biological, financial, temporal, legal, institutional and human, were grouped into the following levels: home-based, farm-based, community-based, Enterprise-based and external. Demands included capital inputs as well as demands in the household economy. Comparing resource availability with demands in the farm-household economy could assess the farmer's ability and/or constraints to adopt the recommendations.

Farmer perception on the following was assessed:

- Risks in shrimp farming
- Future value
- Poverty
- Other stakeholders (other farmers, PL vendors, hatchery operators, Enterprise managers, government agencies, extension staff, etc.)
- Externalities in the shrimp farming-mangrove environment

The trial participants' perception of risks in shrimp farming was compared with that of control farmers in order to assess the farmer's confidence in adopting the recommendations. The perception of future value showed the farmer's appreciation of the profits from mangrove harvests at the end of the 20-year contract. Since the trees on most farms were planted 8 to 10 years ago, the harvest is expected in 10 to 12 years' time.

The farmer's perception of poverty revealed economic constraints to survival, largely relating to the risky and increasingly capital-intensive nature of shrimp farming. It also gave a crude indication of the economic strata within each Group, and helped identify the poorer farmers, who were followed up for additional in-depth interviews. The farmer's perception of different stakeholders showed the latter's relative importance, roles and reliability. Perception of externalities in the shrimp-mangrove environment showed mainly the important factors affecting shrimp yields.

In addition to the above, the control farmers were asked to comment on each of the project recommendations for improved shrimp farm-mangrove management. This exercise was attempted to assess the farmers' confidence in the recommendations and willingness to adopt them. The control farmers' knowledge of the recommendations in itself indicated the extent of information flow within the Group.

#### *Group PRA Exercises*

The group PRA exercises included the following.

- Focus group discussions with farmers
- Trend analysis
- Gender analysis
- Seasonal calendar
- Problem web

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<sup>3</sup> The partial trial participant in TGIII had withdrawn from the trial, and the one in 184 could not be interviewed.

- Daily activity chart

The trend analysis brought out temporal changes in the major factors affecting farming operation and living conditions. The gender analysis helped understand the roles of men and women in carrying out on-farm and household activities (division of labour) and in economic decision-making at the household level. The seasonal calendar highlighted major events during a typical year and seasonal variations in resource availability, use and constraints. The problem web exercise was attempted to trace the root causes of the problems identified by the farmers. The daily chart provided a general picture of activities in a typical 24-hour cycle around the spring tide period, during which the main water exchange and harvesting take place.

### *Stakeholder Interviews*

Interviews were conducted with the following stakeholders:

- Hatchery operators in Nam Can
- Vendors at Vam Dam market, the nearest market for the two Groups
- The officer conducting the project trials;
- Leaders (managers) of the two Enterprises,
- The head of the Ngoc Hien District Department of Fisheries, Nam Can;
- Deputy director of the Provincial Department of Agriculture and Rural Development in Ca Mau;
- Deputy director of the Minh Hai Sub-Institute for Fisheries Research in Ca Mau;
- Deputy director of the Minh Hai Wetland Forest Research Centre, Ca Mau;
- The head of the Provincial Fisheries Extension Service, Ca Mau; and,
- Manager of the Extended-Rehabilitation of Mangrove Forest Project, Ca Mau.

### **Data Constraints**

A number of constraints relating to data collection were evident. First, the time available to conduct the study was limited, so that all aspects of the issues could not be dealt with. Second, the farmers were, at times, unavailable during the visits, especially in the TGIII Group. Third, accurate data on incomes from shrimp farming were difficult to obtain. Farmers were seldom able to recall the exact number of harvests, let alone quantities harvested each time, possibly due to a rather high frequency of harvest (every spring tide for the most part of a year), large fluctuations in shrimp yield from harvest to harvest, and the general absence of record-keeping among the farmers.

Although a general harvesting pattern can be identified in each of the two Group (see “Seasonal Calendar”), the number of harvests vary from one farm to another, depending on the capital capacity for stocking and pond preparation, water quality, pond leakage, experience in shrimp farming and overall pond management.

The MHSIFR (sub-RIA-2) officer conducting the project trials (Mr. Tuan) also collects similar production and income data from a larger number of farms. Since these data are collected on a more regular basis, we felt that they would be more reliable than our estimates. Mr. Tuan provided the copies of questionnaire responses for the target farmers. Income data from these responses are used for the economic analysis in this report, together with the data on household expenses collected during the semi-structured interviews. The MHSIFR data, too, has several handicaps. First, income from non-farm activities are sometimes not recorded, including incomes from shrimp trading, an activity reported by some TGIII Group farmers during the interviews. Second, the MHSIFR data focuses on farm inputs and income only; household expenses (food, clothing, house repairs, education, transportation, etc.) are not considered. Third, pond re-digging (dredging) expenses covered in the MHSIFR surveys cover only one dredging operation, while most of the interviewees reported conducting two dredgings a year.



A consistency check on the data from farmer interviews revealed unusually high or low estimates in some responses of one respondent (TGIII, sample 1).<sup>4</sup> These were adjusted after comparing with values given by the other respondents in the Group.

As for stakeholder interviews, one important stakeholder group missed out in the interviews was the representatives of the government banks in Ca Mau, who could not be reached due to time constraints and some logistical problems in contacting them in advance. Information about bank loans was instead accessed from interviews with the farmers, Enterprise managers, officials at DARD in Ca Mau, and from literature available.

## Socio-economic Study Results

### Background on State Forestry and Fisheries Enterprises

TGIII and 184 are among the 18 State Fishery-Forestry Enterprises (SFFE) currently operating in Ca Mau province. Most SFFEs were set up in the early- to late-1980s. Following massive mangrove forest destruction in the Mekong Delta during the 1980s, mixed shrimp-mangrove systems were promoted through SFFEs (Binh *et al.*, unpublished). The SFFEs issue land parcels (3-5 ha each) on a 20-year lease to individual farmers, who are required to plant and raise mangroves (almost invariably *Rhizophora* spp.) on at least 70 percent of the area; the remaining 30 percent can be used for aquaculture and homestead. Mangroves are harvested at the end of the 20-year cycle and replanted again.

The SFFEs are under the direct supervision of the provincial and district arms of the Department of Agriculture and Rural Development (DARD). In each Enterprise, a management committee (comprising mostly former government officials) runs the day-to-day operations. Most derive their income from sharing mangrove harvest profits with farmers, and from shrimp culture on plots belonging to the committee.

Directives since 1993, particularly the Law of State Owned Enterprises (Decree 388), have made the SFFEs commercially independent and self-financing, and limited the State's and provinces' scope of control (World Bank 1999, ADB 1996). However, following the sharp decline in shrimp yields since 1994 and the ban on mangrove cutting in 1996 (which was later removed in mid-1999), many SFFEs experienced cash flow problems. As a result, in 1997 six SFFEs (including the TGIII) were reclassified by Ca Mau's Provincial People's Committee from being State-Owned Enterprises into Forest Protection and Management Boards (World Bank 1999). These SFFEs now depend on government grants for their administrative expenses and return revenues from forest cutting and tax collection to the provincial government. The remaining, including SFFE 184, are still independent, self-financing production units.

Although declining shrimp yields and the mangrove cutting ban were the main reasons for seeking government support, other factors such as management efficiency, resource availability and the size of the Enterprise (which also determines the amount of land and mangrove resources available) are probably also significant. The TGIII, for example, is much smaller in size than the 184. According to Mr. Vinh, Deputy Director of DARD, Ca Mau, in some Enterprises mangroves are too young to be harvested, so that those Enterprises were not able to generate enough income to meet their budget.

Administratively, an Enterprise is divided into Zones, which are further divided into Groups. A Group is the smallest administrative unit not only of the Enterprise but also in the national administrative system of hamlets, villages, communes, districts and provinces. A Group may consist of between 10 and 50 farming households living in a given area. The two systems may somewhat overlap. For instance, the hamlet to which

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<sup>4</sup> For example, while most farmers estimated their household expenses on clothing within a 1-3 million VND range, this particular respondent's estimate was 10 million VND. Similarly, the cost of gate construction given by this farmer was 1.5 to 2 times higher than those of other farmers.

the 184 Group belongs to, also covers parts of the TGIII (information from farmer interviews). Both the TGIII and 184, together with SFFE Ngoc Hien come under the jurisdiction of the village of Tam Giang.

### *Land Tenure*

All land in Vietnam belongs to the government and the maximum land tenure is for 50 years. The SFFEs hold the land under the 50-year lease (the “red” book), and in turn issue land parcels of an average 3-5 ha to farming families on a 20-year lease (the “green” book). Both types of leases are renewable and allow for inheritance. Land under the 20-year lease, however, cannot be sold, but can be returned to the Enterprise, which must compensate the farmer for the labour and financial investment he/she has made in the land. In practice, this means the green books are traded between farmers, with the approval of the Enterprise. The new lease holder, or the farmer “buying” the land, pays the assessed value of the plot. The new holder may negotiate the lease with the Enterprise, particularly with respect to the profit-sharing arrangements for the mangrove harvest and the duration of the lease, which can be re-issued for 20 years, or used for the remaining years under the previous contract.

Elsewhere in Vietnam, the green book can be used as a collateral for formal (bank) credit. In SFFEs, however, tenant farmers cannot access government credit directly, but need the approval of the Enterprise committee, which acts as a guarantor. Discussions with farmers revealed that there is probably a high turnover of farming households within the SFFEs. According to one farmer, as many as 7 out of 10 original residents have left and their plots taken by new migrants or existing farmers. Although this estimate could be somewhat exaggerated, it does indicate a trend of both high turnover and land consolidation. Enterprise officials attributed the frequent trading of leases to the latter. There is a tendency among Enterprise managers to encourage consolidation, since forest/aquaculture income derived from a 3-5 ha plot is considered inadequate to serve as an incentive for forest conservation. The trend of land consolidation appears stronger in the more autonomous SFFE 184 than in TGIII. According to the Enterprise managers, about 5 percent of land leases change hand each year in 184, while in TGIII only 1-2 households leave each year. Statistics on new settlements and land consolidation at the Enterprise level were not available, nor was it possible to check the data at the village level. The village-level data is perhaps unlikely to reveal the more recent trends, since farmers in the Enterprises are required to register with the village administration after five years of residence, and most do not wish to do so immediately.<sup>5</sup> Out-migration trends probably have set in a few years after the late 1993-1994 period when the sharp drop in shrimp yield first occurred.

### *Farm Characteristics*

The TGIII Group farms are located on the main river, the 184 Group farms on a canal (Canal No. 17) separating the two Enterprises (Figure 1). All the farmers in the TGIII Group practise the separate system of shrimp farming-mangrove forestry, in which shrimp ponds are outside the mangrove area. The 184 Group farmers, on the other hand, practise the mixed system wherein the ponds are located within the mangrove area (see AIMS/RIA2/NACA 1999a for details of the two systems).

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<sup>5</sup> From interviews with farmers and Enterprise officials, January 2000.

The information on farm and farmer characteristics given below is largely based on the semi-structured interviews. Farm and pond surface areas were generally larger and pond depths greater in the TGIII Group than the 184 Group farms (Table 2). Depths of most ponds range between 0.6-1.2 m, but generally are shallower than the depths recommended by the project: viz., at least 1 m for the entire pond, and up to 1.5 m for 30% of the water surface area for ponds with leakage. Depths were slightly greater in the TGIII Group, possibly because several ponds were deepened using machines (suction-pumps), which, in turn, can be attributed to the relative affluence of the farmers in that Group who can afford the higher costs of machine dredging. The availability of open levees for the placement of the dredged mud in a “separate” system may also be an enabling factor for frequent and deeper dredging in the TGIII Group; in the “mixed” system, as in the 184 Group, the levees are occupied by mangroves.

**Table 2.** Farm characteristics in the two study groups

Farm Location	Farm No.	Land Area (ha)	Mangrove Area (ha)	Pond water Surface (ha)	Taxable Area (ha)	Mangrove			Av. pond Depth (m)
						Age (year)	Dbh (cm)	Density (trees/ha)	
TGIII (main river)	1	7.80	3.6	1.5	3.7	7	9	10,000	0.74
	2	7.30	3.6	1.0	3.7	6	5	10,000	0.67
	3	5.00	2.5	1.7	2.5	7	5	10,000	0.84
	4	6.70	3.2	1.4	3.7	3	3	10,000	1.26
	5	5.20	3.2	1.1	2.0	4	3	10,000	1.21
Av. TGIII		6.40	3.22	1.34	3.12	5.6	5	10,000	0.94
184 (major canal)	1	8.06	4.0	1.56	4.0	9	7	8,000	0.68
	2	4.50	2.7	0.71	1.8	9	8	10,000	0.78
	3	3.40	2.4	0.55	1.0	11	-	10,000	0.94
	4	4.50	3.0	1.00	1.4	10	11	10,000	1.05
	5	5.50	3.0	1.40	2.4	9	10	12,000-15,000	0.60
	6	3.90	2.7	0.60	1.2	9	10	13,000	0.70
Av. 184		4.98	2.97	0.97	1.97	9.5	9.2	10,000-11,000	0.79

**Source:** Land areas and pond depths: MHSIFR data, except for sample nos. 5 and 6 in SFFE 184, which are survey data; mangrove age, dbh and density: survey data.

**Notes:** Dbh: diameter at breast height; depths are uneven in all ponds.

Discharging dredged mud into public waterways is illegal, since it is thought to deteriorate water quality. However, observations elsewhere in the two enterprises showed that this practice occurs, especially when the dredgings are carried out using suction machines. Wrongdoers are reportedly caught and fined.

All the farms studied in the TGIII Group have cement gates (at least two each, except one with a single gate), while in the 184 Group, half of the farms have cement gates (two each), the rest a single wooden gate each (see also Table 4 below). According to the farmers, cement gate lasts for 6 or more years, with minor repairs and maintenance during its life. A wooden gate, on the other hand, may last for only about 6-12 months.

### *Farmer and Community Characteristics*

#### *Migration History*

High profits from shrimp farming was the primary motivating force behind the massive population influx to the lower Mekong Delta during the 1980s and the early-1990s. Since 1994, however, there has been a sharp decline in natural shrimp yields while production of hatchery-reared *P. monodon* is beset by disease outbreaks and high shrimp mortality.

Most of the farmers interviewed settled at the present location during 1989-1991 or later. The period of residence (or the year of migration to the present location) was much more varied in the TGIII than in the 184 Group (Table 3). In the former, two of the five farmers interviewed arrived in the 1989-91 period, two others in 1993-94, and one has been living there since 1978. In the 184 Group, on the other hand, all except one of

the six farmers interviewed arrived during 1989-91. The only newcomer (1997) in this Group lives provisionally on a farm he has rented from the original land-holder who lives elsewhere.

For at least five of the 11 farmers interviewed in the two Groups, shrimp farming was the main reason for migration. Three others, who are former government officials, received the land for free from the government. Two farmers came in search of land and livelihood, while one farmer did not specify the reason for migration. Except for the three (former) government officials (including one soldier), all others “purchased” land at various prices. One government official also “purchased” additional plots later.

**Table 3.** Duration of farmer residence (unit: years of residence until 2000)

Farm No.	TGIII	184
1	10	11
2	22	11
3	6	9
4	7	10
5	10	3
6	—	11
<b>Average</b>	<b>11</b>	<b>9</b>

**Source:** Survey data

#### *Economic Status*

During the household visits, most farmers in the TGIII Group appeared relatively well off in comparison to those in the 184 Group. Within the latter, some farmers are apparently poorer than the others. Nearly all of the poorer farmers in 184 rely on fishing and collecting snails from the wild, for additional income. They were also the ones whose farms have wooden sluice gates, and their overall investment for pond improvement was generally lower than the farmers with cement gates (Table 4).

**Table 4.** Comparison of Investments in Shrimp Farms by Gate Type (unit: million VND)

Farm	TGIII			184		
	Type of gate/s (Number)	Cost of gate construction	On-going investment	Type of gate/s (Number)	Cost of gate construction	On-going Investment
1	Cement (3)	4.00	14.50	Cement (2)	2.50	24.00
2	Cement (2)	3.68	11.74	Cement (2)	3.00	14.16
3	Cement (2)	3.00	19.54	Cement (2)	3.50	13.41
4	Cement (2)	3.50	19.11	Wooden (1)	0.70	12.78
5	Cement (1)	4.60	6.91	Wooden (1)	0.50	2.80
6	—	—	—	Wooden (1)	1.00	8.00
<b>Average</b>	<b>—</b>	<b>3.76</b>	<b>14.36</b>	<b>—</b>	<b>1.87</b>	<b>12.52</b>

**Source:** Data on gates: from surveys; data on farm investment: from MHSIFR data, except for farm no. 5 and 6 in SFPE 184, which are from survey data.

**Note:** Costs of gate construction are per gate.

One poorer farmer in the 184 Group is now relying only on natural shrimp recruitment, as he is unable to purchase hatchery seed of black tiger shrimp (*Penaeus monodon*) and cannot afford the necessary pond improvement (see box below).

### Group Dynamics

The level of cooperation and solidarity among Group members appeared to be higher in the 184 Group than in the TGIII Group. For example, during one of the visits we saw farmers in the 184 Group helping each other repair dykes breached by a high tide on the previous night. This help was also extended spontaneously to a farm whose owner was away at that time. In the TGIII Group, on the other hand, even though most farmers replied positively when asked about solidarity in the Group, there was little evidence supporting this claim. On the contrary, one farmer mentioned the lack of sufficient cooperation within this Group. Socialization, by visiting each other's houses and sharing meals, drinks, and farm produce, was more often observed in the 184 Group than in the TGIII Group.

#### **Box 1. Profile of a Poor Farming Household**

Mr. Nguyen, one of the poorest farmers in the 184 Group, lives with his wife and three children on a plot he has rented for the past three years from the original landholder who lives elsewhere.

