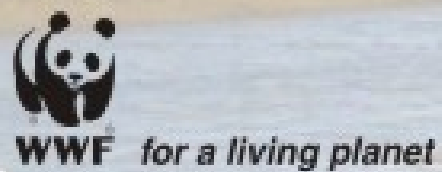




**AN ASSESSMENT OF THE LINKAGES BETWEEN  
TRADE LIBERALIZATION,  
RURAL POVERTY  
AND ENVIRONMENT  
IN SHRIMP AQUACULTURE  
IN CA MAU PROVINCE, VIETNAM**



**WWF Greater Mekong  
Vietnam Programme**

39 Xuan Dieu Str.,  
Tay Ho Dist., Hanoi  
I.P.O Box 151  
Hanoi, Vietnam

Tel: 84-4-719 3049  
Fax: 84-4-719 3048  
[www.greatermekong.org](http://www.greatermekong.org)

October, 2006

**T**his document summarizes a part of the results of research under project "Trade Liberalization, Rural Poverty and the Environment" executed by WWF Vietnam and the World Bank in Vietnam in collaboration with local research institutions. For any further reference, it is suggested referring to the synthesis report of the research in Vietnam.

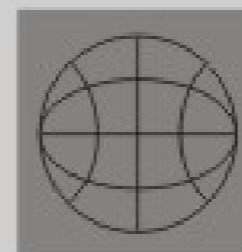
The project is funded by The European Commission and Dutch Directorate-General for International Cooperation (DGIS), and sponsored by The World Bank, WWF-Macroeconomics Program Office (MPO).

**Authors:**

Mai Trong Thong, Hoang Xuan Thanh, Ha Thi Phuong Tien, Nguyen Thu Huong, Tran Tuyet Hanh, Ngo Van Hai, Vu Ngoc Huyen, Le Dang Trung, Le Phu Cuong, Jacques Marcille



*for a living planet*



The World Bank

**T**he authors would like to thank the participants in the workshops and meetings for launching and revision of the project which were held Washington DC, Hague, Hanoi and Ca Mau for their comments and opinions on the subject. They would like to thank the advisory group for their input in the research: Nguyen Viet Thang, Le Van Tai, Le Minh Sat, Bach Van Mung, Nguyen Hai Huu, Le Xuan Sinh and Nguyen Van Hao. Thanks would go to the staffs of WWF Vietnam and the World Bank in Hanoi involving in the project "Trade Liberalization, Rural Poverty and the Environment" Le Van Hung, Cao Chi Hung, Richard McNally, Tham Thi Ngoc Diep and Nguyen The Dung; staffs of WWF- MPO and the World Bank in Washington: John Nash, Owen Cylke, Don Larson, Pablo Gutman and Jonathan Cook.

## Table of contents:

1. Introduction.....	1
2. Baseline conditions .....	2
2.1. National context before Doi Moi .....	2
2.2. Situation in Ca Mau province.....	2
2.2.1. Brief presentation of Ca Mau .....	2
2.2.2 Production policy .....	4
2.2.3. Conditions of local communities .....	4
2.2.4 Conditions of local environment.....	4
3. The trade event; national and local context.....	4
3.1. Liberalization of the economy .....	4
3.2. Specific measures in favour of the aquaculture sector .....	6
3.3. In Ca Mau .....	7
4. Effects on and responses by producers .....	7
4.1. Effect on shrimp production development .....	8
4.2. Market development .....	9
4.3. Change in land usage .....	9
4.4. Use of labor .....	11
4.5. Use of technology .....	11
4.6. Impacts on different producers .....	12
4.7. Recent trends and policy .....	13
5. Livelihood changes .....	14
5.1. Income .....	14
5.1.1 Income structure .....	14
5.1.2 Poverty rate .....	14
5.1.3. Changes in livelihoods of the poor .....	15
5.2. Income distribution and equity .....	16
5.2.1. Income gap .....	16
5.2.2. Gaps in use of land / access to credit .....	16
5.2.3 Loss in aquaculture .....	17
5.3 Job opportunities .....	17
5.4. Other social issues .....	18
6. Environment and ecosystem changes .....	20
6.1. Land/water availability and quality .....	20
6.1.1. Land .....	20
6.1.2. Wastes from shrimp aquaculture .....	20
6.2. Forest cover .....	21
6.3 Biodiversity .....	21
6.4. Provision of ecosystem services .....	22
7. Interventions and reactions .....	22
7.1 By government bodies .....	22
7.2. By other stakeholders .....	23
8. Conclusions and recommendations .....	24

## 1. Introduction

In 1985, ten years after the end of decades of war, the Vietnamese economy and its centrally-planned mechanism proved to be inefficient. In response, the Government of Vietnam decided to implement Doi Moi, a reform process, beginning in 1986. The major focus was to carry out the transformation of the economic management mechanism from a centrally-planned economy to a market-based economy.

The liberalization of economic mechanisms, and particularly the liberalization of trade policy, brought major changes to the overall system, creating the impetus for rapid development. After 20 years of implementation, Vietnam's economy has made great progress with an increased integration into the region and the world. The life of the Vietnamese people has been significantly changed and improved as well.

The effects of the macroeconomic development policies have been particularly pronounced in Ca Mau. From a province specializing in rice agriculture, it essentially turned to shrimp farming and to an export-oriented economy. Rice cultivation areas were massively transformed into shrimp farming ponds, and mangrove forest was reduced. Different shrimp farming techniques were developed, such as mono-shrimp aquaculture, forest-shrimp, rice-shrimp, and industrialized farming, but some of them did not appear to be stable or ecologically suitable.

This transformation totally changed the socio-economic structure of the region, and has significantly affected the overall natural environment. For these reasons, WWF Vietnam's "Trade Liberalization, Rural Poverty and the Environment" project (supported by the European Commission, the Dutch Directorate-General for International Cooperation, The World Bank, and WWF's Macroeconomics Program Office) selected this region to investigate in greater detail the linkages between trade liberalization, rural poverty, and the environment in shrimp aquaculture.

More detailed studies were carried out by the project in selected areas by three working groups. Sites were selected to represent each of the three most common farming models. Research, which included data collection and survey questionnaires, focused on how trade liberalization and the resulting changes in production impacted people's lives, with a particular emphasis on poverty alleviation, and how it affected environmental conditions - focusing on the inter-relationships between these changes.



## 2. Baseline conditions

### 2.1. National context before Doi Moi

Since the 1960s, and until the start of the first phase of Doi Moi in 1986, the Vietnamese economy was nearly totally centrally-planned:

- The state economic sector, including state enterprises and cooperatives, was given a leading role in the economy.
- All enterprises operated as planned by the Ministries.
- Resources were allocated as planned, regardless of market mechanism. Price, interest rates and the exchange rate were determined according to plans.

### 2.2. Situation in Ca Mau province

#### 2.2.1. Brief presentation of Ca Mau

Located at the southern extremity of Vietnam, Ca Mau province – with an area of 5,211 km<sup>2</sup> – accounts for 1.57% of the total area of Vietnam and 13.6% of the Mekong River Delta region (see Annex 4, Map). Its total population was approximately 1.2 million people in 2003. Over 80% of the working population is engaged in the agricultural, forestry and fishery sector. The climate of this southern province is characterised by a monsoon and subtropical climate, with high and stable temperature patterns all year round. Rainfall fluctuates between 1,500 mm and 2,300 mm, mostly occurring during the rainy season from June to October. The dry season lasts from November to April.

- The government held monopoly power in trade activities, especially in foreign trade, and all import-export activities were under centrally-planned mechanisms.

During this period government policy focused on the development of some crops (rice, maize) and industrial plants such as rubber and coffee, as well as household husbandry. Agricultural development was considered the only way to ensure food security and to develop exports, a critical need for the country. Most of the investments in agriculture were therefore made to promote these sectors.

With three sides connected to the sea – the South China Sea (or East Sea) on the eastern and southern coasts, and the Gulf of Thailand on the western coast – Ca Mau is influenced by two different tidal regimes, one semi diurnal and the other diurnal, which has favoured a high natural biodiversity of the natural biotopes. An intricate river and canal system allows direct connections to the South China Sea and the Gulf of Thailand through 20 estuaries. Being a lowland area (in the absence of dikes, nearly 70% to 80% of the total area could be submerged by marine waters during high tide), natural mangroves were prominent in the past, particularly well-developed in a major portion of the province. About 140,000 ha of mangrove forests existed in 1943.

CAMAU ADMINISTRATIVE MAP



### 2.2.2 Production policy

Until the early 1990s, Ca Mau authorities and people, following strong recommendations from the central government, invested actively in the development of infrastructure that was needed for rice production and converted many saline regions to freshwater for rice farming. An important irrigation project was developed by the central government and local authorities to freshen the soil during the dry season and to prevent brackish water invasion into new rice fields in order to facilitate their cultivation.

During this period, clearing of the mangrove forests – which had already been largely reduced and damaged during wartime – increased to provide new land for rice cultivation. The remaining mangroves still covered 82,000 ha in 1975. A further 31,000 ha vanished after 1975 to implement this program of rice agriculture. The annual rice crop of the province increased over the years to reach approximately 1 million tons, achieving not only food security but also allowing a significant amount for export.

### 2.2.3. Conditions of local communities

Most people in the province have traditionally worked in the agricultural and forestry sector. These two sectors, which slightly declined in the late 1980s, were still employing over 60% of the overall working population of the province by 1997.

Generally poor, people were mostly living on the production and sale of rice. Fruits, vegetables and livestock were an additional source of income for the majority of people. In mangrove and forest areas, collection of wood and firewood was a common way to earn extra money, and, in near-shore areas, fisheries products, still quite diversified, were an important source of nutrition and income.

In new rice fields, often developed at the expense of the mangroves and on the bare land located behind them, productivity was low and freshwater irrigation was not possible during the dry season, preventing a second crop. The price of rice was also unstable, which resulted in a continued low income for most of the population. The average income in 1996 was only 270,000 VND/person/month, and the average poverty rate in the province was 33.2%. This poverty rate was even higher in rural areas.

A few farmers therefore started to invest in extensive shrimp farming, to improve their revenues and to gain an additional source of protein. This move was observed especially in the south of Ca Mau, where brackish and saline water can be easily accessed and where abundant natural shrimp seed can be obtained. However, this new activity remained limited through 1983 (when it covered about 3,000 ha).

Later, observing the success of their neighbours, more and more people entered into that activity. They enlarged progressively the area of shrimp farming, on bare land, but also in the newly transformed rice fields and in mangroves, even beyond the control of the local authorities. The land area devoted to shrimp farming increased to 28,700 ha in 1988, still located mainly in the more coastal sectors.

During this period of the early development of aquaculture, it did not yet have any adverse effect on the province's overall rice production. Rice production remained a priority for the government and local authorities, and was still developing alongside and more quickly than extensive shrimp farming.

### 2.2.4 Conditions of local environment

Rice cultivation and aquaculture development in the Mekong delta, as well as in Ca Mau province, have been the major causes of the loss of mangrove forest and of salt intrusion since 1975. From 82,000 ha in 1975, mangrove has been reduced by nearly 40% to 51,000 ha in 1995. The respective contribution of these two activities to forest loss was different in terms of both timing and magnitude. A general view on the issue is that, in Ca Mau, the expansion of rice cultivation during the 1980s was the major cause of mangrove loss, accounting for about 2/3 of the loss, while aquaculture development only began to reduce the mangrove in the early 1990s, replacing an additional 12,000 ha.