Mr. Nguyen has been living in SFFE 184 for the past 10 years. Originally from the neighbouring Dam Doi district (where his brother lives), he once owned a shrimp farm there. But a financial crisis forced him to sell his property and move out in search of work and shelter. Working as a labourer, digging shrimp ponds for wages, he ended up in SFFE 184. The Enterprise allowed him to build a house on its plot. Five years later he rented a plot in the same SFFE on an informal, 3-year contract, but the rent was rather high (5 million VND a year), and he could not afford it after encountering repeated shrimp mortality. Since the landlord was unwilling to lower the rent, he decided to return the plot a year before the expiration of the contract, and moved to the current place. The rent at the current plot is half the previous rent and the land-lord is kind. He helped Mr. Nguyen get the Typhoon Linda recovery loan by signing the papers. This year, owing to another shrimp crop failure, the landlord has waived the rent, but asked Mr. Nguyen to pay the land tax instead (which is about 1.5 million VND). The landlord has also agreed to split his share of the mangrove harvest profit 60:40 between him and Mr. Nguyen, should Mr. Nguyen and his family decide to stay longer there.

Sixty-six-year old Mr. Nguyen has 10 children, seven of whom are married and live elsewhere. The remaining three (2 daughters and a son) live with him. The youngest 10-year-old son is in grade 2 at the SFFE school. The two daughters are unemployed. They used to sell foodstuff to school children, but soon the teachers started selling those things themselves, so they lost this occupation.

The family lives in a simple house they built soon after moving in, using mangrove wood and material from the previous house. There is no furniture, except for an old hammock and a few pots. An old piece of rag on a frame of poles separates the kitchen from the rest of the house. There is no water well. The family uses a neighbour's well, carrying water in plastic cans by boat.

Last year, Mr. Nguyen stocked 20,000 *P. monodon* seeds he purchased on partial credit (at 55 VND per PL). The shrimp seed appeared healthy, but died within a few weeks after stocking. He has not been able to restock since he has not paid the remaining sum of shrimp purchase. Being a recent migrant with no land documents, he is also unable to borrow from other private lenders. This year, therefore, he will have to rely on natural shrimp recruitment. He is also unable to invest in pond improvement.

The family lives on whatever they earn from the shrimp farm (shrimp and the incidental catch of fish), by selling vegetables to neighbours, and from Mr. Nguyen's work as a wage labourer digging shrimp ponds. The seasonality of income makes life harder during some months.

Mr. Nguyen is willing to learn new techniques to improve shrimp yield and overall pond management. He learns from his neighbours and the Group leader, but would like to have more reliable and complete information through training. He is willing to attend training courses either in the Group or elsewhere in the region, provided transportation and other expenses are met, since he can't afford them himself. Despite repeated failures in shrimp farming, he hopes that with better knowledge of farming techniques he may be able to succeed again and lead a better life.

Information about project recommendations also appeared to flow more easily in the 184 Group than in the TGIII Group. For example, control farmers in the 184 Group said they consult the trial participants on project recommendations and have already begun adopting some of the less capital-intensive recommendations (see "Farmer Perception of Recommendations"). In the TGIII Group, while all the three control farmers practise

some of the project recommendations (e.g., growing PL in a nursery pond, feeding the juveniles, etc.), the information was accessed from different sources, not necessarily always from the project trial participant. One control farmer in this Group was unaware of the composition of the project-recommended feed (boiled fish and egg) for shrimp juveniles, and has been instead using the recipe given in a booklet supplied by a research team from Cantho University in 1994.

## Current Practices and Issues

### *Shrimp Farming*

#### *Stocking Density*

At present, most farmers in both the Enterprises stock hatchery-reared black tiger shrimp (*P. monodon*), since the shrimp stocks in the wild<sup>6</sup> are low and decreasing, and because *P. monodon* fetches a better price. Stocking densities are generally high on most farms, given the widely held belief that higher stocking densities yield better harvests. High stocking density increases the cost of seed purchase and probably also causes higher mortality in an environment of poor water quality, no aeration and no supplementary feed.<sup>7</sup> While stocking is normally carried out at the start of each growout period (twice a year around the 2<sup>nd</sup> and the 7<sup>th</sup> or 8<sup>th</sup> lunar month in 184),<sup>8</sup> many farmers stock additionally several times during growout, in order to compensate for the reported shrimp mortalities in nursery/grow-out ponds. Capital constraints prevent farmers from stocking at the desired densities all at once; hence additional stocking is carried out whenever the farmer can afford it (see also, 'Indirect Credit').

#### *Nursery*

Most farmers in the 184 Group did not stock seed in separate nursery ponds. The only exceptions were the full- and partial-trial participants and one control farmer. Lack of capital to meet the feed costs was the main constraint cited in this Group. In TGIII, most farmers used nursery ponds, having learnt the technique from the project trial participants or other sources outside the Enterprise.

#### *Harvesting*

The harvesting period and seasonal variations in harvesting time are detailed in the sections Seasonal Calendar of Shrimp Farming and Daily Activity Chart. Most farmers in the two Groups harvest using the conventional method, in which water intake (Which also allows natural seed recruitment) is followed by partial draining and harvest, and which is carried out during the spring tide (4-5 days around the full and new moon).

#### *Sale of Shrimp*

Most farmers sell their shrimp at farm gate to the shrimp traders arriving in boats. Often the PL vendor and shrimp trader may be the same person. Shrimp traders act as primary middlemen who buy the shrimp from farmers and in turn sell at the local collection points at the nearby (Vam Dam) market. The operator of the secondary collection points act as secondary agents, who sell the collected shrimp to the processing units near Ca Mau (e.g., Tac Van near Ca Mau). The prices of shrimp vary depending on season, with the best prices around the 10<sup>th</sup>-11<sup>th</sup> Lunar (around December), and low prices around 4<sup>th</sup>-5<sup>th</sup> Lunar (around June). During 1998-99, the prices, according to some farmers were 140,000 VND/kg and 80,000 VND/kg for shrimp in size 25/kg for the two periods, respectively. According to another farmer, there was minor price fluctuations during each harvest period around the spring tide, as well. On the first of the 4-5 day harvesting period, the prices are high; they then drop a little on the second day, gaining again on the third day and dropping on the next. This information, however, could not be confirmed from shrimp traders or other farmers.

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<sup>6</sup> These consist primarily of *P. indicus* and *Metapenaeus spp.*

<sup>7</sup> Recently, following the advice of the project trial staff, a number of farmers have started using fertilisers during pond preparation to stimulate pond productivity.

<sup>8</sup> The first lunar month begins with *Tet*, the Vietnamese New Year, around late January to February.

During the survey period (Nov 1999-Jan 2000), the farm-gate prices of *P. monodon* of size 20/kg were around 140,000-150,000 VND/kg. At the collection point at Vam Dam market, the price was 167,000 VND/kg (as on 23 Jan 2000), and at Tac Van near Ca Mau (the secondary collection point) it was 173,000 VND/kg.<sup>9</sup> For sizes other than 20/kg, price varies incrementally by a fixed amount. On the day the price was 167,000 VND/kg for 20/kg size, the increment was 2000 VND. That is, for the shrimp size of 19/kg, the price will be 2000 VND higher than that for 20/kg size, and lower by the same amount for shrimp sized 21/kg. The incremental prices at the two collection points are given below (Table 5).

**Table 5.** Variations in shrimp prices by size (no. of shrimp/kg) (unit: VND/kg)

Shrimp size	Collection Points (Price as of 23 Jan 2000)	
	Vam Dam Market, TG	Tac Van, Ca Mau
16 shrimp/kg	175,000	181,000
17 shrimp/kg	173,000	179,000
18 shrimp/kg	171,000	177,000
19 shrimp/kg	169,000	175,000
20 shrimp/kg	167,000	173,000
21 shrimp/kg	165,000	171,000
22 shrimp/kg	163,000	169,000
23 shrimp/kg	161,000	167,000
24 shrimp/kg	159,000	165,000

**Source:** Information from a local shrimp trader at the Vam Dam market and confirmed later on from another trader at the same market.

#### *Tom Te Harvest*

One of the project recommendations is to close the gates from 45 to 60, allowing only natural seed recruitment (and small water exchanges to replenish evaporation or leakage losses) every 15 days during the spring tides, and catch shrimp during the intake using the *Tom Te* or other “against the water current” techniques. These techniques are carried out, according to the earlier project study, by more successful farmers and involve capturing only large shrimps that tend to move out of the pond against the water current during the intake. Most farmers interviewed, however, did not perceive these techniques, particularly the *Tom Te*, as effective and were reluctant to use them on account of the small yield (10-20% of the regular 15-day harvest, according to some farmers) and increased turbidity which adversely affects water quality and shrimp health. It was unclear whether the farmers’ unwillingness to practise *Tom Te* originated from their lack of hands-on experience and/or skills in practising it.

Most farmers see the benefit of the 45-60 day grow-out and its potential to generate higher profits from larger-sized shrimp. However, since *Tom Te* yields are, according to them, too small to support the household throughout the longer growout period, there is reluctance to follow this recommendation, and preference instead for the conventional 15-day harvesting method which yields a small but more frequent income.

#### *Seasonal Calendar of Shrimp Farming and Harvests*

Farmers in both the Enterprises dredge the ponds twice a year. There are two dredging periods or seasons: around 2<sup>nd</sup> to 3<sup>rd</sup> Lunar month and around the 7<sup>th</sup> to 9<sup>th</sup> Lunar. The TGIII Group considers the former a minor dredging period, while the 184 Group calls it a major period (Appendix 4a and 4b). Shrimp are stocked following the dredging. However, most farmers, apart from the full and partial trial participants, also continue to stock additional post-larvae over several months.

<sup>9</sup> Information from a local shrimp trader at the collection point.

*P. monodon*, and along with its natural (wild) shrimp species, are harvested twice a month for four days around the spring tide for about 6-7 months a year. The final harvest is carried out twice a year, by draining the pond before each dredging season.

#### *Daily Activities*

The typical chart of daily activities (for the 184 Group) is presented in Appendix 5. There are seasonal variations in the daily activities. For instance, during the 9<sup>th</sup>-1<sup>st</sup> Lunar months, harvesting is carried out at night, while in the 4<sup>th</sup>-8<sup>th</sup> Lunar months, harvesting takes place in the afternoon. Usually the male members of the household are in charge of the harvesting work, and of checking and repairing dykes and fixing leakage. Women take the responsibility of cooking, washing, childcare and similar household chores. They also help in mangrove replanting, assist in opening and closing the pond gates during water exchange and feeding shrimp juveniles during the nursery stage.

#### *Hatchery Operators*

The following information was gathered from the interviews with two hatchery operators and the head of the District Fisheries Department in Nam Can, Mr. Chanh.

Nam Can, the administrative centre of Ngoc Hien district, is a small but bustling town, surrounded by canals. Backyard hatcheries and nurseries of shrimp, fish and crab have mushroomed along the waterfront. According to Mr. Chanh, the number of shrimp hatcheries in Ngoc Hien district has increased rapidly from 87 in 1997 to 308 at the beginning of 2000. The two hatchery operators interviewed variously estimated the numbers at around 250 and 450.<sup>10</sup> Most are concentrated in Nam Can, and virtually all produce *P. monodon* seed. According to one operator, majority (about 80%) are medium-scale operations (handling 5-15 spawners a year), some 15 percent are large-scale (15-20 or more), and only five percent are small businesses (1-2 female shrimp a year). Both of the operators interviewed claimed themselves to be large-scale operators. Most appeared to be backyard hatcheries with improvised structures.

Most of the spawners are caught in the East Sea. Rach Goc, a sea-port town south of Nam Can, is the common place of purchase, though one of the two operators also purchased additionally from Song Doc on the western coast.

A healthy spawner weighs about 200-300g and delivers about 700,000 to 1 million nauplii. Survival rates up to the post-larval stage (PL<sub>15</sub>) are about 40-50 percent. Spawner mortality is frequent; fungal diseases being reported as the most common cause for both broodstock and post-larvae mortality.

The two operators interviewed gave contradicting accounts of trends in broodstock abundance and price change. According to one, broodstock supply has been increasing in the past five years, with the broodstock prices having dropped from about 2-3 million VND/shrimp in 1998-99 to about 1 million VND/shrimp in 1999-2000. The other operator maintained that supply has decreased and price has been increasing in the past two years from under 2 million VND to between 2 million and 3 million VND. According to Mr. Chanh, broodstock supply is abundant and prices have stabilized recently after a decline.

One of the two operators who handles about 35-50 broodstock each year gave a cost breakdown of the hatchery operation, which is given in Table 6. Reported profits from PL sales appear far smaller than those calculated from the data provided, suggesting either unreported costs (licence fees, taxes, etc.), or simply under-reporting, or possibly both.

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<sup>10</sup> It was unclear whether the numbers referred to hatchery operators only, or nurseries as well.



**Table 6.** A Shrimp Hatchery Operator's Estimated Costs breakdown (Unit: VND, unless stated otherwise)

Item	Lower estimate	Upper estimate	Average	Percent
Spawner purchase	130,000,000	130,000,000	130,000,000	33.60
Tank repair & maintenance	10,000,000	15,000,000	12,500,000	3.23
Chemicals	3,600,000	3,600,000	3,600,000	0.93
Feed	156,000,000	168,000,000	162,000,000	41.87
Electricity	8,400,000	9,600,000	9,000,000	2.33
Labour <sup>1</sup>	43,500,000	52,500,000	48,000,000	12.41
Boat rental	1,500,000	2,100,000	1,800,000	0.47
Miscellaneous <sup>2</sup>	10,000,000	30,000,000	20,000,000	5.17
Total Reported Costs	363,000,000	410,800,000	386,900,000	100.00
No. of PL sold	43,500,000	52,500,000	48,000,000	
Price/PL (1999-2000) <sup>3</sup>	40	40	40	
Price/PL (1998-1999) <sup>3</sup>	70	70	70	
Income (@40d/pl)	1,740,000,000	2,100,000,000	1,920,000,000	
Income (@70d/pl)	3,045,000,000	3,675,000,000	3,360,000,000	
Profits (@40d/pl) <sup>4</sup>	1,377,000,000	1,689,200,000	1,533,100,000	
Profits (@70d/pl) <sup>4</sup>	2,682,000,000	3,264,200,000	2,973,100,000	
Profits in US\$ (@40d/pl) <sup>4</sup>	98,357	120,657	109,507	
Profits in US\$ (@70d/pl) <sup>4</sup>	191,571	233,157	212,364	
Reported profits <sup>5</sup>	135,000,000	300,000,000	217,500,000	
Reported profits in US\$ <sup>5</sup>	9,643	21,429	15,536	

**Source:** Survey data

- Notes:**
1. Labour is paid as a proportion of sale or production, i.e., 1 VND per PL.
  2. Miscellaneous costs are arbitrary values.
  3. Post larvae prices are the quoted PL<sub>15</sub> prices at hatcheries.
  4. Profits as calculated from the given cost-income breakdown
  5. Profits as reported by the operator. 1 US\$ = c 14,000 VND (as of January 2000)

The profits of 135-300 million a year are considered as “quite good” by this operator for a large operation like his. In a “bad” year, high spawner mortality and lower PL survival rate can bring the profits down by as much as 50 percent.

Overall, the hatchery business appears to fetch a handsome profit. According to Mr. Chanh, at the current capacity, hatcheries in Ngoc Hien meet only 40 percent of the total demand in the district. This under-supply situation means there is potential for further growth of the hatchery operation business in the district.

The Department of Fisheries has developed regulations to control the growth of hatchery and nursery operations. Licences are issued for a one-time fee to operators who satisfy the following conditions.

- The operation must be located in a planned zone designated for this activity.
- A technician with a certificate course in aquaculture must be employed.
- The operation must have a wastewater treatment facility.
- Two adjacent operations should be at least 100 m apart.

An operational area of about 200 m<sup>2</sup> per hatchery has been suggested, though it is not a requirement. In reality, however, most operators were found to be located very close to each other (less than 30 m apart). The District Fisheries Department team carries out spot checks and inspections to check PL health. Hatcheries selling low-quality PL may get their licences revoked. So far, only warnings have been given to operators selling PL of dubious quality. No licence has so far been revoked.

Only a small number of hatcheries specialise in other shrimp species, such as *P. indicus*. There are no crab hatcheries, though there are a significant number of nurseries who sell wild-caught crab seed. Concerns about the increasing pressures on wild stocks of mud crabs led the Ngoc Hien District Peoples' Committee to issue a regulation three years ago banning the sale of locally-caught crab seed outside the district.

### *Mangroves*

#### *Density and Diameter*

Most plots in both Groups were planted at a density of 10,000 trees/ha. The average age of the plantations in TGIII and SFFE 184 are 5.6 years (range about 3-7 years), and 9.5 (range 9-11 years), respectively, with average reported breast height diameter (dbh) of 5 cm (range 3-9 cm) and 9.2 cm (range 7-11 cm), respectively.

#### *Planting Labour*

Most farmers planted mangroves themselves soon after settling down. The system of payment for planting labour differs in the two Enterprises. In TGIII, the farmers were paid wages of about 230,000 VND per hectare, whereas in 184 there was no labour payment. Instead, labour costs are to be accounted for in the profit sharing arrangement at the time of harvest.

#### *Profit-Sharing Arrangements*

The profit-sharing arrangement is different in the two Enterprises. In TGIII, it is 70:30 or 60:40 between the Enterprise and the farmer, respectively, depending on whether the trees were planted by the farmers or already existed at the time of receiving the land contract. In 184, where the farmers are not compensated for the planting labour, the profit sharing arrangement is 50:50. In both Enterprises, profits are calculated after subtracting all costs and the resource tax on the harvest income.

According to the estimates given by the TGIII Enterprise officials, currently the harvest income from a one-hectare plot of 20-year old mangroves (planted at an initial density of 10,000) is about 50 million VND. The costs are about a third, or around 16-17 million VND. When the remaining sum is divided 60:40 or 70:30 between the Enterprise and the farmer, the latter is likely to receive about 10 to 13 million VND from the one hectare plot. The same officials also pointed that thinning hardly yields any profits.

#### *Thinning*

The evidence of self-thinning at the age of 7-8 years in mangroves planted at 10,000/ha density has been reported in the termination report of this project (AIMS/RIA2/NACA a & b 1999), which has recommended the first thinning be carried out at that age, instead of the current practice of thinning at 10 years. Most farmers interviewed, however, felt that 10 years is the right age, since at this age the tree diameter is large enough to fetch a good price.

In reality, however, thinning has not been carried out so far on many farms, where the trees are already 10 years old. This is partly due to the still unclear policies on mangrove thinning after the recent removal of the mangrove cutting ban, and partly to the cumbersome process of applying for permission for thinning (see "Policies").

### *Household Economics*

The semi-structured interviews attempted to cover the various aspects of a farm-household economy, including capital inputs, household expenses and activities.

The main items of expense include: social activities such as attending weddings and death anniversaries, food, clothing, house maintenance, and others, of which food and household essentials (soap, spices, lamp oil, etc.) were the largest items of expense followed by expenses on children's education in TGIII, and social activities in 184. The expenses tend to cluster around the 11<sup>th</sup> to 1<sup>st</sup> Lunar months, as in this period the wedding season coincides with the major dredging and stocking season. It is a period of higher financial demand (deficit).

Accurate data on income from shrimp farming and other economic activities were difficult to obtain. High fluctuations in shrimp yield, high harvesting frequency (every 15 days), and the reluctance or inability of farmers to keep a record of farm income and capital inputs are some of the factors that make it difficult to obtain data on farm incomes. Farmers were unable to recall quantities of shrimp harvested each time during the previous year or even number of harvests carried out; often the averages given appeared to be either too high or too low (probably the highest or the lowest yields achieved?). The project officer from the Minh Hai Sub-Institute for Fisheries Research, overseeing project trials, also keeps a record of capital inputs, harvest amount and income from shrimp farming. Since this data is collected more regularly over a one-year period, it may be more reliable to use when attempting an economic analysis.

Generally, levels of income are low, though there are obviously wide income disparities within each of the two Groups. In both the Groups, the Group leaders (who also happened to be the full-trial participants) appear to be among the most affluent in the Group. Many farmers, especially in the 184 Group, however, apparently make a bare minimum, with hardly any surplus for further farm investment. In most cases, it is quite clear that the capital-intensive nature of shrimp farming, along with repeated crop failures, has caused increased indebtedness, leading to poverty (see also Economic Analysis).

### *Utilization of Time and Labour*

Shrimp farming in the enterprises is not as labour- and time-demanding as, for instance, rice farming (although opportunities for rice farming in the area are very limited). Apart from the dredging and stocking seasons, and the few days around the spring tides when shrimp are harvested, farmers in the SFFE's generally have plenty of spare time. During the slack season, there is only a minor work of checking dykes and leakage, surveillance of the mangroves and firewood collection. Observations during the visits revealed that most male members spent much of the free time in social drinking. These drinking sessions were more frequent in the 184 Group where socialisation and community interaction are relatively strong.

The average household size in both the Groups is five people with three working members. For an average household, using the seasonal calendars and the daily activity chart for the 184 Group, the total man-hours on an annual basis can be roughly estimated as follows (Table 7).

Since about 5 days are spent for shrimp harvesting (as well as water exchange and wild shrimp recruitment) around the 15-day lunar spring tides, with about 16 such harvests (14 in 184 and 18, including 7 monodon harvests, in TGIII) in a year, the total time spent in harvesting is about 80 days/person or about 240 man-days per household a year. Stocking of *P. monodon* is carried out for about 3-5 times on average (including two main and 2-3 additional stocking), takes about half a day for two people, thus involving about 5 man-days a year. Nursery feeding and maintenance may involve two people for the 20 day period. Juveniles are fed 3 times a day, involving an hour or two in all for preparation and feeding. Dredging is carried out using hired labour (and/or machine) and thus does not involve family labour except for monitoring.

Crabs are stocked about 3-4 times a year, and harvested two to four times every month, except during the 7-9<sup>th</sup> Lunar (in TGIII) when the harvesting is banned during the mangrove replanting time (information from respondents). It is assumed that both stocking and harvesting takes about half a day each time.

The monitoring and patrolling the area to check the dykes and mangroves may take about an hour each day for one person, thus accounting for about 365 hours or 45 man-days a year. Planting of cash crops and timber trees is a seasonal activity where water wells are unavailable. It is assumed that the farmer family spends about three working days/person each month on this activity. Additionally, some more time may be necessary for emergency situations such as breaching of dykes during storms and high tides, etc. About 15 days are allocated for this activity, though its highly variable nature means it may take far more time in some years.

**Table 7.** Time Utilization for On-Farm Activities

Activity	man-days	Frequency	days/hours	Persons	Remarks
Dredging	hired labour	2 times	2-10	vary	
Shrimp stocking	5	3-5 times	half a day	2	
Nursery feeding/care	16	2 times	2 hr, 20 days	2	20-day feeding
Shrimp harvesting	240	16 times	5 days	3	2 x 8 months
Monitor dykes/forest	45	each day	1 hr	1	
Crab stocking	2	3-4 times	half a day	1	
Crab harvesting	30	20-40 times	half a day	2	2-4 times/month
Planting crops, trees	72	6-10 months	3 days/mth	3	
Transport/trading	25	each month	1-2 days/mth	1	
Emergency action	15	variable	variable	3	high tides, storms
<b>Total</b>	<b>450</b>				

**Source:** Estimated from farmer responses and observations made during Survey. See Appendix 3 & 4.

Assuming full employment at 240 hours/year (5 days a week for 48 weeks or 11 months a year), the above estimate shows only about 62 percent utilization of labour among the average farmer family. Note that the estimate already takes into account current forms of farm diversification (crab farming, cash crop growing etc.). Thus nearly one-third of the time is potentially available for additional economic activities if there are opportunities and incentives.

#### *Income Sources and Diversification*

Most farmers in both the Groups rely solely on the income from shrimp harvest, though after the Typhoon Linda, there has been increasing income diversification through activities such as crab farming, growing vegetables, raising domestic animals, picking snails, crabs, vegetables and other edible plants in the wild.

There were a few notable differences in the forms of diversification among the farmers. Those with some capital access have diversified into crab farming, animal raising and fruit trees planting (which requires a water-well), and a few in shrimp trading or transport — activities that require a varying degree of capital inputs. Less affluent farmers were diversifying into activities that do not require capital, such as picking snails, crabs, vegetables and other edible plants from the wild. A few poorer farmers also worked as labourers, carrying out farm dredging for other farmers.

In the TGIII Group, at least two farmers were engaged in shrimp trading, an activity that needs substantial capital for the purchase of motorised boat, fuel, ice and ice boxes, etc. They have a locational advantage of being close to the collection point at the Vam Dam market (which is across the river from the TGIII office) and to the 184 Enterprise, where farm gate shrimp prices are lower than in TGIII.

### *Credit*

The credit system to which the farmers in the two Groups have access can be grouped into five categories:

- Credit from State banks (Bank for Agriculture and Rural Development and Bank for the Poor).
- Credit from private lenders (informal, with very high interest rates).
- Credit from formal or informal community based systems, such as People's Credit Fund and ROSCA (*hoi*).
- Indirect credit in the form of purchase of post-larvae and household necessities from vendors.
- Credit from relatives and friends.

### *Credit from Banks*

All the farmers interviewed were in debt to a varying degree. In most cases, however, the debt in question was the soft loan issued by the Vietnam Bank for the Poor in early 1998 for recovery from the damage caused by Typhoon Linda, which struck the Ca Mau peninsula in November 1997. These loans, with a monthly interest rate of 0.5 percent (6% per annum), are due in April-May 2000. The interest rate has been increased this year to 0.75 percent per month, and the Enterprises are urging farmers to prepare for repayment by the scheduled dates.

Some farmers in the 184 Group also received a loan for aquaculture before the typhoon. This loan, with a monthly interest rate of 3.2 percent, was issued by the Bank of Agriculture and disbursed via the Enterprise to the farmers on farm area basis. Following continued shrimp mortality since 1994-95, the bank has amortized this loan. According to the farmers and Enterprise officials, the bank will attempt to recover only the principal, and the recovery will start when the shrimp situation returns to normal. Unfortunately, the bank officials in Ca Mau province were not available to confirm and comment on this information, so that the status and the future of these loans could not be ascertained.

Most farmers complained about not being able to access bank loans anymore. Farmers in the Enterprises can access loans only with the approval of and guarantee from the Enterprise. Due to a large amount of outstanding debt, and the perception among Enterprise officials that farmers invest the credit inefficiently, the Enterprises seem reluctant to borrow again from the banks.

The debt situation and outstanding amounts in the two Enterprises as of January 2000 are as follows (from interviews with officials of the respective Enterprises).

In TGIII, about 100 household are in debt for the Typhoon Linda recovery loan (approx. 2.4 million per household), with the total outstanding amount of 240 million VND. The Enterprise hopes to get all the loan repaid by the deadline of April-May 2000.

In SFFE 184, two sums, 1 billion VND and 2 billion VND, were borrowed from the Vietnam Bank for Agriculture in 1993 and 1994, respectively, and disbursed to farmers on the basis of the land area (on average about 2 million VND/ha of water surface, and varying between 1-3 million VND/ha). Of these amounts, the 1993 loan was fully repaid, while the 1994 loan has a total of 700 million VND outstanding. A total of 480 farmers were beneficiaries of the loans.

### *Credit From Private Lenders*

Credit from private lenders carries exorbitantly high interest rates, 7-15 percent a month or even higher. Loans from private lenders are usually small amounts borrowed in times of emergency, and repaid within a short period of time. Private lenders generally advance loans to farmers they already know and those with a satisfactory credit-worthiness. At least two farmers in 184 reported having borrowed from a private lender an unspecified amount at the rates of 8 percent and 10 percent per month, respectively. In TGIII, one farmer

reported having borrowed a very large sum of money (4 tael of gold or about 18 million VND) in 1990, at the interest rate of 7 percent a month, which he says he has been paying every year for the past ten years. As this farmer could not be reached during subsequent visits by the research team, this information could not be verified for accuracy.

According to the Enterprise officials, following credit advancement by state banks, the importance of private lenders is somewhat reduced and their number is diminishing. It was not possible to verify this information from other sources or to contact private lenders.

### *Community Credit System*

Informal rotating savings and credit associations (ROSCAs or “*hoi*” in Vietnamese), are common throughout Vietnam (exist in many Groups within the Enterprises, including the two Groups studied. This system is sometimes open to non-Group members, as is the case in the 184 Group, but membership is usually restricted to persons known to other members. In this system, the members contribute a certain sum of money every fortnight or month. Loans are advanced from the accumulated amounts to those bidding to pay highest interest rate.

The majority of farmers interviewed were “*hoi*” members. Contributions varied from 50,000 VND to 200,000 VND every 15 days. The poorest three in 184 were all not members of the “*hoi*”.

In addition to “*hoi*”, another system called a community trust fund existed in the TGIII Group before Typhoon Linda. In this system, farmers make a one-time payment of a certain amount. This fund is then used to advance loans to the poorest and needy farmers in the Group at a nominal interest rate. In the TGIII Group, 16 members of the fund contributed 150,000 VND each and four loans were given out at an interest rate of 3 percent a month, which is comparable to the interest rate on the regular bank loans.

### *Indirect Credit*

Yet another type of informal credit arrangement commonly accessed by most farmers is the purchase of shrimp post-larvae (PL) on partial credit. Under this arrangement, the shrimp post-larvae vendor provides the required number of PL to the farmer who pays half the amount up front and agrees to pay the remaining half at the time of harvest, 2 to 3 months later. The price of the PL is usually higher by about 15-20 VND, than the hatchery price. For instance, in December 1999-January 2000, when the hatchery price was about 35-37 VND for a single 15-day old post-larva (PL<sub>15</sub>), farmers purchasing on credit paid about 55 VND. A year earlier, farmers paid 90 VND when the hatchery price was only 70 VND (interviews with farmers, and hatchery operators in Nam Can, Ca Mau).

Considering that half of the amount is paid in cash at the time of purchase and the rest about three months later, this indirect credit carries as much (if not higher) interest rate as the direct credit from private lenders. Farmers buying PL in cash from the vendors usually pay only a slightly higher price than those buying from hatcheries. Because they buy PL in bulk, vendors usually get a better price at hatcheries than individual farmers who also have to bear the transportation cost.

In addition to the high price, the farmers buying PL on credit are unable to select good quality post-larvae. Post-larvae are supplied in plastic bags at about 2000 PL per bag. Farmers usually determine the seed quality by noting the movement of the PL when stirred. The farmers who buy seed on partial credit usually have to buy what the vendor offers, and suspect that the bags with weaker seed are usually given out to those who buy on credit.<sup>11</sup> Many farmers in the TGIII Groups bought seed directly from hatcheries, while most farmers in 184 bought it from vendors on credit, or in cash. Those buying in cash said they had tso stock at a lower

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<sup>11</sup> When purchasing at the hatchery, the buyer can select one of the several nursery tanks, from which the required number of seed are then packed.

density to avoid being indebted to the vendors. Weaker shrimp quality is a serious problem that tends to affect less affluent farmers more due to the manipulation by vendors under the partial credit arrangement (see also “*Hatchery Operators*” in the section on “*Institutions*”).

#### *Credit From Relatives and Friends*

A few farmers in both the Groups reported having borrowed from relatives or friends, but were reluctant to give further details on the amount, credit conditions, etc. In the TGIII Group, however, one farmer has reportedly put his land up for sale, as he is unable to repay the loan he took from his father-in-law to purchase the land.

### **Farmer Perceptions**

#### *Risk*

The results of the risk assessment exercise in the semi-structured interviews show that farmers participating in the project trial tend to have a higher level of confidence in the harvest of their shrimp crop than the control farmers. Farmers were asked about their total investment in the shrimp farm that year and how much they would be willing to sell it for. The difference between the selling price and investment provides an indication of the risks involved in shrimp farming. The more the difference (positive value) the less is the risk. Unfortunately, few farmers answered this question adequately.

#### *Future Value*

The purpose of the future value assessment exercise, also part of the semi-structured interviews, was to assess the future discount rate. The respondent was asked that supposing someone bought the crop for an arbitrary amount (usually the expected value in the risk assessment exercise or simply 10 million VND) this year on credit, what amount would he/she have to pay the respondent next year to pay off the debt? The question was repeated for different years (2, 3, 4, 5, 10 and 20). For comparison, the responses were adjusted to a base present value of 10 million (Table 8).

The future value exercise revealed that, in general, the farmers place a very high discount rate on the future. The discount rates generally correlated well with the levels of income in the TGIII Group (except for one farmer), but in the 184 Group there were wide variations, largely arising from the respondent’s inability to visualise the situation over such a long period of time. Most responses correlated well over the first 3-5 years. Thereafter, the discount rates fell in some cases. This was because, some farmers perceived long term discount rates to be lower than short term rates. The exercise also provides an indication of the farmers’ perception about the benefits from mangrove harvests 20 years later. All the farmers indicated they rather have the 10 million now than the higher amounts later.

**Table 8.** Perceived Discount Rates vs. Levels of Income (unit: million VND)

Group	Farm	Inv.	Exp.	Income	Future Value (years from present)							
					0	1	2	3	4	5	10	20
TGIII	1	8	50	56.63	10	12	15	18	20	22	n/a	n/a
	2	n/a	8	29.93	10	15	30	35		40	60	500
	3	n/a	10	30.10	10	15	30	40	50	60	n/a	100
	4	n/a	50	35.12	10	14	18	20	24	36	50	70
	5	n/a	50	37.50	10	18.4				52	94	178
184	1	n/a	n/a	65.20	10	13	16	n/a	n/a	n/a	25	50
	2	n/a	80	25.50	10	15	24	40	n/a	40	80	160
	3	n/a	70	12.24	10	15	25	30	n/a	35	70	100
	4	n/a	60	24.08	10	12	15	18	n/a	24	39	69
	5	n/a	n/a	15.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	6	3.5	10	10.20	10	13	15	18	21	26	40	60

**Notes:** n/a: not answered; Income calculated from data based on farmer responses.

**Sources:** Survey data

### *Perception of Different Groups*

#### *Community*

Farmers in both Enterprises replied, when asked about the Group's solidarity, that they have good solidarity in their Group. However, one farmer in TGIII mentioned lack of cooperation among farmers in their Group. There was no evidence of competition for status among the Group members

#### *Enterprise*

The farmers in both Enterprises indicated a general lack of trust toward the Enterprise and in the profit sharing arrangement for mangrove harvest, in particular. Since forests are, in most cases, below harvesting ages the farmers have no experience of profits from mangrove harvests. Where thinning was carried out, profits were negligible (pers. comm., officer implementing project trials).

The distrust toward the Enterprise originates partly from the fact that there is no aquaculture extension service from the Enterprise, or any help toward improving the farmers' livelihoods, apart from the two loans in securing which the Enterprise acted as a guarantor. The Enterprise officials admitted the lack of extension officers for aquaculture. With the assistance from the district Department of Fisheries in Nam Can and the Provincial Aquaculture Extension Office in Ca Mau, aquaculture training sessions are held for farmers in different areas in the district. According to the TGIII Enterprise officials, such training sessions are being conducted in the Enterprise. However, the farmers in the Groups studied had not attended or even heard of such training courses.

The Enterprise officials, on the other hand, indicated a lack of trust in the farmers' ability to improve productivity, which they blamed on the farmers' low education level and lack of technical knowledge and experience in shrimp farming. Together this results, according to the Enterprise officials, in an ineffective use of investment, for which reason they are reluctant to act as loan guarantors for more bank credit.