As long as the forests were left nearly untouched, the region was still characterised by a high level of biodiversity in its different biotopes. A great variety of birds, reptiles, mammals and amphibians were present, particularly in the rhizophora mangrove forests and in the melaleuca forests. Valuable species of mollusks (hard clam, blood cockle) and crustaceans (mud crabs, white and greasy-black shrimp, giant prawns) were collected in mangrove areas, as well as bee honey. Forests were traditionally also an important source of fuel wood and round timber collection.

Mangrove forests also efficiently reduced coastal erosion, and played an important role as an efficient nursery for marine organisms which develop there and are later exploited by fishermen.



## 3. The trade event; national and local context

In Ca Mau province, the major change originated when, following the decisions by the central government in favour of aquaculture development, the local authorities permitted the use of low-productivity rice fields land for shrimp farming. Within three years the livelihood of most local people had totally changed. Their incomes, which had depended on rice agriculture, now came to depend nearly exclusively on shrimp within a very short period of time.

This change was favoured by the long process of economic liberalization during the last 20 years, and accelerated by specific measures taken to increase shrimp production as a way to boost exports.

### 3.1. Liberalization of the economy

The liberalization of the economy, Doi Moi, has been a long process of cumulative changes that began in 1986 and has continued through the present.

The first phase, launched in 1986, focused primarily, through the early '90s, on currency devaluation, liberalization of foreign investment, banking reforms, tourism promotion and the elimination of the monopoly of agricultural cooperatives. Agricultural development in this period was still mainly based on the intensification of rice production in order to achieve national food security. Therefore, most agricultural investments in Vietnam were made in rice and some other industrial crops such as coffee and rubber, which were strongly supported by government policies.

The second phase, initiated in 1989, placed an emphasis on liberalizing trade policy, encouraging foreign investment and supporting export-led growth. In 1991 decisions were taken to allow the private sector to participate in export markets, and in 1995 import licenses were abolished for a variety of goods. Two years later the export quota system was loosened, and 1999 saw the approval of the Trade Law giving the right to participate in import-export activities to all economic actors.

Several important land policies were also

issued to encourage production. In 1988, land allocation was permitted for long terms of 10 to 15 years, and in the Land Law of 1993 this was extended to 20 years. An important Decree of the Prime Minister in 1998 (Decree No. 10/CP-TTg) confirmed the full rights of land use to farmers. Farmers were now allowed to invest in the land allocated to them, and were no longer required to sell contracted amounts of agricultural products to the state.

With regard to foreign policy, the “open door” integration of the Vietnamese economy into global markets has been an obvious trend. Foreign investment enterprises were encouraged. Through signing more than 80 bilateral and multilateral trade agreements and participating in trade organizations such as AFTA and APEC (in 1995), Vietnam gained advantages to develop its export markets and to import goods, equipment and advanced technologies for production and consumption\*. A review of the negotiating process for these trade agreements shows that, apart from textiles and apparel, the fisheries sector was their main beneficiary due to high international market demand.

### 3.2 Specific measures in favour of the aquaculture sector

Until 1990 aquaculture was not a priority for the central government. The fisheries sector was based exclusively on wild catch and accounted for only 7.5% of total agricultural production in 1991. The export of fisheries products was low compared to other agricultural commodities such as rice.

Some measures related to aquaculture took place from 1994 to 1998. The key policy that triggered the expansion of aquaculture during this period followed Decision 773-TTg of December 21, 1994. The purpose of this programme was to build infrastructure for aquaculture such as irrigation systems, shrimp nurseries and large-scale aquaculture farms. By 2001 the programme had mobilized US\$25 million (VND340 billion) to develop 211 projects throughout Vietnam.

From 1999, realizing that aquaculture was increasingly becoming a way to boost the country's exports, more vigorous policies were adopted including



-The Aquaculture Development Programme for 1999-2010 (Decision 224/1999/TTg of 08/12/1999)

-Government resolution No 09 in 2000: a package for crop diversification including allowing the conversion of unproductive rice land into aquaculture surface and investment.

-Decision 173/2001/QD-TTg, giving direction for economic development in the Mekong Delta for the period of 2001-2005 including promoting further development of aquaculture. Some numerical targets were set for the region, such as 700,000 ha of water surface and US\$1.5 billion in export earnings.

Under these policies, farmers were allowed to convert rice paddies to aquaculture production. A system of hatcheries, irrigation infrastructure, research programmes and extension services were also set up to support the sub-sector. In addition, aquaculture also benefited from many other policies that supported rural development and poverty reduction. As a result, within a short period from 1999 to 2002, aquaculture production expanded by 80% in area and doubled in volume. The expansion was even more pronounced in the Mekong Delta, where shrimp production reached 144,850 tonnes, tripling the 1995 volume.

From an international perspective, the US trade agreement concluded in 2000 seems to have had the greatest impact on the market growth of Vietnam's aquaculture sector. Statistics show that aquaculture exports to the US have dramatically increased since 1999, beginning even during the negotiation of the agreement. Within the three-year period from 1999 to 2002, shrimp products exported to the US market increased 6.5 times in terms of volume and 5 times in term of export earnings (see Figure 2).

### 3.3. In Ca Mau

The economic development policies of Ca Mau province have experienced great changes. Until the 1990s, local authorities mostly implemented the government policies to prioritize rice farming, but at the same time they began regulating the spontaneous growth of aquaculture, which was developing beyond their plans.

In 2000, implementing the government's Resolution 9/2000, local authorities began to allow the conversion of rice fields into shrimp farms. By 2004, 130,000 ha of rice fields had been converted to mono-shrimp aquaculture or mixed rice-shrimp farming, bringing the total area of shrimp aquaculture up to 247,510 ha (see Figure 1). Shrimp production multiplied fourfold between 1999 and 2004, and export value grew threefold, from US\$150 million to US\$450 million.

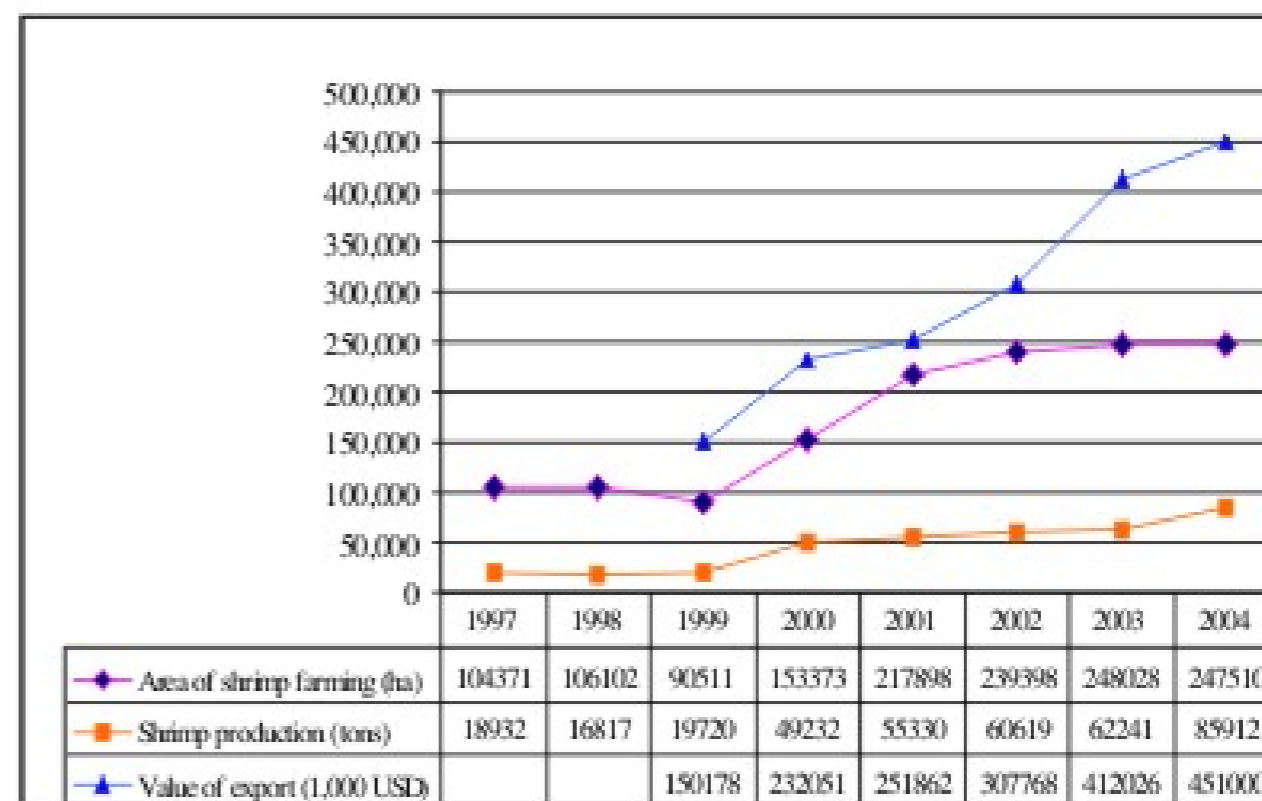


Figure 1. Change in area, production and export value of shrimp in Ca Mau

## 4. Effects on and responses by producers

Traders and shrimp processing factories are at the end of the shrimp market chain. Greater demand from foreign markets encourages processors to scale up their business, and shrimp producers to increase shrimp farming capacity and volume.

The liberalization of the economy has favored the development of new markets and given a positive signal to all the segments of the market

chain. Production and exports increased, and producers changed the use of available land – formerly rice fields and mangroves – adapting for each case specific farming models. The labor structure of the province changed, and many new activities were created to service the shrimp sector. Improved farming technologies also began to affect the environment and rural communities.

\* One additionally important step was the completion of the Vietnam-US Trade Agreement, signed in 2000.

#### 4.1. Effect on shrimp production development

From 1983 to 1999, with market demand and shrimp prices climbing, more and more Ca Mau farmers realized that they could make more money with less effort through extensive shrimp farming. Even some migrants from other provinces began to engage illegally in this activity. From 3,000 ha in 1983, the area of shrimp production grew regularly and reached 90,000 ha in 1999. Extensive shrimp farming was mostly developed in Ngoc Hien and Dam Doi districts at first, and then in Cai Nuoc district. However, with the use of an extensive model of production and a lack of additional seeding, the total shrimp outcome remained at a relatively low level, averaging only about 100 to 150 kg/ha/year.

With the introduction of improved techniques and additional seeding, average productivity increased to 200 kg/ha/year, bringing total production to about 20,000 tons during the period from 1995 to 1999. While the main farmed species were mostly white and greasy-black shrimp in the early years, the production moved progressively to black-tiger shrimp when seeds started to be used. Increased demand and the desire to obtain higher incomes progressively drove producers to invest in better technologies.

From 2000 to 2004, local authorities allowed the conversion of low-productivity rice fields characterized by sulphate and saline soils into

shrimp farming. Over 130,000 ha of rice fields were quickly converted into shrimp aquaculture, bringing the total area of shrimp aquaculture to 247,510 ha. As artificial seed production was quickly developing as well, more farms were able to adopt improved-extensive and even semi-intensive and intensive black-tiger shrimp farming to better respond to growing market demand. The result was a sharp increase in total production, from 20,000 tons in 1999 to 86,000 tons in 2004 (see Annex 1).

##### *The situation in Cai Nuoc district*

This district provides a good example of how rapidly the transformation took place (see Annex 2).

In 1997 there were only 7,510 ha of shrimp farms in Cai Nuoc district, yielding 1,800 tons of shrimp. Five years later, shrimp farms were occupying 64,000 ha and production had increased to 11,485 tons. The transformation from rice to shrimp was massive and did not follow the long-term master plan drawn up by local authorities. Infrastructure, such as channels to direct salt water into the fields or sewage out of the fields, was not adapted to this change. Some additional incidents occurred, like households in some localities destroying the dikes and anti-salt drainage systems to get salt water. This resulted in conflict among villagers and in higher salinity of the soil in a large portion of the district, with losses of the spring rice crop reaching 65% to 70%.

Producers, previously rice farmers, reacted very quickly to the new market demand for shrimp without taking into consideration other issues besides their own short-term interest. They moved towards black-tiger shrimp to reduce dependence on uncertain natural seeding and progressively improved the more traditional extensive type of farming to better respond to market demand and to increase profits.

#### 4.2 Market development

Most of the shrimp produced in the province is processed in the 21 existing local factories for export purpose. Many different types of actors participate in this economic sector: cooperatives, state-owned enterprises, private enterprises and joint-venture enterprises.

While the traditional export market for Vietnamese shrimp was Japan, and it was essentially focused on white shrimp harvested at sea by traditional fishing methods, aquaculture products began to take a leading role in overall shrimp production and led to a jump in exports (see Figure 2). Exports to Japan rose from around 30,000 tons in the late 1990s to 50,000 tons in 2004.

Exports to the US, which were nearly non-existent in the 1990s, rose in 2001 and reached about 60,000 tons in 2004. We can assume that these increases were a direct effect of trade liberalization, which allowed a more rapid response to changes in market demand. The development of the US market was greatly facilitated in particular by their granting of "Most-Favoured Nation Status" to Vietnam. Another reason for the great demand for Vietnamese shrimp was the high quality of shrimp raised under extensive methods and without chemical additives.

As shrimp have become more of a traditional commodity, prices now depend on international market demand and also on potential supplies from other foreign producers (like Thailand and Indonesia). They can fluctuate widely and have done so for many years. The price of shrimp paid to producers at the farm gate also depends on external factors beyond the control of Vietnamese producers and processors.

In 2001 and 2002, shrimp prices in the world market were regularly declining. The EU market refused Vietnam's shrimp products due to excess levels of antibiotic remaining in the products and applied tax rate of 10% to Vietnamese shrimp. In 2004, after an anti-dumping lawsuit by American companies

against Vietnamese shrimp, US customs required that Vietnamese firms had to post bond for an anti-dumping tax on shrimp products imported to the US that is equal to one year of exports. This caused shrimp exports to the US to come to a standstill and led to a new reduction of price at the farm gate.

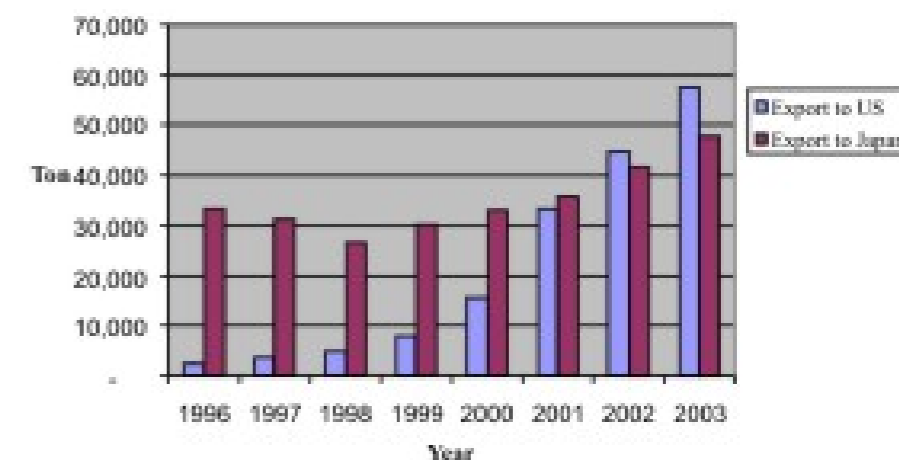


Figure 2. Shrimp export volume of Vietnam to Japan and the USA

In the absence of a mechanism to regulate prices, revenues to producers can therefore fluctuate widely from year to year, which strongly affects their lives. While shrimp processors will never buy at a loss, farming households have to sell their shrimp when harvesting time comes no matter the price, and therefore suffer higher economic losses than processors or exporters. Rapidly finding new substitute markets is not always possible. For instance, following the US antidumping case, shrimp prices to producers declined by more than 20%. Though it may be impossible to totally avoid price fluctuations, which affect all producing countries, the amplitude of the variation may be reduced through diversification of export markets or targeting of high-quality or labeled market segments.

#### 4.3 Change in land usage

Due to the very high density of the population in Ca Mau – more than 220 inhabitants per square kilometer for a population living mostly from agriculture (80%) – finding new land has always been a challenge. Land for aquaculture could come only at the expense of existing rice fields and/or forests, particularly mangrove forests.

Farmers adapted different aquaculture models depending on the pre-existing characteristics and soil utilization of the area where they were living. For instance, farmers living in mangrove areas cleared forest and applied a forest-shrimp model of extensive aquaculture, while those living in former rice fields used the mono-shrimp or rice-shrimp models. (See Section 4.5 for a description of these models.) Many other types of shrimp farming have been used over the years (see general report), demonstrating the extraordinary adaptability of Ca Mau producers.

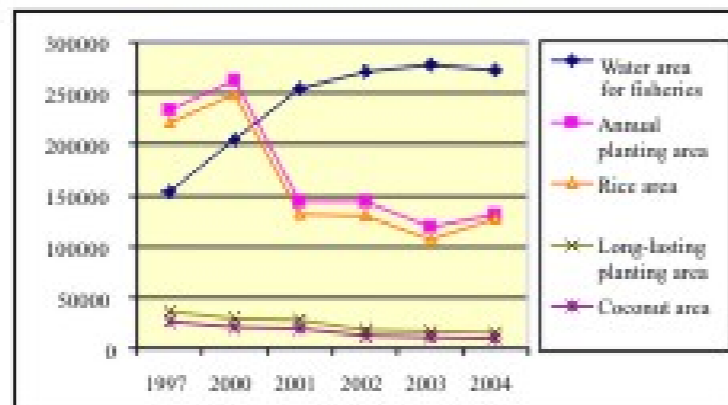
#### Loss of rice fields

Rice areas have been transformed massively into shrimp ponds. From 248,000 ha in 2000, rice farming area declined to 126,000 ha in 2004 (see Figure 3.). Annual rice production dropped from 850,000 tons to 400,000 tons (still enough to maintain food security for the entire province). In Cai Nuoc district, rice farming for one-crop rice, which covered 21,000 ha in 1997, disappeared completely.

In the first stage, people shifted from rice to shrimp without adhering to the recommendation of local authorities to utilize combined rice-shrimp models. The proportion of rice-shrimp systems was much less than the target set by the province. Later, farmers realized the benefits of rice cultivation through this mixed model and that, even when rice does not reach maturity, it can improve the shrimp harvest.

In 2004, due to more active training (that year, provincial agriculture agencies held training in the rice-shrimp model for 73,400 households) and the introduction of salt-resistant rice seeds (OM1490), the rice-shrimp area increased sharply to 43,000 ha (meeting the target set by the province for the first time). However, the early and lengthening drought has increased soil salinity over a large area, leading to a 50% rate of crop failure and reduced productivity on the remaining plantings.

The salinization of soil due to the intrusion of saline water for shrimp farming has not only affected rice production. Vegetable gardens were not reduced in surface, but their productivity decreased by 25%. Coconut gardens, especially common in Cai Nuoc district, nearly disappeared (see Figure 3). Poor households suffered more than others, and most relied on other sources of income due to the volatility of shrimp production and prices.



Source: Ca Mau Statistics Bulletin 2003, Ca Mau Agr. Dept. (2004)  
Figure 3. Area of agriculture and fisheries production in Ca Mau, 1997-2004

#### Loss of forest areas

About 31,000 ha of Ca Mau's mangrove forest vanished between 1975 and 1995 (see Table 1). However, local authorities did take some important measures to prevent illegal mangrove cutting, and they initiated new plantings that resulted in an increase of 16,000 ha in the area covered by mangroves between 1995 and 2003. An allocation system to regulate the conversion of mangrove to aquaculture was set up in order to prevent further spontaneous clearances. These measures did have some effect, but the density of mangroves was still reduced.

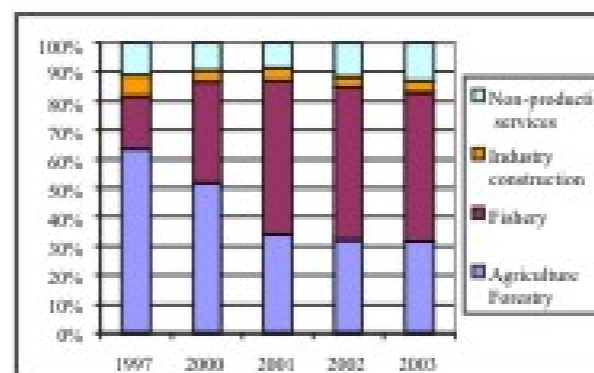
People living in protected forest, including mangroves, have been resettled to new areas. Production forests were allocated to organizations, individuals and households. 107 joint-venture enterprises, 92 household groups and 18,960 households were allocated 6,511 ha, 4,871 ha and 99,087 ha respectively (Report number 160-BC/TU of Communist party committee of Ca Mau province, July 2004). Under this policy, the area of mixed shrimp and mangrove remained stable at 46,330 ha. Under the revised plan, mangrove and shrimp will be separated, and the mangrove-shrimp model will be reduced to approximately 30,000 ha by 2010. The policy is being piloted at Tam Giang Forestry-Fishery Enterprise I and III.

Year	Ca Mau and Bac Lieu	Ca Mau	Year	Ca Mau and Bac Lieu	Ca Mau
1943	200,000	140,000	1995	-	51,499
1975	-	82,000	1997	-	53,605
1983	117,745	-	1998	-	55,693
1988	83,637	-	1999	-	61,890
1989	74,756	-	2000	-	64,632
1990	67,550	-	2001	-	66,370
1991	58,844	-	2003	-	66,770
1992	51,192	-			

(Source: Annual statistics for the year 2001, Report of Environment status of Ca Mau province, 2003)  
Table 1: Change in mangrove forest area (ha)

#### 4.4. Use of labor

The labor structure in Ca Mau has continued to move towards aquaculture. The total labor force in the province climbed from 660,000 to 767,000 between 1997 and 2003. Jobs in forestry and agriculture declined substantially, from 290,000 in 1997 to 194,000 in 2003. During this same period, labor in the fisheries/aquaculture sector increased from 85,000 in 1997 to 312,000 in 2003. Aquaculture has created 227,000 jobs between 1997 and 2003, absorbing all of the jobs lost in the agriculture/forestry sector as well as all the increases in the province's labor force. These mostly low-qualified jobs were created in all segments of the shrimp production and processing chain and related services. In 2003, more than half the households in Ca Mau were directly or indirectly involved in the shrimp business (see Figure 4), though some people included in the fishery sector may also be involved in agriculture as a secondary activity.