Farmers, therefore, turn to private lenders in time of need for loans with very high interest rates raging from 6-10 percent a month. The interest rates may vary depending on the level of acquaintance between the lender and the borrower, and the latter's credit-worthiness. Farmers who are unable to pay back loan in time, gain a low reputation and find it difficult to borrow again.

There was also a feeling among the Enterprise officials and some of the more successful farmers that many shrimp farmers generally concentrated only on quick profits from shrimp farming, and were reluctant to diversify into other income generating activities that could lead to a more sustainable livelihood.



### *Shrimp Post-Larvae Vendors*

Farmers trust the quality of shrimp seed bought directly from hatcheries more than that of seed bought from vendors at farm gate. However, lack of capital for direct purchase from hatcheries forces them to rely on vendors who provide shrimp seed on credit. Farmers are aware of the high prices vendors charge and low quality of shrimp they supply, but in most cases were helpless.

### *Extension Services*

The district fisheries office at Nam Can provides training and extension to shrimp farmers in the Enterprises. Two-day training courses in shrimp aquaculture are organised every 3 months in 3-4 villages in the district. Each course is participated by about 100 farmers. Apart from shrimp, the extension services cover fish culture, crab culture, environment, and fisheries. Additionally, fish feed companies and enterprise officials also provide training.

So far, the farmers in the two Groups have not received or even heard of such services. Some of the farmers expressed willingness to attend short training courses conducted elsewhere in the district, if costs of transportation and lodging were met.

### *Other Agencies*

The farmers in the TGIII Group mentioned visits by researchers from Cantho University some years ago (before Typhoon Linda) and the current visits by the ACIAR project staff. The 184 Group was visited by the staff of the Dutch-funded Rehabilitation of Mangrove Forest Project (RMFP). However, no mention was made of any training received. Generally farmer perception about mangroves, particularly in terms of their links with shrimp farming, was rather rudimentary.

### *Perception of Externalities*

Farmers in both Enterprises perceived that leaf litter from the mangrove forest has an adverse impact on the yield of shrimp. The leaves decay in the water, releasing tannin and other chemicals and increasing acidity. Farmers in the 184 Group who practise the “mixed system” more often made this complaint. The blocking of sunlight (shading of the pond surface) and wind by trees was also a frequently made complaint in the 184 Group. Farmers in this Group want to convert their ponds to a separate system, but appeared unaware of the costs involved.

Agrochemicals from paddy fields, particularly from the nearby Dam Doi district were also blamed for adversely affecting water quality and shrimp yields. Rain is said to affect shrimp yield through its diluting effect. Farmers, however, do not consider rain a serious problem, because water exchanges are frequent. None of the farmers mentioned temperature as a factor affecting shrimp yield. For most farmers, the link between water temperature and pond depth was apparently new knowledge.

### *Farmer's Perception on Technical Management Recommendations*

Overall, the farmers agreed to the ACIAR project technical management recommendations for improving shrimp yields, particularly those relating to deepening the pond to improve water quality, controlling leakages, and raising and feeding shrimp juveniles in nurseries. The major disagreement was regarding the longer growout period with no harvest in the meantime except by Tom Te or other “against the water current” techniques. Most of the farmers believed that Tom Te causes deterioration in water quality due to high turbulence and fetches marginal yields as compared to the normal 15-day harvests. It was not possible to find out if the reluctance to employ Tom Te or similar techniques arises from the farmers’ lack of experience/skills in using these techniques, since according to the previous studies in this project, successful farmers are known to use these techniques which yield only large shrimp that flow against the water current while keeping the smaller shrimp in the pond (AIMS/NACA/RIA2 a & b 1999).

As for the recommendation on pond deepening, most farmers in the two Groups have begun deepening the ponds as far as they can afford. Financial constraints was cited as the main obstacle in employing most of the project recommendations, including nursery feeding.

For similar reason (financial), most farmers are also unable to select healthy shrimp postlarvae, which they buy on partial credit from the vendors (see section Shrimp Post-larvae Vendors above). The recommendation on discarding weak or unhealthy PL was not considered acceptable since the farmers perceive they have spent money on buying them and are therefore reluctant to waste the PL by discarding them.

Most farmers were also reluctant to accept the recommendation on reducing stocking densities. They feel that juvenile mortalities are very high, therefore additional stocking, as and when affordable, is necessary.

Some farmers have been following some of the other recommendations, such as those relating to pond preparation using fertilisers (to enhance plankton growth), acclimatization of post-larvae etc. However, the major drawback is their reluctance or inability to implement longer growout cycles (45-60 day), and reduce stocking density.

## **Institutions**

### *Farmer Groups*

There are two parallel administrative systems for SFFE residents. One is the Enterprise itself, and the other is the local government system comprising of hamlets, villages, communes, districts and provinces. The administrative system within the SFFE comprises of Zones that are divided into Groups. The Group is the smallest administrative unit for both the systems.

The function of a Group is to provide for self-security and self-management of the Group members. As a result of the administrative overlap, SFFE residents do not usually have to deal directly with government agencies, except for house registration with the village authorities, as is the case elsewhere in Vietnam, but through the Enterprise administration, which acts as the representative of all households within the Enterprise.

### *The Enterprise*

As explained earlier (see “*Background on SFFEs*”), the main function of the Enterprise is to manage mangrove forest by issuing land plots to individual farmers. It also acts as a tax collector for the government. An Enterprise committee runs the day-to-day affairs of the Enterprise. The administrative set-up of the two enterprises differ. SFFE 184 is primarily a production unit, which meets its administration expenses through income from forestry. But because the government has now restricted forest cutting, the tax revenue is inadequate to meet all the enterprise expenses, and therefore the enterprise also generate funds by culturing shrimp and mangrove silviculture on the enterprise’s own 50 ha plot (24 ha mangrove and 26 ha shrimp farm including levees; mangrove trees, planted at 10,000/ha are 5 year-old).

The TGIII committee has 36 members, most of whom are trained in forestry or administration. Two of the staff members have a bachelor degree in forestry. Few, if any, have any formal training in aquaculture. SFFE 184 has a staff of 30. In addition, however, community members help as collaborator-workers for which they are paid small token value. Only one staff has formal training in forestry and none in aquaculture, though some have received short-term training in forestry.

### *Department of Agriculture and Rural Development (DARD)*

The provincial Department of Agriculture and Rural Development oversees all the SFFEs in the province. The role of the DARD is to make policies or to pass down policies from the central government to the Enterprises

to carry out. Like most provincial institutions, the DARD appears to have some sort of autonomy in its decision making. For instance, the decision in 1996 to convert the status of the seven loss-making SFFEs to forest management board was Ca Mau DARD's own decision. It increased the financial burden on the DARD, and the central government was not very pleased with this change (from interviews with DARD officials).

The Ca Mau DARD oversees the 18 SFFEs (6 of which are now Forest Protection and Management Boards) in the province. In addition, there are five Forest Protection Units belonging to the provincial Forest Protection Division, and ten other units including some for research, and those belonging to the army etc.

Since 1991 the provincial policy has been to allocate forest land plots to people. The land plots in mangroves are to be 2.5-5 ha, while in Melaleuca about 5-7 ha. Of this, 25 percent forest area can be used residential and household economy purposes, including shrimp farming in mangroves and rice-fish farming in melaleuca forests.

During the first several years since the establishment of SFFEs, everything went well. Later, however, some weakpoints in the system became apparent. These include:

- Land plots are too small per household.
- Low productivity of traditional shrimp culture, which relies on wild shrimp stocks, compels farmers to devote more land (up to 50%) for aquaculture.
- The areas are distributed equally across the SFFEs, so that there are no planned residential areas.
- Infrastructure is not well developed.

The DARD is trying to improve on these weaknesses. For instance, technology transfer is encouraged to improve productivity. Bilateral and multilateral assistance (such as from the Dutch and Danish Governments and the World Bank) has helped a great deal, but still the funding is not adequate to address all the issues. A change from extensive to intensive or semi-intensive shrimp culture is also contemplated, but its capital demanding nature and requirement of technical know-how hinders its easy adoption.

To solve the problem of infrastructure, the Ca Mau DARD has drawn a plan to provide basic amenities and infrastructure, such as schools, hospitals etc. to all households in the Enterprises. Under this plan, farming households will be relocated in groups to specially designed residential areas that are within a few kilometres from the existing farms. The existing houses can be used as farmhouses. The Ca Mau DARD is seeking funding to implement this plan

#### *The Rehabilitation of Mangrove Forest Project (RMFP)*

The RMFP is funded by the Dutch government. It has a small office within the DARD's premises in Ca Mau. The project has attempted to develop a silvo-fishery model for shrimp farming in the Mekong Delta. Work was carried out in some SFFEs for the last several years. The project has also come up with technical recommendations on optimal mangrove planting, management, shrimp farming, shrimp harvest, diversification etc. which are somewhat similar to the ACIAR project. The RMFP has now been extended to include extension and dissemination of the results. Accordingly, training courses are being conducted. The project has developed interesting extension material on mangroves as well as shrimp farm structure and management.

The RMFP together with the World Bank funded Coastal Wetlands Protection and Development Project (CWDP), has developed a Coastal Belt Zoning Plan, which identifies a Full Protection Zone (FPZ), and a Buffer Zone (BZ). This plan will be implemented under the CWDP project (see CWDP)

### *The Coastal Wetlands Protection and Development Project (CWPDP)*

The main objective this World Bank funded project is to protect and develop coastal wetlands of the greater Ca Mau Peninsula through the implementation of the Coastal Belt Zoning Plan it has developed together with the RMFP.

The project covers four provinces, viz., Tra Vinh, Soc Trang, Bac Lieu and Ca Mau. and has six components.

- Mangrove Planting, Rehabilitation and Protection
- Technology Development and Transfer
- Social Development
- Policy Development
- Resettlement
- Monitoring and Evaluation

The core elements of the Project are forest planting and protection activities in the Full Protection Zone.

### **Policies**

#### *Land Tenure*

Land in Vietnam is owned by the government, and leased to individuals or entities. The longest lease available is for 50 years. Within the Enterprises, as mentioned earlier, land is leased to farmers on a 20-year basis (the “green card” or the “green paper”), while the Enterprise management holds the 50-year lease (the “red card” or “red paper”).

Although a 1994 legislation at the national level (Decree No. 2/CP, issued on 15 January 1994) allows individuals to hold forest lands, including mangroves, for “sustainable utilization” under a 50-year lease, farmers in SFFEs are unable to access this lease for at least two reasons. First, 50-year leases have already been issued to the Enterprises, which then issue land plots to individual farmers under a 20-year lease. Second, given the past experience of rampant mangrove destruction following the dismantling of the former communes or farmer collectives, the provincial governments fear that land privatisation may lead to another wave of mangrove destruction.

Some agencies, particularly banks, are reportedly in favour of granting farmers in Enterprises 50-year leases. Under the current 20-year lease, farmers cannot apply for loans directly, but need the Enterprise to act as a guarantor. Given the poor performance of many farmers in repaying loans, Enterprises are generally unwilling to procure more loans for farmers fearing further indebtedness and loan defaults.

Current land regulations at the Enterprise levels allow farmers to hold more than one parcel of land, but do not allow subdivision, or subleasing. However, it is apparent that subleasing is probably not uncommon; poor farmers, who cannot afford to “purchase” land, resort to informal tenancy agreements with absentee landholders. Obviously, the number of such agreements does not enter official statistics, so that despite being poor, the tenancy farmers are likely to miss out on the various poverty alleviation schemes and are unable to access official loans or assistance, such as the Typhoon Linda recovery loan advanced in 1998 by the Vietnam Bank for the Poor (VBP). They are also unlikely to draw any benefits from mangrove plantations.

A few developments concerning land tenure may need to be followed up. One of these is the possible impact of the forthcoming World Bank project on Coastal Wetlands Protection and Development in the Mekong Delta. One of the components of this project is the restructuring of the SFFEs in the coastal buffer zone. A project document highlights the case of the SFFE May 10 (in Soc Trang), which broke up six years ago, and its land was distributed to the resident farmers. Whether or not (and if it does, to what extent) the restructuring

of Enterprises in the coastal zone will have impact on Enterprises outside this zone (such as TGIII and 184) is difficult to say at this juncture.

Another development is the proposed plan of the DARD to provide infrastructure facilities to households. According to the Deputy Director of DARD's Ca Mau provincial office, under this plan, groups of farmers in the SFFEs will be relocated within the Enterprise in areas where facilities such as schools, hospitals, proper housing etc. will be set up. The new housing areas will be close to the farms (within 4-5 km), so that farmers can visit their farms on a daily basis. DARD is now seeking external funding for this plan.

While it is true that infrastructure facilities are greatly needed, the plan for relocation of farmers will need a careful study. Shrimp farming, unlike land-based agriculture, necessitates the farmer's continued on-farm presence for monitoring and surveillance; this is particularly the case with the form of shrimp farming in the Mekong Delta, with its dependence on spring tides for water exchange and harvest. Emergency situations where heavy rains or high tides breach dykes are not uncommon and usually need immediate attention. Whether the farmer will be able to look after the farm day and night while living some distance away is a question that needs to be addressed before implementing this plan.

#### *Taxation*

Tax on aquaculture land is based on the shrimp farm area (including dykes and pond water surface area), and not on the basis of productivity. Generally the tax is higher than the tax on agricultural land.

The land tax (on aquaculture land) is three-tiered. It is highest for a low-lying (shallow) land area, and subsequently lower for farms on higher grounds. The highest tax rate (for low-lying areas) is equivalent to the tax rate for second class agricultural land. Farmers in the TGIII Group complained that the tax rate is high when compared to the agricultural land in the neighbouring districts.

The mangrove plantation area is not taxable, but a resource tax (4% in TGIII and 5% in 184) applies to the gross harvest income.

#### *Credit*

The perception that loans are used ineffectively and the failure of most farmers to repay previous loans have made Enterprise leaders reluctant to help seek additional loans for farmers. Banks, however, appear to be willing to provide more loans and are pushing for the granting of red cards (50-year tenure) to farmers in SFFEs, so that they can access loans without requiring help from Enterprise leaders.

People with genuine credit needs, thus, have few other options than to turn to private lenders as a last resort. Due to very high interest rates, these loans are generally small (a few hundred thousand VND) and of shorter maturity periods. Those who are unable to pay loans, mostly due to repeated failure in shrimp farming, lose their credit-worthiness and usually end up in a more desperate situation as they cannot get loans even from private lenders. Many are then forced to leave the Enterprise.

#### *Mangrove Forest Policies*

The mangrove policy of the province was set out in the Decision No. 64 of 1991 of the Minh Hai government. The Decision was passed in the light of the new migrants from elsewhere in the country. The goal of the Decision 64 is to restore forest on 75 percent of the area, and set aside 25 percent for aquaculture. Another objective was to distribute income from forestry between individuals and institutions. The farmer receives up to 80% of the profit from final harvest, and 100% from thinning.

The provincial government decides which area in the province is to be thinned. The process of applying for permission and conducting the thinning is as follows: The Enterprise submits an application to the Department of Agriculture and Rural Development (DARD), which then sends it to the Provincial Committee. The Committee reviews the application and submits it to the chairperson for decision. The thinning policy is laid out by the government. The Earlier Decision of 1986 allowed first thinning at the age of 7 years, based on the research conducted in Northern Vietnam. But this was scrapped after it was found that the farmers thinned only good trees, leaving bad trees. Currently the first thinning is carried out in 10-year-old forests.

Uncertainties related to thinning age, costs involved when calculating final profit sharing, and the overall policies regarding thinning and harvesting, as well as distrust toward the Enterprise have led to a general perception among farmers of mangroves as a burden rather than a future income source. The 10 year waiting period before the first thinning is viewed as too long, nor is thinning at an earlier age considered profitable. Further, because land plots are rather small, and profits per ha from shrimp harvests are low, there is a clear tendency to increase pond area at the expense of the forest.

In view of the wide-spread forest clearance, a forest cutting ban was enforced in 1996, under the Decision No. 351 passed in November 1995. The ban was later lifted in the middle of 1999. However, uncertainties remain about the age of thinning. To make the policy of mangrove protection more effective, there is a need to identify and provide more incentives for forest protection. Some of these are already given in the project recommendations. For instance, changing the plot structure to one with stands of different ages (5 or 10 age groups), so that mangroves can be harvested more frequently, is an option worth considering. There is also a great need to provide more information about mangroves and their ecological significance and links with shrimp farming, especially for wild shrimp stocks.

#### *Household Registration and Residence Status*

The farmer's household registration is managed by the village administration. One of the criteria to be accepted for residence registration is that the farmer has been residing in the area for at least 5 years.

#### *Core Problems*

The core problem in both Enterprises is poverty. The problem web exercise conducted in TGIII revealed that the root causes of poverty in the Group include:

- Indebtedness (old unpaid debts)
- Tenure (green card: inability to access bank loans without Enterprise help)
- Lack of technical know-how in shrimp farming
- Weather and other inexplicable factors affecting shrimp yields
- Higher land tax on aquaculture than agriculture
- Large families (many children)

In the 184 Group, the problem web revealed the following as the root causes:

- Population pressure
- Government policies on mangrove (inability to thin or harvest forest) and land tenure (inability to access bank loans)
- Mangrove plantations too young to harvest (no income)
- Lack of capital for pond improvement and seed purchase
- Lack of technical know-how in shrimp farming
- Lack of extension services
- Lack of quality control on shrimp seed

- Dependence on PL vendors for credit-purchase (low quality and indebtedness)
- Water quality impacts on shrimp production from agrochemicals and rain
- Lack of water well to grow plants and raise animals (income diversification)

Lack of capital and increasing indebtedness, land tenure within the Enterprises that prevents direct access to bank loans, as well as lack of technical know-how are the common causes in both the Groups. In addition, large family size or population pressure are also mentioned as a cause of poverty, even though in both the Groups, at least among the farmers participating in semi-structured interviews, the average family size of is 5, close to the national average (Johnston et al. 1999).