Source: Ca Mau Statistics Bulletin 2003  
Figure 4: Labor structure in Ca Mau during 1997-2003

#### 4.5. Use of technology

Each model of farming, whether shrimp-forest or forest-shrimp, mono-shrimp or rice-shrimp, can be developed in a purely extensive mode, where only natural seeds are used or seeding density is low, or in an improved extensive mode where the seeding density is higher.

The extensive model requires little investment in pond building and a very simple technology and has been developed by many households, even the poorest ones. The water source for farming depends on the tide. Natural shrimp larvae are combined with a low density of artificial ones; the food source is mostly natural, with few or no chemicals used to prepare the ponds. The level of dangerous pollutants is not very high in extensive

farming. In particular, in the shrimp-forest and forest-shrimp models, the wastes in the ponds are partially absorbed so that the pollution effect is reduced.

Due to high market demand and the high price of shrimps, many extensive models have been transformed, particularly since 2000, into improved-extensive models. This has been the case with most mono-shrimp farming in former rice-growing areas. This mode of farming requires greater funding for seed purchase and to cover the costs of pond preparation.

All extensive models are operated in an open system (i.e. shared sluices in and out), where rejected waters from one farm can become inflow water for another farm. The result is that any pollution source can affect easily the entire system. In particular, when seeds of poor quality are in one farm, the risk for an epidemic to be spread to all surrounding farms is very high.

Depending on the models (extensive and improved-extensive), dredging sludge from the pond must be done once or twice a year. According to SUMA project statistics for Nam Can district, approximately 20% of the sludge is discarded directly into the public drainage system, which forms a great number of compounds, polluting water and increasing the level of suspended solid wastes. This also clogs the drainage system and reduces its flow capacity. In this regard, we can say that improved models are more polluting than purely extensive ones. Solving the pollution problem and reducing the risk of epidemics would require a total reorganisation of the drainage system to separate water inflow and outflow, with in-depth planning and key investments.

The intensive shrimp model, which may produce 3 to 5 tons/ha each year, has grown rapidly in the last five years. The area covered by this model rose from 32 ha in 2000 to 580 ha in 2004. This model requires much greater investment and technical knowledge for soil preparation, water treatment, seed control, food supply, control and adjustment of water quality, oxygenation in ponds, etc. It cannot be developed by poor or average-income households, but only by rich households with borrowing capacity and by some enterprises

and joint ventures. Significant funding is necessary to prepare the ponds and buy aerators, and later to purchase seeds, food (exclusively artificial in this model), and the chemicals required for pond control. This model creates many job opportunities for unskilled workers who are needed for soil preparation, removal of sludge, feeding the shrimp, etc.

In this type of closed-system aquaculture, epidemics can still occur, depending on the seed quality, quality of aquaculture technology, overall use of chemicals and food (resulting in water pollution in the pond), etc. With competent technical management, this model can be very efficient with limited water contamination. The main problem comes from the harmful accumulation of sludge (highly polluting) which must be removed regularly. However, the development of industrial aquaculture is still spontaneous in Ca Mau. Aquaculture technology is not up to the required level, which increases the risks of epidemic outbreaks and the spread of disease into surrounding extensive shrimp farms.

#### High level of pollution risks

Research reveals that the rice-shrimp rotation model creates less pollution and also better stabilizes the ecosystem than shrimp monoculture, even if the alternate rice crop is small or sometime lost. It is clear that more improved or intensive models lead to a higher risk of pollution, and therefore, more negative consequences for the environment and the livelihoods of nearby farmers. Shrimp aquaculture has a high risk of epidemics. This is a challenge for both producers and management authorities, who both want to find a solution that ensures stable production. However, not all producers are equally concerned.

#### 4.6. Impacts on different producers

After the transition is made into shrimp farming, its risky nature becomes more evident, reducing the enthusiasm of some producers. The productivity of ponds has shown a regular decline, and many producers even lose all of their production. In general,

however, even if they have lost one or two harvests, most households involved in extensive farming intend to stay in the business. They often comment that, with extensive models, a “loss” may not be an actual loss given that the investment was quite low. They know that one good harvest can compensate for two years of successive loss.

In mangrove areas the losses are not so frequent, and households there try to extend their farms at the expense of the mangroves – often in contradiction with the local authorities’ regulation to keep 70% of mangroves intact on their allocated land.

In former rice areas where the most improved models have been developed but losses have become more frequent, producers have come to understand the appeal of alternative crops. They have therefore tried to diversify their incomes through mixed farming with other species such as crabs, fish, or oysters.

Improved-extensive farming requires additional funding for seed purchase and to cover the cost of pond preparation. Not all poor households can afford this, especially if borrowing from a bank is impossible. So poor households lacking funding and access to loans cannot purchase high-quality seeds, which puts their farms at a higher risk of collapse.

For the poorest households that have invested in improved-extensive farming with little capital, risks are associated with every crop, every day. Aquaculture risks may lead to bankruptcy. They may have to sell their land to pay debts, or they may become hired hands themselves. Most farmers want to stay in the business, however, and are trying to diversify their sources of income.

Only a few rich households have started, after some initial success in extensive farming, to engage in intensive models. Half of them have been successful; half lost everything, and some even had to sell their land. Similarly, some companies succeeded but some others failed like Tan Tai, which after several seasons of continuous losses is now raising fish.

#### 4.7. Recent trends and policy

The rising market demand, and the varying price of shrimp in recent years, has led to a gradual increase in capital and technology investment within shrimp farming in order to achieve greater efficiency. From extensive models in the early stages, farmers have moved increasingly into improved models. (Of course, this trend applies less to the category of poorest farmers.)

The risk in shrimp farming is pushing more people to diversify their sources of income and develop new kinds of “associated” shrimp farming. Provincial guidelines tend to stress diversification and encourage people to restore their gardens and to combine shrimp with other agricultural products.

In mangrove forests, organic/ecological shrimp farming seems to offer good potential. Under this model (about 5,000 ha in 2004), shrimp are fed only by natural food provided

higher margin when they get Naturland certification. Other models that raise shrimp in association with crabs are also being developed.

With the shrimp-forest model, the total production area in 2003 was 56,000 ha, with an average proportion of 40% forest (the actual shrimp farming area was 33,600 ha). Plans are to reduce the actual shrimp farming area and to increase forest area to achieve a proportion of 30% shrimp/70% forest. Targets for actual shrimp farming area with the shrimp-forest model are 34,000 ha by 2005 and 30,000 ha by 2010.

Areas of mono-shrimp farming are still predominant; some of them have already transformed into rice-shrimp farming, which covered 45,000 ha in 2005. Rice-shrimp models have yielded demonstrably better shrimp crops than shrimp monoculture. Rice-shrimp areas will continue to increase, as will mixed-shrimp models where shrimp is



by the mangrove forest. It has been tried mainly by Forest and Fishery Enterprise 184, but is planned for an additional 10,000 ha in other forest and fishery enterprises such as Dam Doi, Kien Vang, and Sao Luoi. After each crop, water inside the canal is released to the outside, and the canal is treated to make sure that it is sufficiently safe for the new crop. The most distinct characteristic of this model is that it does not harm the mangrove forest, because it just makes use of existing canals inside the forest. Organic/ecological shrimp farming is less productive (average yield: 150kg/ha), but the quality and size of farmed shrimp meet high standards for export. They can be sold at a 20%

associated with crabs or fish. The area of shrimp-garden and ecological shrimp monoculture will decline due to the increase of shrimp-rice and industrial shrimp systems.

The policy for industrial shrimp aquaculture is presented in the “Development plan for industrial shrimp aquaculture in Ca Mau in 2005 – 2010,” issued together with Decision 819/QĐ-CTUB (dated 12/11/2004) by the People’s Committee of Ca Mau. Under this plan, 7,000-7,500 ha of industrial aquaculture in large-scale farms are planned for concentrated zones. An additional 3,000-3,500 ha is scheduled for household-scale structures with scattered distribution.

## 5. Livelihood changes

Economic and ecosystem changes triggered by trade liberalization have affected the way of life of many people in Ca Mau province.

### 5.1. Income

#### 5.1.1 Income structure

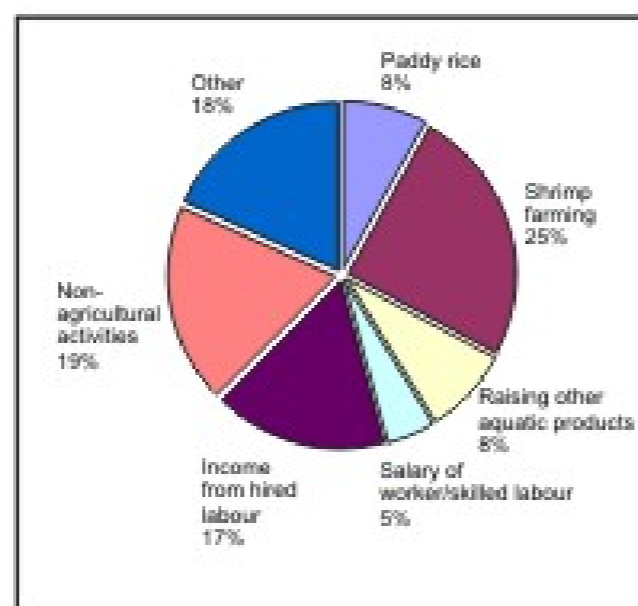
A recent survey (VHLSS 2002) with sample size of 670 households has shown that the average income of a typical household in Ca Mau in 2002 was 8.5% higher than the average level in the Mekong River Delta region, and 20% higher than the national average.

Income from shrimp aquaculture for the whole province accounted for nearly 25% of total household income (see Figure 5) - much higher than the average level in the Mekong River Delta and nationwide - while income from rice farming accounts for only 8%. More recently, due to the instability of shrimp prices and the increasing risks from pollution and the spread of diseases, people have started to diversify their income, often combining shrimp farming with crabs, fish, or other products. Diversification is considered a good way to avoid the risks incurred with mono-shrimp aquaculture.

Surveys carried out for this project in three typical aquaculture communes in Ca Mau showed that the more diversified aquaculture is, the better the livelihoods for all categories of farmers, including the poorest. An example is Tan Hong village (Ta An Khuong Nam commune, Dam Doi district), where people raised freshwater and brackish-water fishes, as well as animals and crops. Along with diversification of economic options, labor time is better utilized for both men and women. There's less idle time than formerly, when income came solely from shrimp.

#### 5.1.2 Poverty rate

In 2001, according to the income standards of the Ministry of Labor (MOLISA), among 229,118 households in Ca Mau classified by income group, there were 26,428 rich (11.5%), 59,628 above-average (26.0%), 10,7602 average (47%), and 35,460 poor households (15.5%).



Source: Le Dang Trung (2005), calculated from VHLSS 2002

Figure 5: Household income structure in Ca Mau, 2002

-In 2003, 13,532 households escaped from poverty, reducing the poverty rate in the province from 15.5% down to 9.6%. The lowest rate was observed in Ca Mau city at 3.4%, and the highest in Cai Nuoc and U Minh at about 13%.

-In 2004, the number of poor households was 18,136, still accounting for 7.8% of a total of 237,085 households. It can be said that shrimp aquaculture development has significantly reduced the poverty rate from 2001 to 2004, from 15.5% down to 7.8%.