### Economic Analysis

The economic analysis of the mixed mangrove-shrimp farming system in the Mekong Delta is presented here in two sets. The first set analyses on-farm and other (off-farm) income from various sources, and farm costs and household expenditures. It uses the data obtained during the survey (farmer interviews) as well as the MHSIFR data. The shrimp income data in the latter is derived from harvest periods that are often shorter than one year and therefore extrapolated for one complete year. The extrapolation is done by using the harvest schedule presented in the seasonal calendar (Appendix 4) for the respective Group. The number of possible harvests during the period are calculated using the simplified schedules given below (Table 9). The quantities harvested are obtained from the income data using the average per kg price of *P. monodon* (20 shrimp/kg), i.e., 125,000 VND, and from this is calculated the estimated quantity per harvest. Extrapolated yields are then derived by multiplying the estimated quantity per harvest by the maximum number of harvests in a year (Table 9). Harvests of natural shrimp are extrapolated likewise using the rate of 25,000 VND per kg (approx. 50-60 shrimp/kg) at the time of survey.

**Table 9.** Harvesting, dredging and stocking schedules for the two groups

Lunar month	1	2	3	4	5	6	7	8	9	10	11	12	Harvests
TGIII Group													
Monodon	g g	- +	++	+ d	d +	- +	- +	d d	d d	sg	sg	sg	~7
Natural	- +	- +	++	++	++	+ -	+ -	+ -	- +	++	++	++	~18
184 Group													
Monodon	+ d	ds	s +	++	+	+	d d	d d	+	++	ss	s+	~10
Natural	+ d	ds	s +	++	++	++	d d	d d	++	++	- +	+ -	~14

Legend: g: growout; d: dredging; s: stocking; +: harvest;  
Source: Adapted from Seasonal Calendars

The second set of analysis takes the estimated on-farm costs, including the costs of implementing the ACIAR Project technical management recommendations, for different stocking densities of *P. monodon*, and calculates survival rates that would fetch enough return to balance the expenditure. Incomes from natural shrimp and other on-farm activities (fruit and tree crops, animal raising) are not taken into account.

The results of the first set, the income-expenditure analysis, are somewhat suspect because the income data may be less reliable for reasons mentioned earlier (see section *Data Constraints*). Furthermore, the fact that fewer shrimp harvests were carried out by many farmers in that year may mean that the year the data was collected may have been a particularly bad year.<sup>12</sup> If that is the case, then simply extrapolating yields to the possible number of harvests may not give a correct indication of a normal year harvest since yields per harvest may also have been lower than in a normal year. Fluctuations in shrimp yield in the Mekong Delta are caused

<sup>12</sup> Most of the farmers complained of decreasing yields and incomes over the last several years, and the MHSIFR data was collected in the latest year.

by a number of factors, including weather conditions and other natural factors. For instance, higher than usual tides washed away shrimp (*P. monodon*) crops on many farms in December 1999.

#### *Adjusted Incomes and Farm Household Expenditure*

##### *Fixed Costs*

Fixed costs include costs of land “purchase”, pond construction, sluice gate construction and other expenses incurred during pond construction (Table 10). There are large variations in all of these costs except those of sluice gate construction. Land purchase value varies from as high as 20 million VND for a plot of 6.7 ha (purchased in 1993 in TGIII) to zero for the government employees who were given the land for free. Some land plots already had a pond constructed in them at the time of ‘purchase’ (from the previous land holder), and may have needed only minor digging, so that the cost of pond construction also varies from farm to farm. The fixed costs are therefore not considered in the analysis.

**Table 10.** Fixed farm costs

Farm no.	Year Settled	Land Area (ha)	Land Value	Sluice Gate Construction	Pond Digging	Others	Total Fixed Costs
TGIII 1	1990	7.8	11.50	12.00	40.00	15.00	67.00
TGIII 2	1978	7.3	0.00	7.35	20.00	0.00	27.35
TGIII 3	1994	5	14.00	6.00	50.00	0.00	56.00
TGIII 4	1993	6.7	20.00	7.00	32.00	0.00	39.00
TGIII 5	1990	5.2	1.27	4.60	20.00	0.00	24.60
Av. TGIII	1989	6.4	9.35	7.39	32.40		42.79
SD	6.40	1.25	8.55	2.79	12.99		18.33
184 1	1989	8.06	8.60	5.00	9.00	0.50	14.50
184 2	1989	4.5	0.00	6.00	11.73	0.00	17.73
184 3	1991	3.4	19.66	7.00	8.40	0.00	15.40
184 4	1990	4.5	9.17	0.70	18.00	0.00	18.70
184 5	1997	5.5	5.00	0.50	0.00	0.00	0.50
184 6	1989	3.9	0.25	1.00	12.00	0.00	13.00
Av. 184	1991	4.98	7.11	3.37	9.86		13.31
SD	3.13	1.67	7.29	2.96	5.91		6.61

Source: From Survey

Notes: Land value vary depending upon the value added by the previous occupant. The cost of pond digging varies depending on whether the pond already existed and needed re-digging or if it was constructed anew.

Where costs were given in gold units, these have been converted to current prices in VND using historical world gold prices in US\$ and average VND:US\$ exchange rates for the respective years.

##### *Variable Costs*

The variable costs consists of the following: Shrimp farm costs, which include dredging, sluice gate maintenance, seed stocking, feed for the juveniles, chemicals, labour (for planting mangroves), net mending and purchase; and the other costs, which include costs of animal rearing and planting fruit and other trees (Table 11).



**Table 11.** Variable (running) farm costs (unit: million VND)

Farm	Dredging	Gate maint.	Seed Stocking	Feed	Chemicals	Labour	Nets	Other	Total Shrimp Pond Costs	Total Other Costs	Total Costs
TGIII 1	10.00	1.00	2.10	0.70	0.08	0.00	0.60	0.02	14.50	0.90	16.40
TGIII 2	4.50	Na	7.00		0.24	0.00	na	na	11.74	2.25	15.69
TGIII 3	6.00	2.00	11.44		0.10	0.00	na	na	19.54	0.53	20.88
TGIII 4	11.00	Na	6.75	0.60	0.06	0.00	0.70	na	19.11	2.24	22.16
TGIII 5	3.00	Na	3.85		na	0.00	na	0.06	6.91	0.01	7.68
Av. TGIII	6.90	1.50	6.23	0.65	0.12	0.00	0.65	0.04	14.36	1.18	16.56
SD	3.47	0.71	3.56	0.07	0.08	0.00	0.07	0.03	5.29	1.02	5.69
184 1	14.00	0.00	9.11	0.80	0.06	0.00	na	0.03	24.00	3.97	29.76
184 2	6.50	0.00	7.00		0.60	0.00	0.06	na	14.16	4.20	19.08
184 3	6.00	0.50	6.00		0.31	0.00	0.60	na	13.41	2.37	16.38
184 4	6.00	0.90	5.77		0.11	0.00	na	na	12.78	0.75	14.13
184 5	0.00	0.50	2.30		na	0.00	na	na	2.80	1.00	5.30
184 6	1.10	1.00	3.30	0.15	na	0.00	0.20	2.25	8.00	0.00	8.76
Av. 184	5.60	0.48	5.58	0.48	0.27	0.00	0.29	1.14	12.52	2.05	15.57
SD	4.97	0.43	2.48	0.46	0.25	0.00	0.28	1.57	7.07	1.76	8.58

**Notes:** The other farm costs include, mainly, the stocking of crabs or the raising of other animals and planting vegetables and fruit trees

**Source:** Survey and MHSIFR data

### *Household Expenditures*

The total household expenses are shown in Table 12. Household expenses are generally higher in the TGIII Group than in 184 Group. Generally, households with small (school-going or pre-school) children or large households have higher expenses.

### *Income*

The various sources of income include shrimp farming, crab and domestic animal rearing and planting of fruit trees and vegetables. Shrimp farming accounts for over 88 percent of the total reported income for all but one farmer in the TGIII Group, while only two of the six farmers in the 184 Group derive similarly high incomes from shrimp farming (Table 13). A lower percentage of shrimp income in total income indicates successful diversification into other income-generating activities.

**Table 12.** Household expenses (unit: million VND)

<b>Farm no.</b>	<b>Clothing</b>	<b>Education</b>	<b>Health</b>	<b>Social Activities</b>	<b>Transport.</b>	<b>House repair</b>	<b>Recreation</b>	<b>Debt Payment</b>	<b>Household needs</b>	<b>Food</b>	<b>Other expenses</b>	<b>Total h'hold Expenses</b>
TGIII 1	2.00	5.00	0.60	2.00	0.60	2.00	2.00	0.00	4.00	6.00	0.00	24.2
TGIII 2	2.00	0.8	2.40	0.00	2.88	0.50	0.00	0.00	7.20	5.50	0.00	20.78
TGIII 3	1.00	4.5	1.00	1.00	1.20	1.00	1.00	0.20	3.00	3.50	0.00	17.4
TGIII 4	1.00	2.5	0.84	0.30	0.60	0.90	2.00	0.00	2.00	5.00	0.00	15.34
TGIII 5	0.00	1.3	0.10	0.50	0.15	0.10	0.00	8.40	1.20	3.50	0.00	15.65
<b>Av. TGIII</b>	<b>1.00</b>	<b>2.82</b>	<b>0.99</b>	<b>0.76</b>	<b>1.09</b>	<b>0.90</b>	<b>1.00</b>	<b>1.72</b>	<b>3.48</b>	<b>4.70</b>	<b>0.00</b>	<b>18.67</b>
SD	1.00	1.88	0.86	0.78	1.07	0.71	1.00	3.74	2.33	1.15	0.00	3.77
184 1	1.00	0.00	0.30	1.50	1.20	0.20	0.00	0.00	2.85	1.83	na	8.88
184 2	3.00	5.15	0.20	3.00	0.20	0.00	0.00	0.00	4.50	7.00	na	23.05
184 3	1.00	0.00	2.00	2.00	0.20	0.00	0.00	0.00	4.20	7.12	na	16.52
184 4	2.00	3.00	0.60	3.00	3.60	0.00	0.00	1.00	4.39	6.94	na	24.02
184 5	0.00	0.20	0.60	0.60	0.12	0.00	0.00	2.50	0.36	2.56	1.10	8.44
184 6	1.00	0.25	0.20	0.50	0.00	0.00	0.00	0.00	1.80	6.08	na	9.32
<b>Av. 184</b>	<b>1.00</b>	<b>1.43</b>	<b>0.65</b>	<b>1.77</b>	<b>0.89</b>	<b>0.03</b>	<b>0.00</b>	<b>0.58</b>	<b>3.02</b>	<b>5.25</b>	<b>1.10</b>	15.04
SD	1.00	2.16	0.69	1.11	1.40	0.08	0.00	1.02	1.68	2.41		7.23

**Note:** Unusually high values in data for farm TGIII-1 have been adjusted by taking the average for the remaining farms in that Group.

**Source:** Survey (farmer responses) Nov-Dec 1999 and Jan 2000

**Table 13.** Reported farm and non-farm income (unit: million VND).

Farm	Monodon Harvest	Wild Shrimp Harvest	Fish Harvest	Crab Harvest Income	Mollusc Harvest Income	Animal Rearing Income	Vegetables Income	Other Income	Total income	Monodon (% of total)	Wild shrimp (% of total)	Total shrimp (% of total)
TGIII 1	40.00	14.89	1.20	0.50	na	na	na	Na	56.63	70.70	26.29	97.00
TGIII 2	15.00	4.25	0.00	2.68	0.30	1.80	na	5.50	29.93	51.45	14.22	65.67
TGIII 3	23.00	4.50	0.50	2.00	na	na	na	na	30.10	76.74	14.95	91.69
TGIII 4	28.00	3.24	1.00	3.20	na	na	na	na	35.12	78.81	9.23	88.04
TGIII 5	20.00	16.20	0.40	1.10	na	na	0.20	na	37.50	52.27	43.20	95.47
<b>Av. TGIII</b>	<b>25.00</b>	<b>8.62</b>	<b>0.62</b>	<b>1.90</b>	<b>0.30</b>	<b>1.80</b>	<b>0.20</b>		<b>37.86</b>	<b>66.47</b>	<b>22.76</b>	<b>89.24</b>
SD	9.00	6.36	0.48	1.11					10.99			
184 1	32.00	14.00	1.40	3.00	na	8.00	0.00	7.00	65.20	48.77	21.47	70.25
184 2	8.00	7.00	1.20	5.00	na	0.00	0.00	4.80	25.50	29.41	27.45	56.86
184 3	6.00	5.00	0.04	1.20	na	0.00	0.00	0.00	12.24	49.04	40.87	89.91
184 4	16.00	6.60	0.80	0.85	na	0.00	0.08	0.00	24.08	65.41	27.41	92.82
184 5	0.00	9.00	0.00	6.00	na	0.00	0.00	0.00	15.00	0.00	60.00	60.00
184 6	2.00	3.00	0.00	0.40	1.20	0.00	0.40	3.60	10.20	15.69	29.41	45.10
<b>Av. 184</b>	<b>10.00</b>	<b>7.43</b>	<b>0.57</b>	<b>2.74</b>	<b>1.20</b>	<b>1.33</b>	<b>0.08</b>	<b>2.57</b>	<b>25.37</b>	<b>41.16</b>	<b>29.30</b>	<b>70.46</b>
SD	12.00	3.80	0.64	2.33		3.27	0.16	3.02	20.49			

**Notes:** Income data adjusted for a normal year by extrapolation. See text for explanation.

Unusually high values in the data for farm TGIII-1 have been adjusted by taking the average for the remaining farms in that Group.

**Source:** MHSIFR data (except samples 5 and 6 in 184, which are from the survey)

Table 14 below shows the total profits/deficit after all expenses and costs in a farm-household economy. While the reliability of data is questionable, a general trend of deficits among the 184 Group members provides evidence to the repeated failure of shrimp crop and higher indebtedness in this Group.

**Table 14.** Profits from shrimp and total surplus/deficit (unit: million VND)

Farm no.	Profits from shrimp	Farm Costs	Household Expenses	Total income	Total surplus /deficit
TGIII 1	42.00	16.40	24.20	56.63	16.04
TGIII 2	8.00	15.69	20.78	29.93	-6.54
TGIII 3	9.00	20.88	17.40	30.10	-8.17
TGIII 4	13.00	22.16	15.34	35.12	-2.38
TGIII 5	29.00	7.68	15.65	37.50	14.17
<b>Av. TGIII</b>	<b>20.00</b>	<b>16.56</b>	<b>18.67</b>	<b>37.86</b>	<b>2.62</b>
SD	15.00	5.69	3.77	10.99	11.61
184 1	23.00	29.76	8.88	65.20	26.56
184 2	2.00	19.08	23.05	25.50	-16.63
184 3	-2.00	16.38	16.52	12.24	-20.66
184 4	10.00	14.13	24.02	24.08	-14.07
184 5	6.00	5.30	8.44	15.00	1.26
184 6	-3.00	8.76	9.33	10.20	-7.89
<b>Av. 184</b>	<b>6.00</b>	<b>15.57</b>	<b>15.04</b>	<b>25.37</b>	<b>-5.24</b>
SD	10.00	8.58	7.23	20.49	17.36

- Notes:**
1. Income data adjusted for a normal year by extrapolation. See text for explanation.
  2. Unusually high values in the data for farm TGIII-1 have been adjusted by taking the average for the remaining farms in that Group.
  3. Profits from shrimp are obtained by subtracting shrimp pond costs from shrimp income.

**Source:** MHSIFR data (except samples 5 and 6 in 184, which are from the survey) and the survey (farmer responses) Nov-Dec 1999 and Jan 2000.

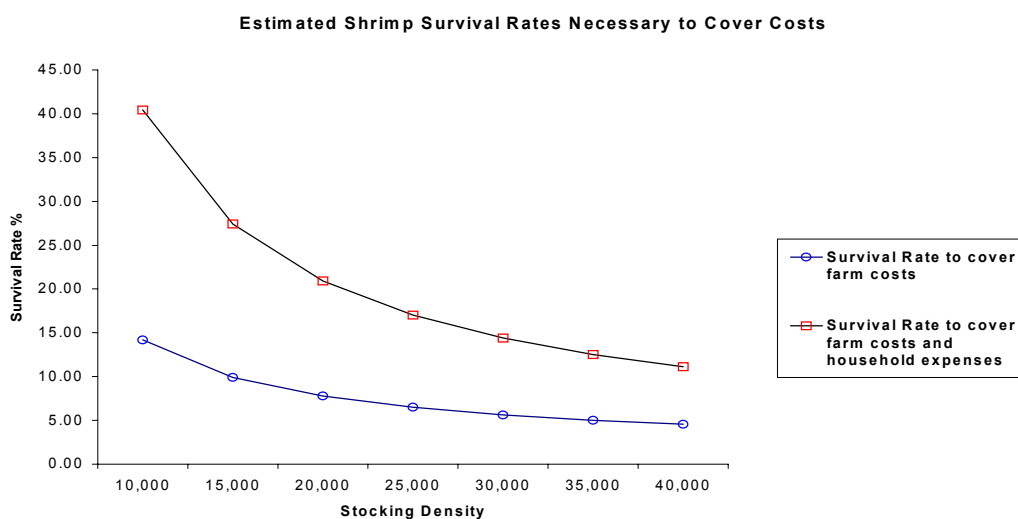
#### *Costs and Benefits in Relation to Stocking Practices*

The tendency of the farmers to stock at very high densities owes largely to the uncertainty inherent in the extensive nature of shrimp farming and the resultant high mortality. In this exercise, farm costs for different stocking densities are determined, including the costs for implementing the technical management recommendations of the ACIAR Project. Using the average shrimp price (VND 125,000/kg for 20/kg shrimp), survival rates are calculated to determine the minimum survival rates necessary to balance the costs (Table15).

**Table 15.** Estimated shrimp farm costs and minimum survival rates for varying stocking densities (unit: million VND).

Item	Stocking density (PL/ha)						
	10,000	15,000	20,000	25,000	30,000	35,000	40,000
PL purchase	0.70	1.05	1.40	1.75	2.10	2.45	2.80
20-day feeding cost	0.14	0.22	0.29	0.36	0.43	0.50	0.58
Chemicals	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Nursery nets	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Tom Te harvest	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Transportation	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Extra pond digging	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Sluice gate/nets repairs	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Miscellaneous	0.50	0.50	0.50	0.50	0.50	0.50	0.50
<b>Total shrimp farm costs</b>	<b>8.88</b>	<b>9.30</b>	<b>9.73</b>	<b>10.15</b>	<b>10.57</b>	<b>11.00</b>	<b>11.41</b>
Household expenses	16.41	16.41	16.41	16.41	16.41	16.41	16.41
<b>Total farm+h'hold</b>	<b>25.29</b>	<b>25.71</b>	<b>26.14</b>	<b>26.56</b>	<b>26.99</b>	<b>27.40</b>	<b>27.82</b>
Yield to break even farm costs (kg)	71	74	78	81	85	88	91
No. of shrimp (20/kg)	1,421	1,489	1,556	1,624	1,691	1,759	1,826
Survival rate (farm costs) %	14.21	9.92	7.78	6.49	5.64	5.02	4.57
Yield to break even farm+h'hold costs (kg)	202	206	209	212	216	219	223
No. of shrimp (20/kg)	4,047	4,114	4,182	4,249	4,317	4,384	4,452
Survival rate (farm+h'hold) %	40.47	27.43	20.91	17.00	14.39	12.53	11.13

- Notes:**
1. PL price: 70 VND/PL; PL prices have fluctuated between 40 and 100 VND/PL
  2. Costs of feeding, chemicals, nets, Tom te harvest, follows the costs specified in the ACIAR Project's budgets for farms undergoing experimental trials in 1999-2000. Transportation and miscellaneous costs are arbitrary.
  3. Cost of additional pond digging (to reach 1 m depth) is averaged to 5 million VND due to increases in these costs and the varying depths of the farms.
  4. Household expenses are derived from the average expenses for farms in the two Groups.
  5. Yields to cover the costs are estimated using the average shrimp price of 125,000 VND/kg for 20/kg shrimp size in the local market at the time of survey.



**Figure 5.** Anticipated minimum survival rates at varying stocking densities

The survival rates for the two costs (only farm costs and farm costs+household expenses) are plotted in Figure 5. The results show that the survival rate needed to break even drops rapidly at first, and then tends to level out for higher and higher stocking densities. That is, the marginal costs increases with higher stocking densities. However, this rather preliminary analysis does not take into account other factors that may influence the survival rate. Increased stocking densities are likely to create competition for available food and environmental resources in the pond, creating stress and causing higher mortalities. It would then become increasingly difficult to maintain the desired survival rates for higher stocking densities. Thus, farmers should be made aware of the excessive costs involved in higher stocking densities and the diminishing returns that are likely to result, if not a complete production crash. The ACIAR project recommends low stocking densities of 10,000 to 15,000 PL/ha. Assuming two crops of 3 to 4 months are taken (one each in the dry and wet seasons), the survival rates needed to break even may be even less, approximately half of those mentioned above. However, the difference in wet season and dry season yields should also be borne in mind.

The MHSIFR data revealed that the farmers in the two groups used stocking densities of about 36,000 (in TGIII) and 46,500 (184) per ha of pond per crop (assuming two crops). These are more than twice as high as the recommended densities. Lower stocking densities will not only reduce production costs, but perhaps also improve survival rates. At the PL price of 70 VND/PL, this would mean that bringing down the stocking rates to 10,000 and 15,000 PL will release, respectively, the amounts of 1,820,000 VND and 1,470,000 VND for the TGIII Group farmers and 2,555,000 VND and 2,205,000 VND for the 184 Group farmers, bringing down the amount of money needed to implement the project recommendations drastically.

## **Discussion of Socio-economic Study Findings**

There is clearly a vicious circle of poverty, indebtedness, production failure and more indebtedness, which affects a significant number of farming households in the State Fishery-Forestry Enterprises. Those who succumb to this vicious cycle are obviously the less successful ones with low technical know-how or experience in shrimp farming, but also those with few alternative income sources and no access to capital. The lack of technical know-how often leads to ineffective or wasteful use of resources (e.g., stocking shrimp at high densities). Lack of capital and access to formal, low-interest credit, on the other hand, forces farmers to purchase capital inputs such as shrimp post-larvae on credit from informal sources at exorbitantly high interest rates. With fluctuating production, repeated crop failures, and a lack of alternative income sources, the end result is growing indebtedness and more poverty. Uncertain land tenure, inavailability of marketing channels and lack of incentives for diversification, as well as uncertain income from mangrove plantation, together with low community bonds due to a relatively recent settlement history, only add up to the larger problem of poverty and indebtedness.

Some farmers who have migrated to these areas for purely speculative reasons (in search of lucrative profits from shrimp farming) may, in some cases, have additional plots of land elsewhere. In the two Groups visited, at least two farmers (one in each Group), had plots of agricultural land elsewhere; one even had a shrimp farm in another Enterprise. Within the Enterprises too, land consolidation has been happening. Obviously, it is the more successful shrimp farmers, or those engaged in high-income generating activities such as trading in shrimp, who are usually able to “buy” more pieces of land. Since mangrove incomes from a small plot of land do not provide sufficient incentive for forest conservation, Enterprises tend to welcome (and probably encourage) land consolidation. Generally on most smaller plots, the requirement to maintain a 70:30 forest-to-farm ratio is often breached, with shrimp farms occupying much larger area.

Among the poorest of the poor are those who are not even able to “buy” a piece of land for themselves. Some of these, as one case in this study suggests, live on lands “rented” from official land holders. Such

“sub-leasing” is illegal, but probably not uncommon, though its extent is hard to estimate. Tenant farmers are, however, likely to fall outside all the safety nets for the poor (including the loans from the Bank for the Poor). Extension services too may not reach such farmers.

The reluctance of farmers to incorporate all of the ACIAR project technical recommendations is partly due to lack of knowhow and experience in shrimp farming, and partly due to a lack of capital. Simply providing capital access may lead to its ineffective use in the absence of proper technical knowhow, causing further indebtedness.

The importance of reducing stocking densities to more sustainable levels could not be stressed more. Not only the high densities currently employed create a financial strain on farmers, they may also be causing higher mortalities. However, the awareness about the significance of low stocking densities also need to be accompanied by ways to reduce the uncertainty in the farming systems. To a great extent this can be achieved by providing appropriate technical knowhow. The uncertainties arising from natural causes (weather changes, unusually high tides, etc.) are hard to control, but efforts should be made to include contingency measures that can build preparedness for such events that appear to be frequent in the Mekong Delta.

### **Poverty and Capital Constraint**

As mentioned in the results section, most are poor at the edge of survival. This presents the capital constraint in following the recommendation. The recommendation such as digging the pond to the depth of 1-1.2 meters deep, and 1.2-1.5 meters deep in case of much leakage from the ponds is capital demanding. In addition, poor farmers are dependent on the regular flow of income from the practice of 15-day harvest cycle.

It will be difficult for these poor farmers to follow the recommendation of closing the gate for two months after stocking and following a 45 day harvest cycle instead of 15 day cycle. One option to address this issue is to provide loans to live on during these two months (perhaps with some guarantee that they will be pardoned of the loans if the crop turns out to fail after closing the gate for two months).

As mentioned in the results section, during the slack season, most of the labour and time are not used. There is a potential in using the time and labour available during the slack season for making additional income sources. However, most farmers here do not have other skills and resources.

The recommendation to diversity income sources such as planting fruit trees and vegetables and raising crab, and fish together with shrimp seem to meet with difficulties. First, farmers say that they do not own a water well to irrigate their fruit trees and they were afraid that there would be no market for the vegetables if they were produced on a commercial scale. The research team paid a visit to the most important local market (Vam Dam market) and could not find any produces from the area. Most of the produces were brought from other provinces in the Delta and from Dalat. Vegetables sellers at the market said that they had some supplies from the farmers in the rainy season, but not in the dry season.

Compared to the annual profit from a good shrimp harvest, the profits from a mangrove plot after 20-year waiting period do not seem to be very attractive. Furthermore, farmers are unsure about the profits from mangroves as the cost outlay is unclear for them, even though they may know the market prices of mangrove wood. There is, therefore, a general distrust towards the Enterprise and the profit sharing in particular. As a result, farmers see mangroves more as a liability than a future income source. Coupled with the general lack of awareness about the ecological importance of mangroves (and the possible link between the large-scale mangrove deforestation and the decline in natural shrimp stocks), the farmers would like to have larger areas allocated to shrimp farms than mangroves, and are dissatisfied with the

current restriction of having to keep 70 percent area for mangroves. Indeed, most farms surveyed had less than 70 percent area under mangroves.

It is quite likely that if a farmers shrimp harvest fails consistently, as has been a problem during the past 6 years, and if the alternatives such as fish farming are not available in time, some farmers may forfeit their land contracts and migrate elsewhere. This appears to be happening already in both Enterprises. In TGIII, some farmers said that less than a third of the original residents have remained in the area, although the Enterprise officials did not agree with this estimate. According to them, the migration trend was only 1-2 families moving out each year in the whole Enterprise. In 184, about 5 percent of the land contract changed hands each year. However, because there is also a significant land consolidation happening in this Enterprise, it was not clear how much of this exchange was between local farmers and outsiders.

The study suggests also that there is no sense among households of ownership of the mangroves. Clearly, this issue of incentives has to be addressed if farmers are to manage the mangrove forests in a sustainable manner.

## **Recommendations**

Based on the above, this socio-economic case study makes the following recommendations:

### **Training and extension**

Sustainable income is obviously the most important need for sustainable livelihoods, and in this it is difficult to wean the farmers away from shrimp rearing, high profits from which was the motivating force for most farmers who have settled on the Enterprise lands. To improve shrimp yields, therefore, extension and training is necessary. Currently, the local district-level fisheries offices, with help from the sub-institute (Minh Hai Sub-Institute for Fisheries Research), a few days training is given to farmers. However, the number of farmers is so large, that the training has not reached most farmers yet. Therefore, in addition to these training programmes, Enterprises can be given a role in training and extension relating to shrimp farming.

### **Credit**

Growing indebtedness is a major problem affecting most farmers. Most farmers need small amounts of cash during culture period to meet daily expenses and also for capital inputs such as shrimp fry, nets, dredging etc. However, under the current practices of high stocking and high mortalities, most farmers suffer repeated crop failures and this only leads to further indebtedness. The study team shares the perception of some Enterprise officials about the ineffectiveness of loans in the absence of proper technical knowhow about shrimp farming. At the same time, the question of high-interest informal credit farmers access as a last resort is also important. A large number of farmers are already in debt to banks and it is quite likely that debts from informal sources may also be large.

Therefore, some mechanism for advancing small, short-term loans should be devised. Preferably, such loans for a specific activity such as shrimp farming can be advanced in a package that also includes some training. This, however, may be a difficult task given the low capacity and manpower at the existing extension and training services, unless the capacity of the Enterprise staff can be enhanced to act as providers of training and extension.

Some Groups in the two Enterprises are members of the People's Credit Fund schemes, and most Groups have the informal rotating savings and credit associations (ROSCA or *hoi* in Vietnamese).



In accessing formal credit, the current structure, which requires the Enterprise to act as a guarantor, is rather cumbersome. The reluctance of Enterprise officials to act as a guarantor is probably due not just to their perception that loans are ineffectively used and farmers end up in debt, but also to high transaction costs, unless a sufficiently large number of farmers apply for loans at the same time.

One option the study team considered was to tie loan repayment to incomes from mangrove cutting; ie., using assessed value of mangrove income as a collateral. However, given negligible to zero profits from thinning and the long wait period before the final harvest (20 years), this option seems impractical. If incomes from thinning and harvesting can be improved using the project recommendations, this should be considered as a viable option.

## **Income Diversification**

### *Farm Production*

Since shrimp farming, even in the extensive systems typical of the Mekong Delta, comes with its risks of production failures and high capital requirements, it is advisable to have more diversification of farm income. Our study found that farm households have surplus time and labour that can be effectively used for income-generating activities if proper incentives, training and extension services are provided. Subsistence-type simple diversifications such as growing vegetables and fruit trees can be undertaken without very high capital inputs. There is certainly a great potential for growing salt-tolerant cash crops on dykes and levees and also for raising farm animals such as chicken, ducks and pigs. The latter, however, require some capital inputs which many farmers lack. Crab culture is catching up among many farmers as a supplementary income source.

A few other options would be polyculture of fish and shrimp, or monoculture of fish and shrimp in adjacent ponds. Some farmers are considering shifting to fish culture (sea bass), if shrimp culture fails again this year. The capital input costs are, however, high, and farmers may need proper technical advice before launching this new venture. Most farmers do not have prior experience in fish rearing and the only reasons they are willing to shift to fish farming are the repeated failures in shrimp farming and the perception that fish farming is less risky.

### *Market Access*

Currently most farm produce (vegetables, crabs and fish) is sold at the local market, where there is still room for additional supply which currently comes from other provinces, particularly in the dry season. Local markets may not be able to absorb large amounts of production if diversification is encouraged on many farms. Markets as far as Can Tho, if not up to Ho Chi Minh City can be reached if proper collection and transportation systems are in place, and if farmers are guaranteed reasonable prices.

Enterprises can be encouraged to undertake collection and marketing of farm produce. The Provincial DARD has considered this issue, and in the opinion of one official at DARD, the many commitments most Enterprises have make them unwilling to take additional responsibilities. Incentives should be developed for Enterprises to take up a role in organising collection and transport of farm produce to markets. Such collection systems may also include shrimp, which are currently collected by private traders (primary traders) and often sold at high prices to secondary traders at illegal collection points. Alternatively, these systems could be developed at the zonal level within an Enterprise, or NGOs can be invited to develop them among farmer Groups.

## **Mangrove**

Profits from mangrove thinning appear to be negligible, and even the anticipated profits from final tree harvest do not serve as incentive for mangrove conservation. According to one estimate given by

Enterprise officials at TGIII, current harvest income from a one-hectare plot of 20-year old mangroves (planted at an initial density of 10,000) is about 50 million dong. The costs are about a third, or around 16-17 million VND. When the remaining is divided 60:40 or 70:30 between the Enterprise and the farmer, the farmer is likely to receive about 10 to 13 million VND from the one hectare plot.

The long waiting period before the final harvest (20 years after planting) and the general feeling of insecurity among farmers about the actual profit sharing with the Enterprise shape the farmer perception of mangroves as a liability or burden than a future income source, even though they derive such direct or indirect benefits as wood for fuel and construction and feeding grounds for crabs. Farmers practicing the “mixed” shrimp-mangrove system are particularly apprehensive about mangrove benefits, largely because of the impact of mangrove leaf litter on water quality and the blocking of sunlight and wind from reaching the ponds as the trees mature. Most farmers want the area under mangroves to be reduced and converted to shrimp farm. Indeed, a significant number of farms have less than 70 percent of the area under mangroves. There was some evidence of cutting of mature trees for incidental purposes (such as house repairs or as planks for crossing pond canals). However, because of regular patrolling by Enterprise officials, most farmers ensure that mangroves are protected from large-scale theft or other dangers to the trees.

It is recommended that the profit sharing arrangements be reviewed as well as more incentives be provided for mangrove conservation. These include increasing the compensation for planting labour about which there was a general dissatisfaction among the TGIII Group farmers (no payments were made in 184, since labour costs are supposedly included in the final profit sharing arrangements). The World Bank project has a sub-component on providing more incentives for mangrove protection, including increasing financial assistance under the present protection contracts. It will be interesting to see how these developments will affect Enterprises outside the coastal protection and buffer zones.

An additional recommendation for mangroves would be on increasing species diversity in a small section of the land-holding, and is again in line with a proposed activity in the World Bank project. Currently virtually all plantation is of *Rhizophora* spp. for economic reasons. A small section of the land holding, preferably at the back where it shares the border with the neighbouring land plots, can be devoted to a mixed forest with a variety of mangrove plants. Obviously, however, the ecological aspects of mangroves and the natural zonation patterns need to be taken into consideration.

Few farmers were aware of the importance of the ecological functions of mangroves, particularly as nursery grounds for fish, shrimp and other aquatic species. These ecological as well as other non-monetary benefits of mangroves need to be stressed and awareness about these can be increased through extension. However, as farmers may not see direct benefits from such secondary functions, therefore may be difficult. Nevertheless, the RMFP, which is now in its extended phase, has prepared some excellent extension material on the importance of mangroves and on developing and managing mangrove-shrimp aquaculture systems.

### **Implementation of Project Management Recommendations**

Farmers generally agree to most recommendations the ACIAR project has suggested for shrimp farming as well as mangroves. The only major exceptions were adoption of low stocking densities, a longer growout period with harvesting after 45-60 days (instead of 15 days), and the use of the *Tom Te* or other “against the water current” harvesting techniques during the spring tide water exchanges. The reasons for these are described below.

The heavy shrimp mortality during the growout seems to be the main factor that drives farmers to stock at higher densities. Ironically, though, higher stocking densities themselves may lead to high mortality due to competition for food, water fouling and self-predation. These factors have been identified by the previous

studies under this project. There is a need to increase awareness among farmers about the ineffectiveness of high-density stocking.

The reluctance to shift to a longer growout period is due to the forgone harvest income from the 15-day harvests. Moreover, most farmers believed that yields from Tom Te and similar techniques are far less than suggested (less than 30% of the regular 15 day harvest). Tom Te is also believed to deteriorate water quality by creating turbulence in the pond. From the description of use of this technique by more successful farmers, given in the earlier project reports, it appears that both low yields and the alleged turbulence are probably due to farmer inexperience with the finer points of the technique. If this is really the case, then more training may be necessary from the more successful farmers.