Analysis of the poverty rate in different districts confirms this fact. Freshwater land without significant shrimp farms (Tran Van Thoi, Thoi Binh) have a higher poverty rate than the salt and brackish water areas, and the rice-shrimp model areas (Cai Nuoc) have a higher poverty rate than the forest-shrimp areas (Ngoc Hien, Nam Can). The reason is that, in Cai Nuoc, the newly transformed rice-shrimp areas still face difficulties in shrimp aquaculture, and the average area for shrimp aquaculture per individual household is also less than in coastal areas. The forest-shrimp areas have a higher poverty rate than the coastal areas, but this is due to the fact that they also have a higher number of lower-skilled migrants engaged in low-paying jobs than other districts.

	Total number of households	Total number of poor households	Rate of poor households (%)	Number of poor households increasing	Ratio of increasing number/total number of poor households
U Minh	17387	2243	12.9	355	15.83
Thoi Binh	26357	2754	10.44	297	10.78
Tran Van Thoi	37166	4096	11.02	921	22.49
Ca Mau city	37627	1283	3.4	179	13.95
Cai Nuoc	46170	6092	13.19	1013	16.63
Dam Doi	35588	2907	8.16	788	27.11
Ngoc Hien	32291	2519	7.8	313	12.43
<b>Total</b>	<b>232586</b>	<b>21894</b>	<b>9.41</b>	<b>3866</b>	<b>17.66</b>

Source: poor household revision 2003, LISA department

Table 2: Number of near-poor households falling back in poverty in Ca Mau, 2003

In reality, when revisiting the poor households under the new national poverty standard (income lower than VND100,000/month/person), the ratio of near-poor households (already escaped from poverty) falling back into poverty is not that low. The average level of household falling back into poverty is 18% over the total poor households, most of them are newly separated households and some unlucky households failing in shrimp production (see Table 2).

VHLSS 2002 data allow a comparison of the poverty rates following an "expenditure poverty standard" between the shrimp-farming group and the non-shrimp farming group. In 2002 in Ca Mau, the poverty rate of shrimp-farming households (28.6%) was much lower than that of non-shrimp farming households (34.7%). The poverty gap of shrimp-farming households was also lower than that of non-shrimp farming households. It was, however, significantly higher in both categories than in the Mekong Delta and nationally. This data shows that, on average, shrimp-farming households have a greater chance to escape from poverty than non-shrimp farming households.

There are many causes of poverty. The livelihood of people in Ca Mau does not depend only on shrimp. However, based on interviews with provincial, district, and commune officials and villagers, and classifications of living standards and in-depth interviews of households in six villages, it is clear that nearly everyone feels that the shrimp has changed the life of the poor in the region during the last five years. Although there have been some losses in some villages, people generally feel that these recent changes have brought positive effects.

#### 5.1.3. Changes in livelihoods of the poor

From 2000 to 2004, the production model of poor households changed significantly. The rate of poor households participating in shrimp and other aquatic product (crabs, fish) aquaculture increased sharply. In 2000, half of poor households were practicing shrimp aquaculture. In 2004, the proportion was two-thirds. The rate of poor households hiring out their labour also increased during the last five years. The rate of poor households raising pigs and poultry increased slightly, but less than in other groups.

The non-shrimp farming poor households that were surveyed also feel dependent on the gains or losses of the shrimp aquaculture season. In survey sites, poor households with little or no land can still benefit from shrimp aquaculture by providing direct or indirect services such as:

- Hired work: dredging shrimp ponds, maintaining shrimp ponds for others
- Working for seafood processing companies: mainly single young women who live near cities



- Running small businesses, such as providing collection services
- Running boats: serving shrimp dealers and producers

Asked about changes in the importance of income sources during the last five years, more than one-half of poor households said that the income from acting as hired labour has become more important.

## 5.2. Income distribution and equity

### 5.2.1. Income gap

The income gaps between shrimp-farming and non-shrimp farming households, poor and rich household, and households with and without land, are quite clear through the survey data and the PRA results in survey sites.

According to VHLSS 2002, the average per capita income of poor households is equal to only 40% of that of non-poor households. The average income of shrimp-farming households is 1.5 times higher than that of non-shrimp farming households. According to the expenditure quintile, the average per capita income of the richest group is 4 times higher than that of the poorest group.

Survey data also show that the income gap between rural and urban areas is not significant in Ca Mau. This result is different from elsewhere in Vietnam. This is a positive impact of shrimp aquaculture, which has increased income in rural areas to meet that of cities.

Looking specifically at shrimp aquaculture, we see that it can generate an average income of about 4 million VND to poor households, but can bring more than 11 million VND to the non-poor. The income from shrimp aquaculture in non-poor households is triple that in poor households. From the expenditure quintile, we see that the shrimp can bring more income to the rich group; and income from shrimp accounts for a larger portion of total income than in other groups. The income gap between groups 5 (richest) and 1 (poorest) from shrimp aquaculture reaches more than 12.3 million VND. For the richest group, income from shrimp aquaculture represents 68% of total income from aquatic products, while in the poorest group, it represents only 44%.

Rich households can survive more easily after a lost harvest, which is not the case for the poor.

The increased risk in shrimp farming pushes the poorest households to diversify agricultural production and do more hired work. Adding other crops has been an increasingly difficult task, however, as a result of the salinization of most soils.

### 5.2.2. Gaps in use of land / access to credit

The primary reason for the income gap between rich and poor is the gaps in size and use of land holdings. Before the 1990s, many people migrated to coastal areas to reclaim land, mainly by cutting down mangrove forests for rice cultivation or aquaculture or taking over cleared but unused land. Many households obtained large areas (up to 10 ha). In response to a trend of reduction in forest cover, the local authorities issued a Decision (64/1991) to regulate land allocations. It was a way to legalize the rights of land use on land already being used by households. Therefore, since the 1990s, there has emerged a gap in land use among households in the coastal areas of Ca Mau province. This gap has tended to increase due to the development of shrimp aquaculture, specifically:

- Many households migrated to the area (beginning in 1995), and newly separate households (e.g. new couples) could get only small land holdings, or no land at all. They have had to sell their labour to other people engaged in aquaculture.

- Some households had to sell their land due to business failures (including failures in shrimp farming). Rich households thereby got additional opportunities to accumulate more land.

Results from a survey of 120 households in 3 communes shows that the rich households have more than 4 times the land as poor households; non-shrimp farming households have almost no land at all (see Table 3). The trend of land accumulation in shrimp-farming households has been clear during the last five years. This trend is amplified by the fact that land prices have increased sharply.

Area of land use	%
No land	35.24
From 1 – 5,000 m <sup>2</sup>	10.64
From 5,000 – 10,000 m <sup>2</sup>	11.80
From 10,000 – 20,000 m <sup>2</sup>	17.15
Over 20,000 m <sup>2</sup>	25.17
<b>Total</b>	<b>100.00</b>

Source: Lê Đăng Trung (2005), calculated from VHLSS 2002  
**Table 4: Household structure according to land use**

Year	Forest-shrimp	Rice-shrimp	Specialized shrimp	Ecological shrimp	Rich	Above average	Average	Poor	Having shrimp aquaculture	Not having shrimp aquaculture	Total
2004	4.32	2.04	3.42	2.89	5.26	3.12	2.80	1.43	3.26	0.02	2.87
2003	4.02	1.81	2.49	2.46	5.26	3.07	2.78	1.49	3.25	0.02	2.87
2000	3.85	1.48	2.07	2.05	5.32	3.03	2.77	1.50	3.24	0.02	2.86

Source: survey of 120 households in 3 communes of 3 districts (1/2005).  
**Table 3: Average land area of households (ha), change by years**

According to VHLSS 2002, if we divide households in Ca Mau in terms of land area, we can see two extremes: a lot of land, or none at all. Landlessness in Ca Mau is very common. Though the average quantity of land in Ca Mau is higher than in other places (the average area of land in households with land in Ca Mau is 20,000 m<sup>2</sup>, in the entire Mekong Delta only 10,800 m<sup>2</sup>, and nationwide less than 8,000 m<sup>2</sup>). Of a total of 670 households surveyed in Ca Mau, 35.2% have no land, while 25% have more than 2 ha of land (see Table 4). Yet households in Ca Mau have little ability to increase their production by increasing their land. Unused land is very limited: Only 6.8% of households have it, and its percentage out of total land area is only 4%. This means that supporting the poor in Ca Mau by increasing their land use is not feasible.

The second reason for the income gap in Ca Mau is the differences in loan accessibility, which is closely related to the gap in land use. Poor households often have little or no land, and thus difficulty in accessing bank loans. Instead, they often borrow from unions (e.g. Farmers' Union, Women's Union). According to the survey, nearly two-thirds of households had loans from banks: more than 70% of shrimp-farming households, but only 7% of non-shrimp farming households. The amount of loans was also higher in shrimp-farming households.

Significant borrowing is typical in the transformation from freshwater production, with low investment, profits, and risks, to salt and brackish water production, with higher investment, income, and risks. In group discussions and interviews in the surveyed villages, most shrimp producers said that they depend on future shrimp harvests to pay off their loans. However, shrimp aquaculture has faced greater risks of late, leading to considerable difficulty in paying back those loans.

### 5.2.3 Loss in shrimp farming

Reduction of income and losses from shrimp aquaculture were common across all surveyed sites. After one or two seasons of profitability, losses often begin to emerge as shrimp productivity decreases. In 2004, the situation appeared to be more serious than in previous years. Survey results from three communes show that losses in forest-shrimp and rice-shrimp models were much higher in 2004 than in 2000. According to local people, the reasons for this were "low quality water source" (62%) and "low quality seed" (57%).

Note that losses in shrimp aquaculture are not an unavoidable consequence, but a manifestation of the instability of the production during a transition period with specific characteristics for each household and each sub-region. Therefore, at a given time, one area can profit, while other areas can lose. Since extensive aquaculture depends heavily on nature (with many uncontrollable elements), losses in shrimp aquaculture are a problem with many unknown variables and few easy solutions.

## 5.3 Job opportunities

Many new jobs have been created in shrimp farms and processing enterprises, and in associated services.

### -Shrimp farms

Many unskilled people have been hired for dredging and guarding on shrimp farms, especially intensive shrimp farms.

### -Processing enterprises

In Ca Mau province, there are 25 aquatic products processing enterprises (21 of which are for shrimp processing) with 20,000 workers (15,000 full-time and 5,000 seasonal), of which 60% are women.

**-Establishments producing and supplying equipment, materials, and food for shrimp farming**

The system of service suppliers for shrimp farming, particularly the number of households running small businesses, has developed quickly in response to the increase of shrimp aquaculture in Ca Mau. Trade liberalization has provided favorable conditions, with fewer administrative burdens, to import materials, chemicals, and food for shrimp from Thailand and other markets in the region.

**-Shrimp seed production establishments**

Approximately 50% of shrimp seed demand in Ca Mau is met by hatcheries in the province. Other seeds are supplied from Shrimp seed company no. 2 in Bac Lieu province and from Vietnam's central region (Nha Trang city). Seeds are distributed through a network of nearly 700 agents.

**-Raw shrimp collection establishments**

Raw shrimp collection establishments in Ca Mau are very diverse in terms of scale and mode of operation. Processing enterprises often establish a system of collecting agents or shrimp traders in shrimp farming areas, or they set up shrimp collection sites right at the gate of the processing factories. Many households also collect raw shrimp to sell to processing enterprises, or hire these enterprises to process and then sell finished products to exporting enterprises. Many related jobs have been developed in transportation, usually boat-related, or in ice supply, etc.

One discouraging fact is that the educated labour rate in Ca Mau is quite low, only 16% in 2004 (the target for 2005 is 20%, still much lower than the national average of 30%), mainly in education, health care, civil administration, aquatic products processing, shipping, construction, and apparel. The portion of labour in science and technology for agriculture, forestry, and fisheries is still very low. Despite more than 250,000 ha of aquaculture, the fisheries sector has only several dozen engineers working in administrative and technical areas.

**5.4. Other social issues**

**Unemployment** – Ca Mau's unemployment and underemployment rate has dropped from 5.9% of the total labour force (660,000 in 1997) to 5.4% in 2003 (for a total labour force that has increased to 767,000 people). The total number of unemployed increased slightly, however, from 39,000 to 41,500.

**Minorities** - 39% of ethnic Khmer households are in the category of poor households. Poor ethnic Khmer households totalled 1,991 in 2001, representing 5.6% of the overall number of poor households. 64.5% have no land and are mainly doing hired labour. The provincial people's committee provided special support to ethnic Khmer people in terms of loans and land reallocation, and consequently, 491 households emerged out of poverty, reducing the overall poverty rate of ethnic minorities from 39.78% in 2001 to 30% in 2003.

**Migration** - In 2001, 5,058 poor households, of a total of 35,460, were migrants. Migration to Ca Mau is closely linked to shrimp aquaculture development. We can divide the migration into two periods:

-Up to 1996-1997, some of the migrants started to raise shrimp (illegally). All of them became local residents.

-From 2000 until today, the issue of free migration has re-emerged, with an average of 2,000 migrants arriving annually, especially in coastal districts. For example, in Nam Can district in July-August and March-April (at the time of upgrading the shrimp ponds), many people, mostly men, come from other places to do hired work. Some of them stay and become temporary residents. Most are poor and have no land. They do hired labour that is often directly related to shrimp activities, or engage in small trade.

**Gender issues** - Shrimp aquaculture has created many jobs for women in processing and servicing, though the portion of women in the total labour force is still below 40%. Processing enterprises employ 20,000 people, of which nearly 60% are women. About 6,000 people (mostly women) are finding jobs outside Ca Mau province.

The number of women staying home for housework has dropped in comparison with 1997, but is still high. In 2003 there were 66,900 women (accounting for 8.7% of the total labour force), mainly in rural areas, who were unemployed or underemployed. Especially in former rice-growing areas where women used to be very busy with farm work, the shift to shrimp aquaculture has caused many women to become unemployed.

**Education** - A worrying trend in areas of shrimp aquaculture is that people do not care much about education for their children. Survey results show that poor households often let their children study only through grade 5. A study done in Cai Nuoc district (by a geographical institute in Ho Chi Minh City) has shown that the development of shrimp aquaculture did not improve education. Also, children in the region must still take a boat to get to school. While the boating expenses are only about VND80,000-100,000/month, this is still a significant deterrent for some. Also, boating is not safe in bad weather.

In surveyed villages, leisure time is high as a result of shrimp aquaculture ("shrimp aquaculture is God's charge, we don't have to feed them"), especially when mono-shrimp farming is active. For example, in Trai Luoi A village (Dat Moi commune, Nam Can district), in 395 households (1,580 people, of which 876 women), up to 90% of working-age women do nothing other than housework and child care. Almost all children stay home with their mother; there is only one kindergarten with about 10 children in the village.

**Summary**

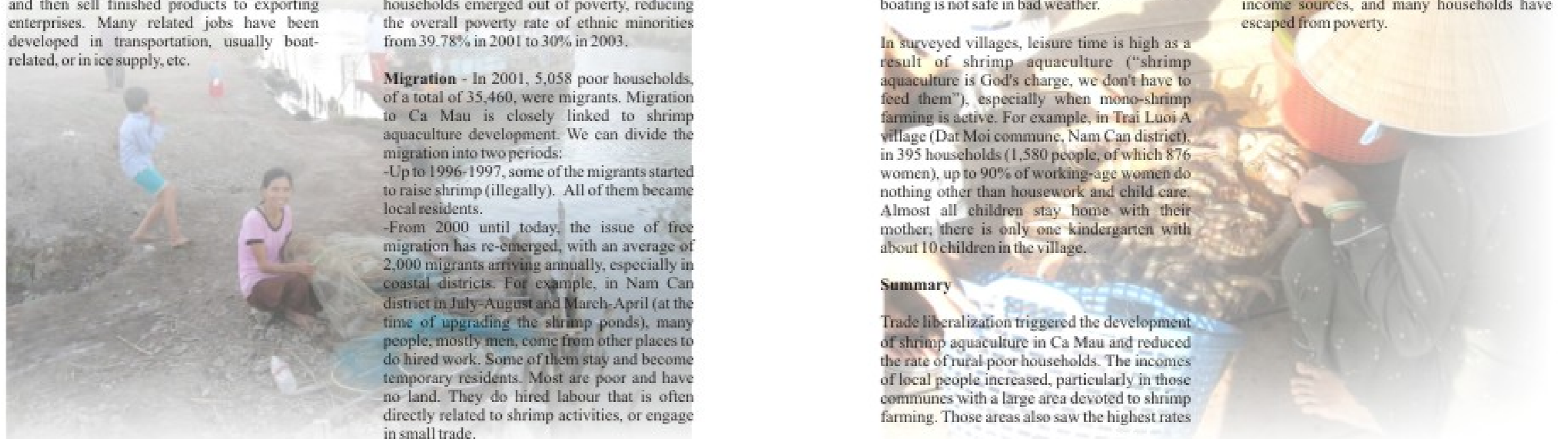
Trade liberalization triggered the development of shrimp aquaculture in Ca Mau and reduced the rate of rural-poor households. The incomes of local people increased, particularly in those communes with a large area devoted to shrimp farming. Those areas also saw the highest rates

of poverty reduction.

The poor with little or no land, however, have limited opportunities to benefit from the positive aspects of trade liberalization. Their primary livelihood is either hired labour or natural resource exploitation, which has been largely reduced during the last five years (see Chapter 6 of main report). Also, those with land for shrimp aquaculture often incur losses due to a lack of capital for investment, buying quality seeds, improving their technology, etc. An increasing number of households are selling their land to pay debts, and people are becoming wage laborers due to failures in shrimp production.

While shrimp aquaculture continues to grow, bringing higher incomes to many medium-income and well-off households, the rate of near-poor households falling back into poverty has increased in Ca Mau. The major reason is that many households previously escaping from poor or medium-income households have failed in shrimp aquaculture, and have to sell their lands and alter their livelihoods.

However, trade liberalization has brought new livelihoods to those poor who are not farm owners or operators, such as hired labour, collecting raw shrimp, working in processing factories or hatcheries, etc. Therefore the landless poor have developed some new income sources, and many households have escaped from poverty.



## 6. Environment and ecosystem changes

From 1984 to 1995, unplanned shrimp farming in coastal areas greatly reduced the area of mangroves. Thousands of hectares of mangrove forest were felled with significant effects on the ecosystem. From 1996 to the present, the initial profitability of shrimp farming pushed farmers to spontaneously transform hundreds of thousands of hectares of rice into shrimp farms. This conversion of coastal mangrove forests and rice fields has had serious consequences to the environment and has degraded the different ecosystems and their biodiversity, resulting in reduced opportunities for people, especially the poorest, to maintain some of their traditional activities.

### 6.1. Land/water availability and quality

#### 6.1.1. Land

**Alum soils** - Alum soil is the main soil type in Ca Mau, covering about 65% of the province. This kind of soil is characterised by a high iron content that traps phosphorous and lowers its concentration in pond waters. In some ponds, the quality of both water and soil was good originally, but as there were no grasses or plants covering the pond borders, the soil was exposed to the sun and oxidized, creating sulphate acid soil. Rain caused soil erosion of the banks or pond borders and brought acid soil to the centre of the pond, reducing the water's pH. This had a direct effect on the natural health and activity of shrimp, and increases their chances of becoming diseased. When PH is less than 4, shrimp may die.

**Saline soils** - The salinization process often occurs inland during the dry season due to the low levels of freshwater in former rice fields. The salt invasion has been increasing since the beginning of the transition of rice-producing areas to aquaculture. A number of the irrigation systems built to prevent salt invasion and freshen soil have been destroyed in order to conduct salt water into the rice fields during the dry season (to ensure shrimp cultivation). This has led to the destruction of the previous ecosystem, which had progressively adapted to a freshwater environment. Some vegetation cannot adapt to this change; for example, coconut trees have nearly disappeared and vegetable production has become less productive.

#### 6.1.2. Wastes from shrimp aquaculture

**Wastes of sediment and sludge** - Wastes from

shrimp aquaculture in the form of sediment - including wastes of shrimp, rotten food, used chemicals, and toxins - typically accumulate in the alum mud at the pond bottom. An anaerobic process then occurs that is very dangerous for shrimp farming. Sludge has to be removed regularly; and the more a farming system intensifies, the more sludge accumulates.

According to statistics from Pham Dinh Don (2003), the total volume of waste mud from shrimp aquaculture in Ca Mau province was 90 million m<sup>3</sup> in 1999, 217 million m<sup>3</sup> in 2001, and 248 million m<sup>3</sup> in 2003. It is a harmful waste source that pollutes soil and causes direct losses to shrimp aquaculture.

As producers usually disperse these wastes into rivers and channels without proper treatment, pollutants are spread to all surrounding areas, increasing the risks of an epidemic in all surrounding areas. To limit the negative impacts in their pond, farmers use many de-aluming products such as Diatomite, Dolomite, powdered lime, etc. As mentioned before, the more intensive the technique in use, the greater the quantity of polluting mud it generates.

**Water pollution in river and channels** - The content of DO or dissolved oxygen (oxygen demand) in rivers and channels is a good indicator of pollution level. It ranges between 1.2 and 7.2 mg/l in Ca Mau, lower than the coastal water standard (TCVN 5943-1995), especially during the dry season. Low DO content greatly impacts the oxygen volume needed for aquaculture. In the rainy season, it is the pH that falls due to the increased erosion of alum soil back to rivers. Other indicators of pollution as COD (chemical oxygen demand) are not in accordance with environmental standards.

In general, it can be said that the existing Ca Mau ecosystem cannot absorb the increasing amount of pollutants released into its water system. This is particularly true in the northern districts of the province (U Minh, Thoi Binh, Tran Van Thoi). In southern Ca Mau (south of Ca Mau city, Cai Nuoc, Dam Doi, Nam Can, Ngoc Hien, southern Tran Van Thoi), the situation is not satisfactory but less dramatic because the higher density of canals and rivers allows a higher self-cleaning capacity of the system.

### 6.2. Forest cover

During the period from 1975 to 1983, about 20,000 hectares of mangrove forest were changed to rice farming. Shrimp aquaculture development during the 1980s led to the additional destruction of about 12,000 ha of mangrove forest in Ca Mau.

To avoid uncontrolled deforestation, the province has applied a forest allocation policy, transforming traditional forest management measures into the socialization of forestry. This policy has provided a lot of positive outcomes and reduced some deforestation and forest fires.

Each household, according to the policy, is assigned a portion of forest (3-10 ha) in which they can build a shrimp pond, with the obligation to leave up to 70% of mangroves intact. This mangrove protection policy has been relatively efficient, especially when management has been carried out by the Forestry Fishery Enterprises and the Forest Management Boards, but the ratio between pond and mangrove is unfortunately not always strictly applied. Households tend to increase pond surfaces well above authorized levels, and at present the actual proportion of forest cover is often less than 60%.