For most of the other recommendations related to shrimp farming, the major constraint was the lack of capital (e.g., for pond deepening, nursery, feeding). The project recommendations and constraints or farmer responses to these are listed in Appendix 6.

Implementing most recommendations would require small financial support, where capital is the major constraint (e.g., digging the pond, good quality post-larvae, etc.), and training and extension. Institutional reforms are necessary both at the Enterprise levels as well as provincial or national government levels.

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During the preparation of this case study, the senior author was on secondment to the Network for Aquaculture Centres in Asia-Pacific, Bangkok, Thailand.

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## Appendix 1. Terms of Reference

### **Case Study on the Social and Economic aspects of Shrimp Aquaculture within Mixed Aquaculture-Mangrove Farming Systems in Ca Mau province, Mekong delta, Vietnam**

#### *Background*

There are a number of current and planned projects involved with aquaculture and mangrove forest rehabilitation in the lower Mekong delta area. One of these projects is the ACIAR project FIS/94/12 “Mixed shrimp farming-mangrove forestry models in the Mekong delta” operated from 1996 until 1998, which has recently been extended into a second phase until September 2000. The project is jointly implemented by the Australian Institute of Marine Sciences (AIMS), Research Institute Number 2 (Vietnam) and NACA.

During the period from 1996-1998, the project largely achieved its two main technical objectives of investigating the main factors limiting shrimp and wood production, and identifying improved culture options for these systems. However, the project has not yet achieved its objective of assisting national and provincial authorities to transfer project results and recommendations to coastal farming communities in the lower Mekong Delta. In the longer term, the success of the project will be judged by its impact on the ultimate beneficiaries, the coastal farming communities of Ca Mau and nearby provinces.

In an independent review of the project in June 1998, the review team commented that “The ACIAR project Final Report is expected to contain the most comprehensive data set and interpretation available on mangrove-aquaculture systems in the lower Mekong Delta. These data, plus the experiences from the project of working with farmers, extension workers and provincial authorities in Ca Mau and Ministry of Fisheries (RIA II) represent a valuable corpus of knowledge which can be helpful to a number of new projects being planned for the lower delta provinces – including the World Bank Coastal Wetlands Protection and Development project. These will be more developmentally orientated than the ACIAR study and can benefit especially from the scientific information now available on how the mangrove-aquaculture systems function, and what the main constraints are on their productivity and sustainability.”

Bearing these points in mind, the Review Team recommended that follow-up activities should include development of the information obtained into forms suitable for dissemination to various stakeholders in Vietnam, specifically

- Coastal farmer families in the Mekong Delta.
- Community leaders (Heads of villages and hamlets, lead farmers).
- Community associations and groups (e.g. Women’s Union).
- Extension services and departments in Ca Mau (principally Provincial Fisheries, Forest Protection Department, Dept. of Agriculture and Rural Development).
- The mangrove forest and fishery Enterprises and forest protection and management boards in Ca Mau.
- Key scientific institutions in Vietnam, especially within the Mekong Delta (Min. Fisheries RIA-II and sub-institute Ca Mau, Wetland Forest Research Centre Ca Mau, DOSTE Ca Mau, Cantho University (CTU), University for Agriculture and Fisheries (UAF)).

In order to achieve such follow-up, the review team recommended specific aspects of ACIAR support beyond the project period (i.e. after 31 August 1998) to cover various activities including a full cost-benefit analysis for the mangrove-aquaculture systems studied and development of a more robust

economic analysis of farm level opportunities and constraints with respect to the technical side of project findings.

Drawing on the combined experience and resources of present project staff and collaborating agencies, together with additional inputs from other institutions with appropriate expertise and experience, ACIAR provided an extension of the project for 18 months to focus on:

- Limited scale on-farm trials to validate key recommendations.
- The preparation of appropriate extension materials for government agencies, extension officers and farmers, based on the technical outputs from the project.
- Training a core group of extension officers to a high level of competence.
- Developing linkages with other existing and planned new projects in the lower delta provinces, so that other projects can build on the results and experience of the present ACIAR project, thereby maximising spill-over benefits. This is seen as a key activity towards ensuring that long-term benefits from the present project flow on to farming communities. The more developmental orientation of planned new projects in lower Mekong Delta, and of the World Bank Coastal Wetlands Protection and Development project in particular, would provide an appropriate channel to maximise spill-over benefits.

The primary focus of the extension is on the effective transfer of project outputs to farmers, particularly in Tam Giang III and SFPE 184 Enterprises, but the outcomes are considered to be of wider benefit to the Mekong delta provinces.

#### *Case Study on Shrimp Aquaculture Management*

Related to the further development of shrimp and mangrove activities in the Mekong delta, a programme entitled ***Shrimp Farming and the Environment***, consisting of several complementary case studies in a number of shrimp farming countries and a few thematic reviews, jointly financed and executed by the World Bank, NACA, WWF, and FAO, has been developed. The programme is based on the outcome of 1999 April expert meeting in Bangkok on “best management practice in shrimp aquaculture”, recommendations of the World Bank review on shrimp aquaculture and the environment, and other ongoing initiatives and recommendations including the FAO Bangkok consultation in December 1997. The project activities are directed at the implementation of the Code of Conduct for Responsible Fisheries, and other key areas of shrimp farm sustainability. The case studies and thematic reviews are expected to complete by March 2000.

In general terms, the programme is expected to:

- Generate improved and more detailed information on key issues related to sustainable shrimp aquaculture development and management.
- Facilitate further identification of key issues and consensus among stakeholders at various levels from international, regional, and national, through to local levels.
- Facilitate identification and development of appropriate management strategies for sustainable shrimp aquaculture, which will be of assistance to the financing and executing agencies, participating countries, investors and farmers.
- Provide a basis for review and evaluating successes and failures in sustainable shrimp aquaculture, which can broadly inform policy makers on management strategies for sustainable shrimp aquaculture, identifying contributing factors, including both technical and non-technical issues.

- Provide a platform for identification of future development activities and assistance for implementation of improved management strategies for sustainable development of shrimp culture.

The activities being implemented under the ACIAR and World Bank projects in the Mekong delta are being developed as a case study. A social and economic input is required to specifically address the social and economic aspects of the management of shrimp-mangrove systems in the Mekong delta and in contributing to meeting the objectives of the ACIAR project extension.

*Objectives for the Social and Economic Input*

The broad objectives of the proposed work under this social and economic study is to identify the social, economic and institutional constraints to implementation of recommendations for improving management of mixed shrimp-mangrove farming systems, and to provide specific recommendations on the best ways to overcome these constraints and ensure maximum benefit to farm households, including to poor households resident in the Enterprises.

The specific TOR is as follows:

1. To prepare a framework for carrying out an economic analysis<sup>13</sup> of mixed farming system management practices, based on the technical recommendations developed by the ACIAR Project FIS/94/12.
2. To identify social and economic benefits and constraints to implementation of these technical management recommendations.
3. To assess institutional constraints to implementation of these management recommendations, and recommendations for overcoming such constraints where possible.
4. To provide recommendations on the optimal institutional arrangement to support farmers in improving benefits from their mixed farming systems, and how this institutional structure(s) be developed. What is the optimal level of institutional support and how could this be provided? The analysis should also include an analysis of the requirements to support and manage risk in poorer households.
5. To provide recommendations on how to promote farmer Groups and improve local management of resources (including co-management possibilities).
6. To identify strategies to ensure benefits from improved management strategies reach the poorer farm households and their members;
7. To review documentation from other relevant projects (World Bank, DANIDA as appropriate/available) to support the further development of recommendations and in meeting the objectives of the TOR.
8. To prepare a work-plan and tentative budget for follow up work to collect additional key information where required to complete the work according to the terms of reference above.
9. To prepare a report based on the above according to the schedules outlined below.

A key element of the work will be to provide a framework and approach for local scientists and extension officers to monitor and assess social, economic and institutional constraints to the adoption of improved management practices, together with strategies to overcome these constraints. This is expected to lead to

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<sup>13</sup> The economic analysis, which is considered outwith the scope of the contract with Dr. Phil Hirsch, will be carried out through follow up work to be conducted in Vietnam/Thailand, under the supervision/guidance of Dr. Hirsch.

more effective adoption of management practices for sustainable shrimp aquaculture in the lower Mekong delta, including upcoming World Bank investments, beyond the geographic and temporal scope of the ACIAR project.



## Appendix 2. Trend Analysis

### Appendix 2a. Trend analysis: TGIII Group

Item	Trend	Period	Indicators	Reasons
Population	↑	1996-present	Don't see infants	Economic hardship
Natural Shrimp	↓	1994-present	From shrimp culture experience	Overharvesting, agrochemicals from rice fields in Dam Doi, Ca Mau
Income	↓	1994-present	From talking to neighbours about their shrimp harvest	Decrease in natural shrimp stock
No. of people culturing <i>P. monodon</i>	↑	1998-present	From own observation	Decrease in natural shrimp stock
Outmigration and land purchase	↑	—	From own observation	Some settlers lacked capital to invest, so sold to those with capital
Hired labour (from Soc Trang and Bac Lieu provinces) for dredging	↑	1998-present	From own observation	Increasing trend to culture <i>P. monodon</i>

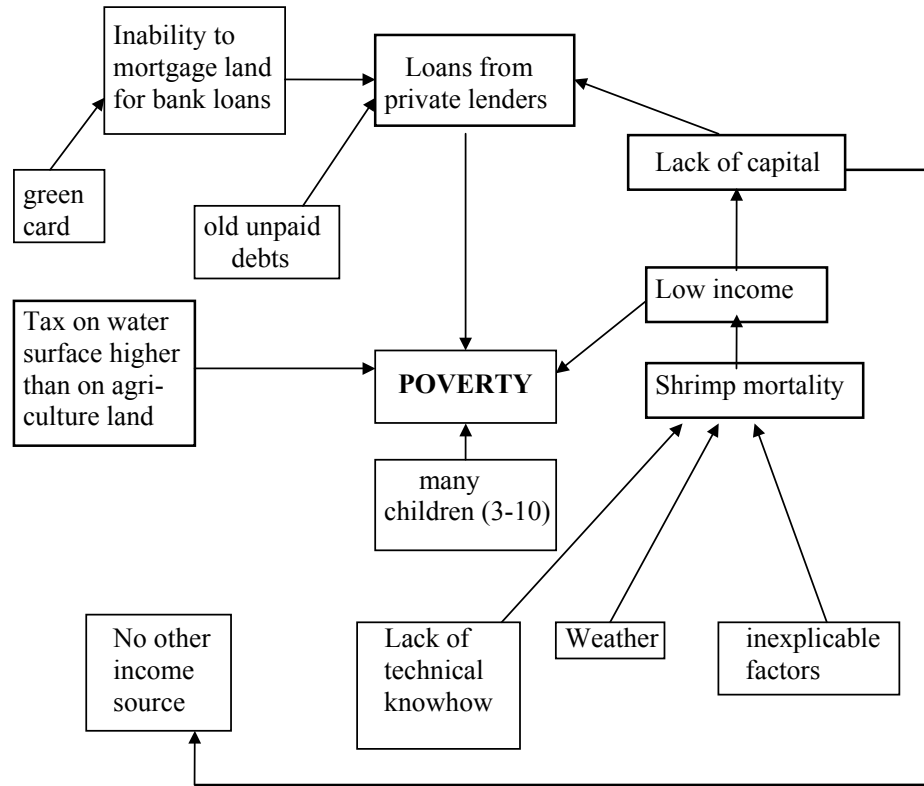
### Appendix 2b. Trend analysis: SFPE 184 Group

Item	Trend	Period	Indicators	Reasons
Shrimp mortality	↑	May 99-now	Dead shrimp floating on the water surface	??? Don't know
Natural Seed	↓	1994-now	Low catch	??? Don't know
Income	↓	1994-now	Own experience	Shrimp mortality
Acid sulphate soil	↓	1997-now	Soils harder, more structured (less heated in sun)	Soils washed by rains
Population	—	—	Own observations	Poverty and awareness
Outmigration	↑	1997-now	See people returning or "selling" the land	Failure and losses in shrimp farming
Interest rates from loan sharks	↓	1994-now	Own experience and observations	Bank loans via the Enterprise
living costs	↑	—	Own experience	??? Don't know
Monodon prices	↑	1998-now	Own experience	Less shrimp
No. of children going to school	↓	1996-now	Own observation	The only local, elementary, people-founded school collapsed that year. The other one in the village is a bit far
Land price going down	↓	1994-now	Own experience	Shrimp death, less buyers

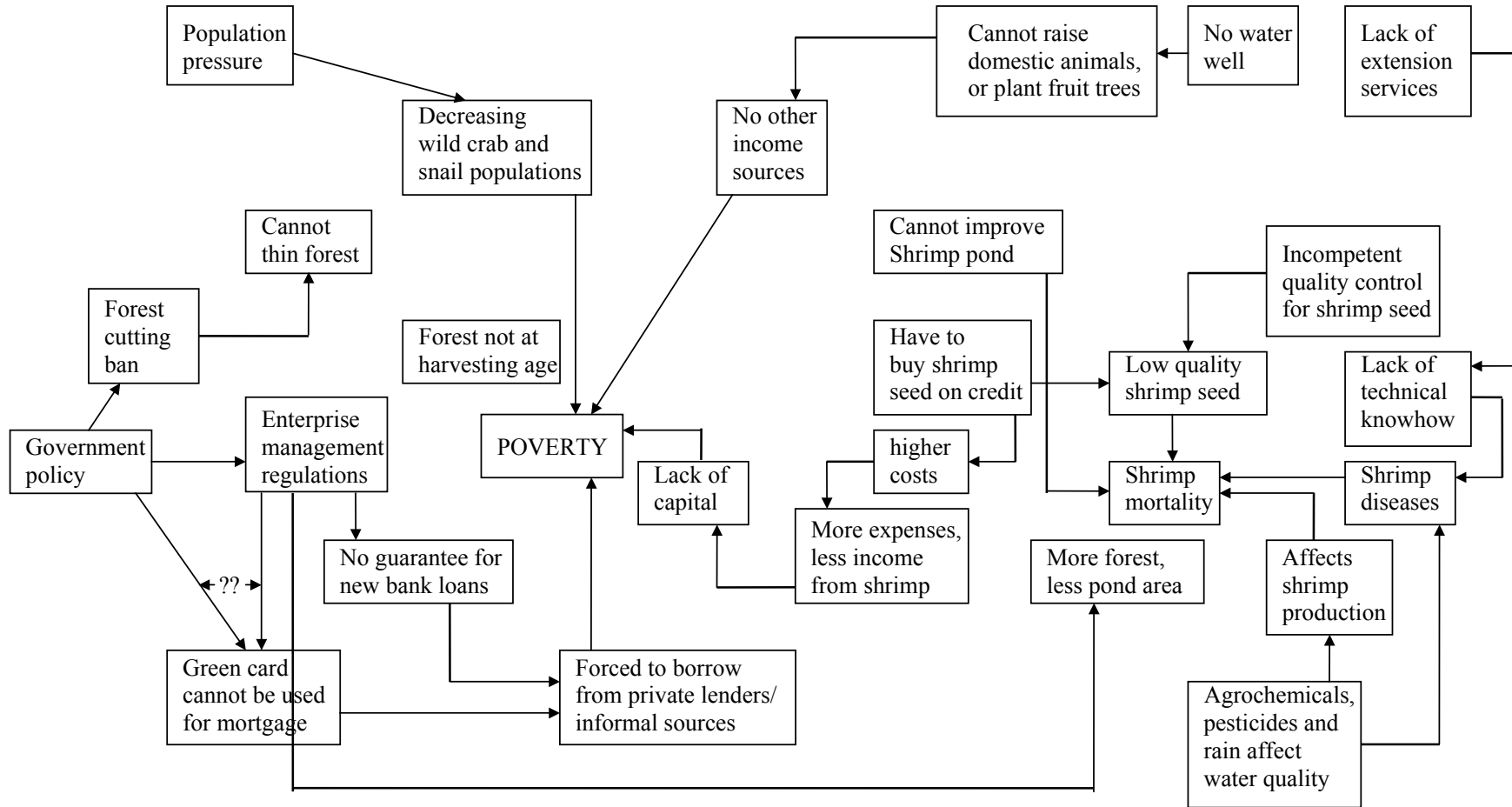
**Note:** The terms "land selling" or "land prices" as used by the farmers actually refer to the sale of value added to the land, since the land, in reality, can be sold only by the Enterprise, which holds the 50-year land lease document (the red card).