In addition, the result of the policy has been a fragmentation of small forest blocks with negative impacts on biodiversity. It should be mentioned that coastal mangrove forests are a critical and necessary ecosystem for the reproduction and development of many aquatic species (fish, crabs etc.). The cutting and fragmentation of mangroves may lead to lower recruitment in the sea, and lower productivity in traditional fishing activities outside the forest itself.

### 6.3 Biodiversity

Ca Mau province has three major types of natural ecosystems: the mangrove ecosystem, the marsh and submerged forest ecosystem, and the estuarine ecosystem. All three have their own value and function and are very sensitive to external changes. Over the past years, the evolution in environmental conditions as well as the indiscriminate use of land has progressively broken their natural equilibrium.

The reduced surface and density of Ca Mau's mangrove forest, the largest mangrove area in Vietnam, has severely restricted the available habitat for wild animals. That has already resulted in a measurable decline of wild fauna both in quantity and variety of species. The diversity of forest trees has been reduced, and already five species of plants as well as ten species of birds have vanished. These include some rare and precious birds such as *Placanus onocrolatus*, *Ibis leucocephalus*, and *Leptoptilos dabius*.

In those regions transformed from freshwater rice agriculture into salt or brackish-water shrimp aquaculture, the biotic communities have changed, creating a reallocation of the ecological tolerance range for many fauna and flora species. This has considerably affected the aquatic ecosystem and, as a result, many valuable species of freshwater aquatic organisms have disappeared. Salinization has brought disturbances to the distant areas of estuaries, and brackish fauna has invaded further inland.

Migrant species requiring freshwater have died due to the salty environment or moved further into more continental areas. Some freshwater grasses useful for feeding cattle have died or faced competition from saltwater grasses. Most coconut plantations have disappeared.



#### 6.4. Provision of ecosystem services

The emergence of shrimp aquaculture in mangrove forests and coastal farmland has created major changes in the resource supply of these ecosystems. Collection activities (for wood, firewood, natural fishes, crabs, honey etc., as described in Annex 3) strongly declined. Coastal and riverside erosion have increased. The serious decline of provisioning and supporting services from coastal ecosystems has led to negative changes to local livelihoods, particularly for the poorest.

##### Main features

Environmental pollution due to shrimp farming and degradation of the mangrove forest has led to negative impacts to the productivity and production volume of shrimp aquaculture, making it unsustainable, and has limited the positive impacts of trade liberalization, particularly for the poor.

Due to massive development without suitable initial analyses of impacts, the water in rivers and channels has been polluted and soil quality in many areas totally changed. This has resulted in an increased occurrence of epidemic diseases that are facilitated by the interconnection of all shrimp ponds in open extensive farming. The productivity and production volume of shrimp aquaculture is on the decline, probably due to an excessive development of shrimp farming with regard to the capacity of the environment to efficiently absorb all of its wastes.



## 7. Interventions and reactions

### 7.1 By government bodies

Successes in aquaculture in the 1990s, especially in the Mekong Delta in general and in Ca Mau in particular, were the foundation for the formulation of stronger central government policies vis-à-vis aquaculture in order to boost exports. A series of policies on aquaculture development were issued (see Chapter 3 of the general report) which supported investment in hatcheries, research and development for farming techniques, and aquaculture extension by both private and state entities. The results of this policy, associated with a liberalization of trade and the entire economy, have been spectacular; in a very short period, from 1999 to 2002, aquaculture production developed rapidly in terms of area (an increase of 80%) and production (200%).

In the early stages of the development of aquaculture, which was largely spontaneous, the local authorities were largely unable to anticipate problems. Despite that, they have reacted relatively early to sensitive issues such as mangrove protection. The Provincial People's Committee (PPC) of Ca Mau issued decision number 64/QD-UB in early 1991, which directed the allocation of land for agriculture, forestry, and aquaculture to individuals and state-owned enterprises. Also, under the decision, local people were allowed to use canals (approximately 30-40% of total cultivated area) for aquaculture. This decision was effective in that it not only prevented people from cutting down mangrove forest indiscriminately but also offered good conditions for people to earn their living through aquaculture and to protect mangrove forest more effectively. However, while this policy prevented clear-cutting, it did increase mangrove fragmentation.

The speed of the spontaneous move to transform rice fields into shrimp ponds also appears to have been largely uncontrolled, and the scale of pollution and its negative effects was largely unexpected. However, in the late 1990s, in response to the massive transformation from rice cultivation into shrimp aquaculture, the Ca Mau PPC issued decision number 14/2000/QD-UB to restructure the economic mechanism towards

fishery-agriculture-forestry. They prioritized the conversion of low-productivity rice fields, characterized by sulphate and saline soils, into shrimp farming in combination with alternative rice production. The advice to alternate rice crops was not followed in the beginning, but is now more widely implemented.

In response to growing environmental pollution, Ca Mau province subsequently issued many decisions and instructions to mitigate negative impacts on the environment, such as Instruction no. 17/2004/CT-UB, issued in December 2004, on reinforcing measures for pollution treatment; Decision 80/2004/QD-UB, also issued in December 2004 in replacement of Decision 24/1999/QD-UB, regarding regulations on environmental protection related to the production and supply of shrimp seed in Ca Mau province; etc. Through these decisions, the province has assigned the tasks of environmental management and monitoring to provincial functional agencies, and it has set instructions for imposing fines on organizations and individuals for violating environmental protection regulations.

Plans were set up to promote the ecological and organic shrimp farming models. The use of chloramphenicol (an antibiotic) and other toxic chemicals was forbidden. Decisions were taken to upgrade processing plants in order to improve the quality of exported products, etc. Many other measures were taken to facilitate access to credit for farmers, including poor households, for job training. Special funds were also allocated for the poorest.

One of the problems in the management of aquaculture is that conditions are quite diverse across the different districts and areas. Planning must be adapted to specific local conditions and requires a great deal of coordination. A possible step towards the improved efficiency of planned regulations could be found through an "open" planning system for each sub-region. The development of models, production systems, and cooperative forms would then be based on the participation of stakeholders. Planning and building irrigation systems at the sub-regional level would help to promote this cooperation.

### 7.2. By other stakeholders

Many organizations played an important role in reorganizing the economic structure of the province. For instance, since the Ca Mau authorities did not have the administrative structures to control and reorganize everything, the existing State Companies were given a leading role in implementing various changes in coordination with districts and communes, especially in terms of the allocation of land in natural forests and mangrove areas. They were in charge of controlling the decisions taken by local authorities regarding forest preservation.

Unions and cooperatives have played an important role in providing loans to the poorest households. Also, in some places, people have formed clubs, groups, or cooperatives, some of which have active operations (such as Tan Hong commune). However, cooperatives are generally set up with facilitation of local authorities but they fail to act as a mechanism to reduce risks for shrimp farmers, for example in terms of buying seed together, controlling quality, planning irrigation systems at the sub-regional level and selling products.

People are very aware of the need to have more closely controlled seed quality. They also understand that increasing pollution is a major issue and would like the different farming models to be studied further, particularly with regard to their ecological impacts. Better access to finance is another issue that is frequently mentioned, and most farmers would prefer to be able to borrow directly from banks rather than be obliged to get loans through forest or fisheries enterprises.

Since the shrimp business has been so directed towards exports, the end users (foreign importers of shrimp) are obviously playing an increased role in the ongoing transformation of the industry. Quality is always an important factor, and some importers have directly promoted important transformations in the processing technology as well as certain farming practises (like the growth of organic and ecological farming) through labelling or bans on the use of some chemicals. However, there is, in general, an increasing doubt with regard to the long-term sustainability of shrimp farming, especially in the former mono-shrimp

## 8. Conclusions and recommendations

The story of the development of shrimp production for exports in Ca Mau province presents a close and comprehensive view of the interactions between trade liberalization, rural poverty, and the environment. The efficiency of the trade liberalization process has been positive in terms of enrichment of the province, better living for most people, and increased opportunities for landless people to obtain work. But the negative aspects that arise from this process are important realities for producers, managers, and policymakers at local and national levels.

Shrimp farming is associated with various risks due to changes in market prices, epidemics, water pollution, etc. leading farmers to losses, particularly in those households that have little land or are poor. There is an increasing trend in shrimp farming areas in which people are thrown back to poverty. So most poor people do not directly enjoy the benefits from trade liberalization. The response from policymakers has usually been fairly rapid in terms of socio-economic problems, but inefficient in terms of environmental protection.

The study has shown clearly the danger of passing too rapidly from one monoculture, like rice farming, to another one, like shrimp farming. The more trade liberalization promotes a specific type of production for exports, the more a country and its people become dependent on external market and price fluctuations, and on regulations (or protective reactions) that may affect their livelihoods.

The study also shows that before moving to a new type of monoculture, in-depth environmental studies must be carried out to understand whether the new activity being developed will be sustainable. This is particularly important for a country like Vietnam that has strong demographic pressures and very little land available. Such studies should include research into how similar problems have been addressed, and/or solved, in other countries, such as (in the case of shrimp) India or Thailand.

The Ca Mau case study has shown that economic growth together with trade liberalization can also impact the food security of poor people, as it destroys traditional methods of land use and may lower natural resources, reducing the livelihood options of the poor. It can also increase the disparities between different groups of people. The study shows that better access to loans could favour a diversification of shrimp farming techniques towards less-polluting systems; and that many problems cannot be solved at the national or even regional levels but should be studied in cooperation with the affected people at a sub-regional level.

Some of the problems that appeared in Ca Mau have been observed in neighbouring countries. In Thailand, declining shrimp productivity after one or two years of exploitation has been a general trend. Intensive farming, in particular, has accumulated so much pollutant mud that, after three or four years, some farmers have moved to new lands in order to continue their lucrative business. How long it will take for these lands to become productive again, and for what kind of use, is still unclear.

Many aspects of the major environmental changes that are occurring in Ca Mau province remain uncertain and require more in-depth study. Little is known about the long-term effects of soil salinization and on the actual capacity of the Ca Mau ecosystem to absorb increasing pollutant releases. The recent decision to develop intensive farming models should be carried out very carefully and be based on a master plan of aquaculture development that takes into consideration all of the socio-economic as well as environmental aspects – not only a short-term target of boosting exports.