### Appendix 3. Problem Webs

#### Appendix 3a. Problem web: TGIII Group



Appendix 3b. Problem web: 184 Group



## Appendix 4. Seasonal Calendar

### Appendix 4a: Seasonal Calendar: TGIII Group

Item	1st	2 <sup>nd</sup>	3rd	4th	5 <sup>th</sup>	6th	7th	8th	9th	10th	11th	12th
Weather												
Acid sulphate problem	—	—	—	✓	✓	—	—	—	—	—	—	—
Monodon stocking	seeds	seeds	—	—	—	—	—	—	—	seeds	seeds	seeds
Dredging	—	—	—	minor season	—	—	—	major season	major season	—	—	—
Harvest <i>P. monodon</i>		+	++	+	+	+	+					
Harvest nat. shrimp	+	+	++	++	++	+	+	+	+	++	++	++
Crab raising in shrimp ponds	+	stocking	+	+	Stocking	+	+	+	+	stocking	+	+
Vegetable	Harvest enough for home cons.	+	+	+	+	+	+	+	+	+	+	+
Chemicals to kill predators		+						+				
Harvest fish in ponds	+	+	+	+	+	+	+	+	+	+	+	+
Catching crabs and snails in mangrove	2 times a month 2 days a time	+	+	+	+	+	+	+	+	+	+	+

**Appendix 4b: Seasonal Calendar: SFFE 184 Group**

Item	1st	2 <sup>nd</sup>	3rd	4th	5 <sup>th</sup>	6th	7th	8 <sup>th</sup>	9th	10th	11th	12th
Rain	Sun	Sun	Sun	s cloud	s cloud	cloud	cloud	Cloud	cloud	cloud	s cloud	sun
Highest high tide	- 10cm	- 20 cm	- 30 cm	- 20 cm	-10 cm	0 cm	20 cm	40 cm	60 cm	60 cm	40 cm	0 cm
Acid sulphate problem	—	—	—	✓	✓	✓	—	—	—	—	—	—
Leaf litter	—	—	—	—	—	—	—	✓	✓	✓	✓	—
Shrimp mortality (this lunar year)	—	—	—	✓	✓	✓	—	✓	✓	✓	✓	✓
Shrimp culture/harvest	Harvest	stock.	Harvest	harvest	Harvest	harvest	—	—	harvest	harvest	stock.	addi. stock.
Dredging	—	major	—	—	—	—	minor	minor	—	—	—	—
Expenses (May=1)	6	10	3	3	1	1	5	1	2	3	7	5
Expenses reasons	Parties	dredging seed, parties	--	--	--	--	dredging	--	ice for shrimp storage	ice for shrimp storage	seed, parties	parties
No. of parties	7 weds. 0 d.a.	7 weds. 3 d.a.	1 wed. 2 d.a.	1 wed. 2 d.a.	0 wed. 1 d.a.	0 wed. 1 d.a.	0 wed. 1 d.a.	0 wed. 1 d.a.	0 wed. 1 d.a.	1 wed. 1 d.a.	3 weds. 0 d.a.	7 weds 0 funer
Income (Feb:=1)	5	1	1	3	10	5	0	3	5	6	7	10
Diseases	—	—	—	Malaria, common cold	Malaria, common cold	Malaria, common cold	Malaria, common cold	Malaria, common cold	—	—	—	—
Vegetables	Buy	Buy	Buy	plant/harvest	plant/harvest	plant/harvest	plant/harvest	plant/harvest	plant/harvest	plant/harvest	plant/harvest	plant/harvest
Raising livestock	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

1. Expenses: January: parties; February: dredging, stocking, parties; March and April: Ice for shrimp storage; July: Dredging; Sept, Oct: Ice for shrimp storage; Nov.: stocking, parties; December: parties

2. Weds: weddings, av. 30,000 VND/wedding; d.a.: death anniversary, av. 20,000 VND/death anniversary

## Appendix 5. Daily Activity Chart: Group 184

Item	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	00h	
Making meals (Dredg. Seasn)						✓					✓						✓								
Making meals (other season)								✓									✓								
<b>Lunar 9<sup>th</sup>-1<sup>st</sup></b>	—	—																				+	+	+	+
Day 1 of cycle	+	+																					—	+	+
Day 2 of cycle	—	+	+	+																					+
Day 3 of cycle	—	+	+	—	+	+	—																		
Day 4 of cycle	+	+	+	+	—	+	+	+	—																
Day 5 of cycle		+	+	+	+	—	+	+	+	—															
<b>Lunar 4<sup>th</sup>-6<sup>th</sup></b>																									
Day 1 of cycle													+	+	+	+			+	+	+	+			
Day 2 of cycle													—	+	+	+	+		—	+	+	+	+		
Day 3 of cycle														—	+	+	+	+	—	+	+	+	+		
Day 4 of cycle	—	—					—	—								+	+	+	+	+	+	+			

Legend: + water intake and release (harvest) period (half hour); time gap between intake and harvest (half hour)

### Note on water intake and harvest:

9<sup>th</sup> to 1<sup>st</sup> Lunar: Water intake begins at 22.00 hr (10 pm) the previous night and continues until 00 hr (midnight). Then a gap of half hour (midnight to 12.30 am), followed by water release and shrimp harvest until 2 am. The next day this process starts one hour late (beginning at 23 hr or 11 pm). This keeps on going for five days until the water release (harvest) ends at 6 am. From 22 hr to 6 am farmers check dykes, fix leakages and sluice gates. 4<sup>th</sup>-6<sup>th</sup> Lunar: Water intake from 13 hr-15hr (1 pm - 3 pm) water intake; harvest 18 hr to 20 hr (6 pm-8 pm). The next day, the intake is one hour late, but the harvest is at the same time. This goes on for four to five days until the intake ends at 18 hr (6 pm), before the harvest time.

Both processes are carried out twice a month for four to five days around spring tides.

Dredging: Dredging is carried out during low tide for about three hours a day, until the whole pond is dredged.

## Appendix 6. Farmers' Perception About Management Recommendations

Project Management Recommendations	Constraints/Farmer Response
Dig the pond to a water depth of 1 m.	Capital constraint
In ponds with a high rate of leakage, dig 30% of the pond water surface area to a water depth of 1.5 m. Dig 1 channel (to a depth of 1.5 m) between this deeper area of the pond and the sluice gate.	Capital constraint
Maintain a high water level by reducing leakage, especially around the sluice gate.	Agree
Reduce the amount of water drained on 15 d wild shrimp harvest cycles, or <u>preferably</u> replace 15 d harvest cycles with 30 or 45 d harvest cycle for wild shrimp. Top up pond water level and recruit wild shrimp seed on 15 d lunar spring tides.	Dependency on the regular flow of income of 15 day cycle.
Ensure that material excavated during pond construction or cleaning is placed on areas where it cannot subsequently influence the pond or mangroves.  Ideally all pond spoil should be deposited in one area to build up a larger area of land above the tidal limit on which terrestrial trees and other crops can be grown	No room on the levee banks. When dredging by hands, mud cannot be carried far away. Pumping the mud into the river is illegal.
Check quality of PL visually at time of stocking. Stock only with the largest and healthiest PL (at least PL15). Discard the rest. Aim initially for 20-30% survival rate.	Farmers purchasing seed from vendors on credit cannot choose. For those buying from hatcheries, at the hatcheries, they can only select among the nursery tanks from which the PL are packed, they cannot choose the PL individually.  Farmers don't discard the weak PL once they have spent money buying them.
Use a nursery area/pond of 10-20% of the final water surface area.	They can follow this, but some cannot afford the cost of the feed.
Aim for a final stocking density of 1-2 m <sup>-2</sup> . Do not overstock. Stock into nursery area/pond at 10-20 times the density finally required in the growout pond.	Do not agree. Difficult to ascertain mortality happening after stocking. Most believe high stocking density will give more yield.
Acclimate PL to pond water temperature and salinity for not more than 30 min with vigorous aeration.	Agree. Some keep the bags of PL in the pond before opening.
Count number of PL stocked	No need to count because seeds are packed at 2000 per bag. The mortality during transport is visually estimated before stocking.

Project Management Recommendations	Constraints/Farmer Response
Stock into the nursery pond/area in the late afternoon or evening.	Agree, though most stock during the morning when vendors arrive.
Feed juveniles daily in nursery pond for 20-30 days.	Feed costs too high for some farmers.
Monitor survival and growth in nursery pond weekly, and in growout pond every 10-15 days.	Do not know how to monitor survival since dead shrimp are eaten by other shrimp or lay on pond bottom.
Do not drain the pond to harvest every 15 d. Instead, recruit wild seed on 15 d lunar spring tides, and harvest using “Tom te” or “against water current” harvesting techniques. Drain pond after 45 or 60 days for a full harvest.	<p>-Dependency on the regular flow of income.</p> <p>-Tom te provides little income, not enough to live on.</p> <p>-farmers do not have real experience on using Tom Te.</p>
Plant at a density of 10,000 ha-1 or 7,000 ha-1. Current policy is to plant at 10,000 ha-1.	Agree but farmers have little say in the decision about planting density.
<p>If planted at 10,000 ha-1, thin to 5,000 ha-1 at 7-8 years, with a second thinning to 2,000 ha-1 at 12 years. Harvest at 18-20 years.</p> <p>If planted at 7,000 ha-1, thin to 3,000 ha-1 at 8-9 years, with a second thinning to 1500 ha-1 at 13 years. Harvest at 18-20 years.</p>	<p>When to thin is the decision of the Enterprise and the government, farmers cannot make decision. Some farmers say that 7-year old steres do not fetch good price.</p> <p>Enterprises are unsure about the government policy on mangrove cutting since the ban was only recently lifted (mid-1999).</p>
It is recommended that farmers gradually move to having stands of either 5 different ages (with an area for each age class equal to 1/5 of the total mangrove area; each age class separated by an interval of 4 years) or 10 different ages (with an area for each age class equal to 1/10 the total mangrove area; each age class separated by an interval of 2 years).	May be possible on new plots, but not on already planted lands. Unsure about the benefits and whether Enterprise would accept the proposal
Remove the current ban on cutting of mangroves.	Ban removed in mid-1999.
Adapt overall forest management policy to provide the flexibility to implement the actions listed above	Decision for the government



Project Management Recommendations	Constraints/Farmer Response
Carry out an assessment of sedimentation and erosion and the consequent expected changes in land forms and topography.	For researchers
Implement policies that promote a gradual transition in land use based on expected changes in land form and topography	For governments to decide
Implement policies that promote a gradual transition in land use based on expected changes in land form and topography	For government to decide
Plant salt tolerant fruit and timber trees on levees and other high land above the tidal limit.  Plant annual cash crops during the wet season.	Need water wells for irrigating the trees in the dry season.
Stock crabs at low density ( $\leq 1$ per 20 m <sup>2</sup> ) to minimise self-predation and avoid the need for feeding. Monitor growth to assess the need for supplemental feeding.	Agree. Most farmers are successful in crab farming.
Polyculture of shrimp and fish together, or culture of fish alone, could be trialled, especially during the wet season.	Must choose the species that do not prey on shrimp.  They do not have experience with Tilapia, although this species is not a predator of shrimp.
Change policy to permit longer land leases or provide options for farmers to acquire ownership of land	Decision no 02/CP Jan 15.1994 allowed farmers to have red cards.  Red cards already issued to Enterprises. Government reluctant to dismantle Enterprises fearing mangrove destruction.
Provide a line of credit to Enterprises, which in turn could act as lenders to farmers for farm improvements at low interest rates.	Enterprise doesn't want to take this role anymore. They have had bad past experience recovering the loans.
Increase the number of provincial extension officers	Funding?
Develop and progressively refine extension materials for provincial extension services and farmers	Government/project to decide
Provide ongoing and effective training to upgrade the skills of extension officers	Government/project to decide
Provide additional budgetary support for provincial extension activities.	Government/project to decide

## Appendix 7. Semi-Structured Interview Schedule, Guideline Questions

### Socio-Economic Study Component

#### Guideline Questions For Semi-Structured Interviews with Farmers in SFFE Tam Giang III and SFFE 184, Ngoc Hien District, Ca Mau, Vietnam

November 1999

#### **I. MIGRATION HISTORY:**

When migrated, from where (place of emigration), reason/s for migration, previous occupation

#### **II. RESOURCES:**

##### **1. Home-based resources:**

number of people at home; working (male/female), non-working (male/female), highest education level of the respondent, economic skills, income sources and relative importance.

##### **2. Farm-based:**

###### **a. Land-related**

- Mangrove: area, age, density, diameter
- Shrimp farm: dyke area, pond area and depth, number and type of water gates.
- Bioresources: vegetables (wild+planted), animals raised.

##### **3. Community-based:**

- information sharing among Group members: methods of sharing, willingness to share and acceptance.
- labor exchange among Group members
- community credit system within the Group
- barter systems within the Group
- land exchange
- loan (from informal sources): eligibility, rate, duration.
- institutions within the community: formal and informal; their role, kind of help provided, dynamics.

##### **4. Enterprise-based:**

- Role of Enterprise and help provided (e.g., for credit, technical help for mangrove/shrimp culture, legal help, etc.)
- profit sharing arrangement with respect to mangrove harvest

##### **5. External:**

- Agencies concerned: formal and informal; their role, accessibility, influence on villagers and vice-versa

#### **III. DEMAND**

##### **1. Capital inputs:**

1. Land Acquisition (purchased/given/rented etc.) and costs involved.
2. Mangrove: planting labour costs; source of saplings and costs; maintenance and care (time given or labour paid); thinning/harvesting labour costs; transport of harvest; income from thinning/harvesting; resource tax; other costs

### 3. Shrimp Farm:

One-time costs: land, gates, pond digging (construction), other

On-going costs (annual): shrimp seed; dredging, chemicals, feed (including at the nursery stage); taxes paid; other on-going costs related to shrimp production

## 2. Home-based Demand (expenses)

One-time Expenses: house construction costs; furniture, kitchenware etc.; water well; other one-time expenses

Ongoing Expenses:

A. Annual: clothing, education (include. transportation to and from school), health, social activities, transportation (other than for school), house maintenance and repairs, recreation, debt payments, others.

B. Monthly: household needs (soaps, oils, fish sauce, spices, generator battery recharge, alcohol, etc.)

C. Daily:

- food (rice, fish, meat, eggs, vegetables, ice, etc.) home-grown or purchased?, drinking water.

## IV. MARKETING

### 1. Selling

Produce sold, source of produce (farmed/reared or collected from wild); sold where and to whom; price and quantity sold; when sold (time of year); proportion of produce used for home consumption; terms of sale and credit management with purchaser.

### 2. Buying

Commodities purchased; where and from whom; price and quantity (how much)  
- credit management; when purchased; terms of purchase and credit management.

## V. LEGAL ENVIRONMENT

Residence status, legal requirements/conditions (e.g., restrictions on land division or merging plots, sub-leasing, pond/forest area proportion, thinning, etc.; type of land tenure and associated rights and responsibilities; trends of concentration of land-holdings if any.

## VI. PERCEPTIONS

### 1. Perception of Risk in Shrimp Farming

In shrimp farming: Using a game in which the facilitator offers to buy the crop along with the farmer's perceived risks. The farmer (interviewee) is first offered a specific amount which is a certain percentage of the investment he/she has made in the farm. The stakes are raised until the offer is accepted. The bidding may start at 10 percent of the investment cost, and raised up to, say, 300 percent.

## 2. Future Value

To determine the perceived discount rates.

Year	Value
now	million VND
1 year later	million VND
2 years later	million VND
3 years later	million VND
4 years later	million VND
5 years later	million VND
10 years later	million VND
20 years later	million VND

## 3. Poverty

The farmer's own definition of poverty and criteria for the definition; farmer's assessment of poverty situation in the Group/community.

## 4. Perception of Stakeholder Groups (mainly narrative descriptions)

- neighbours and community (feeling of solidarity with them)
- village government
- Enterprise
- The ACIAR project
- hatchery operators
- shrimp seed vendors
- shrimp buyers (traders or middlemen)
- extension workers
- forest protection units
- Minh Hai Wetland Forest Research Centre
- Minh Hai Sub-Institute for Fisheries Research, Ca Mau
- other government and non-governmental agencies

## VII. GENDER ISSUES

### 1. Labour Division within family

The role of men and women in household chores and other activities such as meal preparation, washing and cleaning, fetching water, child care, house repairs, pond dredging, pond water exchange, shrimp harvesting, trading (buying/selling), planting mangrove saplings, etc.

### 2. Economic Decision-making Power

The role of men and women in decision-making.

## VIII. EXTERNALITIES, PROBLEMS, ETC.

Mangrove leaf litter (in shrimp ponds), chemicals from rice farming; effect from rain on pondwater salinity; health of post-larvae; theft of shrimp/wood, competition (for economic as well as status reasons) within the Group

## Appendix 8. Government Decree on Forest Land Allocation

Unofficial translation of the relevant parts of the Decree No. 2/CP 15 January 1994  
(issued by the Central Government of the Socialist Republic of Vietnam)

Regulation on Forest land allocation to Organizations, Households and Individual Persons, for the Sustainable Utilisation of Forest Land

### Article 5.

The entities eligible for forest land allocation:

1. Organisations including: coastal protecting forest (mangroves and marshes) management boards, management boards of special-use forests, military units involved in forest management, forestry Enterprises, agricultural Enterprises, aquaculture Enterprises, the forestry seed companies or stations, schools and vocational schools, mass organisations, and other economic entities.
2. Households residing in local areas, and certified by the people's committee of the village, wards or towns.
3. Individuals

### Article 6.

#### 1. Duration:

For government organizations, the duration of land allocation will be according to the government plan. For other organizations, households and individuals, the duration is 50 years. After this period, if the households/individuals/organizations are interested in continuing to use the land, the duration may be extended by the government. If the trees are planted with the harvest cycle of more than 50 years, then after 50 years the terms will be renewed until the harvest time.

#### 2. Starting time:

- a) If the land was allocated before October 1993, it will be considered to have been allocated on October 15, 1993.
- b) For land allocated after October 1993, the actual date will be taken as the starting date of the 50-year contract.

### Article 15.

#### Rights and Responsibilities

##### 1. Rights

- a) The land certificate (the red card) is issued to the land user.
- b) The government protects the legal rights of the farmer on the allocated land.
- c) The user can harvest the fruit of their labour, the fruit of their investment on the allocated land in accordance with the technical feasibility plan, the management strategies, the investment projects or the contract.
- d) The land-user is entitled to governmental support for forest protection and development.
- e) In case of the land being taken back by the government within the scope of law, the value-added (meaning the labour and monetary investment contributed by the user) will be compensated.
- f) The land-user has the right to inherit, sell, mortgage in accordance with the law.
- g) The land-user is entitled to tax deductions, when reforesting on bare hills and lands, according to the government regulations.

##### 1. Responsibilities:

- a) It is the responsibility of the land user to follow the regulations on management, protection and development of the allocated forest land.

- b) The land user is responsible to compensate at the current rates the previous user of the land whose land was taken back by the government and given to the current user.
- c) It is the land user's responsibility to pay tax according to the law.

Article 18.

This regulation nullifies all previous laws and regulations that are contradictory to this regulation.



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