## References

- 1 Barry C, et al, 1999a. Termination Report: Project PN 9412: Mixed shrimp farming mangrove forestry models in the Mekong Delta. Australian Institute of Marine Science
- 2 Barry C. et al., 2000a. Mixed Shrimp-Mangrove Farming Practices - A Manual For Extension Workers. ACIAR - MOFI Project FIS/94/12
- 3 Barry C. et al., 2000b. Mixed Shrimp-Mangrove Farming Practices - A Manual For Farmers. ACIAR - MOFI Project FIS/94/12
- 4 Barry C. et al., 2002. Silvofishery Farming Systems In Ca Mau Province, Vietnam.
- 5 Be T.T., 1994. Sustainability of Rice-shrimp farming system in a brackish water area in the Mekong Delta of Vietnam. MSc thesis submitted to University of Western Sydney, Hawkesbury.
- 6 Ca Mau DARD (2002). Progress Report on the Implementation of annual Agriculture and Rural development Plan in 2001, 2002.
- 7 Ca Mau DARD (2002). Progress Report on transformation of Economic Structure in Agriculture and Rural Sectors in Ca Mau
- 8 Ca Mau DoF (2003). Progress Reports on Implementation of Annual Sectoral Plan in 2001, 2002 and 6 early months 2003 .
- 9 Ca Mau DOSTE (2000, 2001, 2002) Ca Mau State of the Environment Report 2000, 2001, 2002.
- 10 Ca Mau PPC (2002). Draft of organizational renovation of forest management and forestry land in Ca Mau province.
- 11 Ca Mau PPC (2003). The Synthetic Report on Amendment of the General planning in Socio-economic development in Ca Mau province up to 2010.
- 12 Ca Mau PPC(2003). Socio-economic Development in Ca Mau - Progress Reports in 2001, 2002 and 6 early months 2003.
- 13 Center of Fishery Extension, (2003). The state of aquatic product farming in Ca Mau province in 2002. Department of Fisheries Ca Mau.
- 14 Chu Tien Quang, Nguyen Thi Hien (2002). Negative Impacts of some Economic Incentives and Taxation in Selected Sectors on the Environment and Natural Resources: Initial findings and Recommendations. UNDP project of Support to formulation and implementation of Vietnam's National Agenda 21 - VIE/01/021
- 15 Dang Trung Tan (1998). Project report "Applied Techniques for developing fishery-shrimp mixed farming model for ecological sustainable management of mangrove ecosystems in Minh Hai".
- 16 Dang Trung Tan (2001). General report of floral resources in Ca Mau province.
- 17 Danida, 2001. Component Description - Fisheries Sector Programme Support. Component 3: Support to Brackish Water and Marine Aquaculture (SUMA). Vietnam
- 18 DFID (2002). Linking poverty reduction and environmental management - challenges and Opportunities (DFID, UNDP, WB, EC, 2002)
- 19 DFID, 2001. Poverty and Aquatic Resources in Vietnam: an assessment of the role and potential of aquatic resource management in poor people's livelihoods
- 20 Diep Minh Tam (1996). Economy and Environment in Mekong Delta
- 21 Donna B. et al. 1999b. Economic and Social Characteristics and Farm Management Practices of Farms In The Brackish Water Region of Soc Trang and Bac Lieu Provinces, Mekong Delta, Vietnam: Results of a 1997 Survey.
- 22 Donna B. et al., 2002. An Evaluation of Rice--shrimp Farming Systems in the Mekong Delta.
- 23 Environmental Justice Foundation (EJF).2003. Risky Business : Vietnamese shrimp aquaculture - impacts & improvements
- 24 General Statistic Office (GSO), 2004 - Key Statistics of VHLSS 2002.
- 25 General Statistic Office (GSO).2002 - Preliminary Results of the National Survey on Agriculture and Rural Areas in 2001.
- 26 General Statistics Office (GSO), 2003. Statistical Yearbook of Viet Nam in 2002.

- 27 Hoang Duc (1994). Forestry Development Planning in Mekong Delta.
- 28 Huynh Minh Hoang (1999). Analysis of economic efficiency and sustainability of some cultivation models of mangrove forest in forestry-fishery location 184, Scientific Workshop, Hanoi National University.
- 29 Institute of Agricultural Planning, MARD (2003) Report on Amendment of Crop Pattern and Land Use Plan for Agriculture-Forestry-Aquaculture in Mekong Delta.
- 30 Lam Minh Triet et al (2001). State and developments of environmental quality in Mekong delta, Scientific and environmental and disaster Workshop in Mekong delta.
- 31 Le Minh Loc (2002). Build effective, sustainable forestry-fishery method in mangrove forest in Ca Mau province.
- 32 Le Quang Tri et al (2002). Socio-economic aspect of coastal areas in district of Vinh Loi, Thanh phu, and Dam Doi, Mekong delta, Scientific research Newsletter of Can Tho University .
- 33 Le Sam (2003). Issues in Transformation of Production Pattern in Mekong Delta. Magazine of agriculture and rural development .
- 34 Le Trinh (2001). Environmental characteristics of Mekong Delta and research proposal of economic, ecological area for sustainable development. Scientific and environmental and disaster Workshop in Mekong delta .
- 35 Mai Trong Thong et al (2003). Final Draft of Report of " Ecological assessment of wet land in lower section of Mekong river", Vietnam Millennium Ecosystems Assessment Report
- 36 Ministry of Fisheries (MOFi), 2001. Sustainable Aquaculture for Poverty Alleviation (SAPA) -A Strategy Paper.
- 37 Ngo Xuan Hai (2002). Irrigation development for aquaculture in Mekong Delta .
- 38 Ngoc Hien district PC (2002). Report on Land use planning in Ngoc Hien district, Ca Mau for the period 2002 - 2010.
- 39 Nguyen Duy Chuyen et al (1995). Mangrove forest in Minh Hai province - Orientation for Restoration and Development .
- 40 Nguyen Sinh Cuc (2003). Vietnam agriculture and Rural Development in the renovation period (1986-2002)
- 41 Nguyen Van Be (2002). Analysis of ecology and finance of shrimp farming model combined with mangrove forest in Mekong delta, Science Magazine of Can Tho University
- 42 Nicholas M. and Bob B., 2003. Methods used in the project "Poverty Mapping and Market Access in Vietnam".
- 43 Niimi, Y. et al. 2002. Trade Liberalisation and Poverty Dynamics in Vietnam.
- 44 Oxfam (2002). Double standards
- 45 Oxfam GB, 1999. Participatory Poverty Assessment - Tra Vinh province.
- 46 Oxfam GB, 2001. Rice for the Poor. Case Studies in Vietnam.
- 47 Oxfam GB, 2002. Impacts of trade liberalization on coffee growers in Daklak province
- 48 Oxfam GB, 2003. A survey on landless people in Mekong Delta.
- 49 Oxfam GB, 2002. Summary report on Village Consultation on interim PRSP paper.- Tra Vinh province.
- 50 Patricia J.& Julie L.2002. Poverty Dynamics in Rural Vietnam: Winners and Losers during Reform.
- 51 Phan Nguyen Hang (1997). Characteristics of Viet Nam's mangrove forest - recovery and sustainable use .
- 52 Phan Nguyen Hong (1996). Environmental degradation problem of shrimp farming and disease in coastal area in Nam Bo.
- 53 Phan Nguyen Hong (1999). Building management strategy and protection of overflow water area in coastal area of Viet Nam, Proceeding of Workshop of Hanoi National University .
- 54 Porter G. (2002). Agricultural Trade Liberalization and The Environment in North America: Analyzing the "Production Effect"
- 55 SRV.2002. Comprehensive Poverty Reduction and Growth Strategy (CPRGS). Hanoi.
- 56 Statistics Office of Ca Mau (1997). Socio-economic data in Ca Mau province during the period of 1991 - 1996.
- 57 Statistics Office of Ca Mau. Statistical Yearbook of Ca Mau province in 2000, 2001, 2002.
- 58 Thang N. et al.2001. Globalization and Its Impacts on Poverty: Case Studies. Volumes I, II and II. Report Prepared for Action Aid Vietnam.
- 59 The World Conservation Union (IUCN) & International Institute for Sustainable Development (IISD), 2003. Expanding Shrimp Aquaculture on Sandy Land in Vietnam: Challenges and Opportunities.
- 60 Tran Thanh Be (1999). Study cooperation project result " Assessment of rice-shrimp farming system in brackish water of Mekong Delta ", The volume of Science Study Project of Can Tho University .
- 61 Tran Thanh Be (2002). Study cooperation project result " Assessment of rice-shrimp farming system in brackish water of Mekong Delta ", Science Magazine of Can Tho University .
- 62 Tran Thanh Be et al (1999). Comparison of results from production activities of rice-shrimp farming in Gia Rai and My Xuyen during 2 years 1997, 1998, Science Conference in Can Tho University.
- 63 Truong Hoang Minh et al (1999). Water quality and growth of shrimp in the shrimp-rice Rotation practice. The volume of scientific research project, Can Tho University.
- 64 Truong Hoang Minh et al (2002). Assessment of forestry-fishery management method in Ca Mau province.
- 65 Truong Hoang Minh et al (2002). Assessment of forestry-fishery method development in buffer zone of Ca Mau province. Science Magazine of Can Tho University .
- 66 Truong Quoc Phu et al (2002). Current State of the Application of Forestry-Fishery mixed farming practice in Ngoc Hien and Dam Doi districts, Ca Mau province. Scientific research newsletter of Can Tho University.
- 67 Truong Quoc Phu et al(1999). Study on environmental indicators for coastal wetland in Mekong Delta, The 1999 proceeding of Research projects of Can Tho University .
- 68 UNDP, 2001. Vietnam Human Development Report 2001.
- 69 UNDP, 2003. Participatory Poverty Assessment - Mekong Delta region (draft)
- 70 UNEP, 2003. Millenium Ecosystem Assessment: Ecosystems and Human well-being -a framework for assessment.
- 71 Vuong, D.Q.T. and Lin, C.K., 2001. Rice-Shrimp Farming in the Seawater Intrusion Zone of the Mekong Delta, Vietnam. ITCZM Monograph No. 6.
- 72 Wheeler D. et al. 2003. The Poverty/Environment Nexus in Cambodia and Lao People's Democratic Republic. World Bank Policy Research Working Paper 2960.
- 73 Winter A. 2001. Trade and Poverty: Is There a Connection ? paper prepared for WTO
- 74 World Bank.1999. Vietnam Development Report 2000: Attacking Poverty.
- 75 World Bank.2003. Vietnam Development Report 2004: Poverty.

## ANNEX 1

### Area – productivity of products in Ca Mau, 1997-2004

	Unit	1997	2000	2001	2002	2003	2004
<b>A. PLANTING</b>							
Area of planting annually	Ha	233662	262374	144219	143616	118822	131533
Long-term tree	Ha	35677	28974	27701	18113	16915	15197
1. Rice: - area	Ha	220844	248241	131570	130563	107009	126517
- productivity	Ton/ha	2.48	3.42	3.18	3.22	3.29	3.16
- output	Ton	549402	850399	418452	420452	352835	400000
In which: - area of 2 seasons rice	Ha		86158	32931	37304	34117	36120
- area of rice-shrimp	Ha	-	-	26500	20738	19547	43458
2. Sweet potato: - area	Ha	590	872	587	518	547	503
- output	Ton	2833	4231	3048	2093	2215	2220
3. Cassava: - area	Ha	700	1449	909	458	570	516
- output	Ton	3559	6444	4709	2747	2811	2590
4. Vegetable: - area	Ha	5762	4391	5308	5347	5166	4519
- output	Ton	17258	27986	15146	25653	25172	20881
5. Sugar cane: - area	Ha	5689	5655	5327	5988	4899	3357
- output	Ton	160643	335494	337424	445470	289725	209326
6. Coconut: - area	Ha	26559	20102	18868	12067	10755	9195
- output	Ton	68955	66285	61960	21054	28552	24415
7. Fruit tree: - area	Ha	9118	8872	8833	6046	6160	5935
<b>B. LIVE STOCK KEEPING</b>							
1. Buffalo	Unit	3426	1816	768	763	714	684
2. Cow	Unit	-	395	19	9	59	45
3. Pig	Unit	206219	285832	187827	201803	216086	227265
4. Poultry	Unit	1951000	2879337	1487041	1384665	1327472	822520
<b>C. FORESTRY</b>							
1. Area of planting forest	Ha	3143	688	3624	5664	6200	4271
<b>D. FISHERY</b>							
1. Area of water for aquatic product aquaculture	Ha	154036	204381	254191	270851	277688	272000
2. Output	Ton	45995	73139	87688	88314	91917	107447
In which: shrimp aquaculture	Ton	18932	35377	55330	60619	62241	85912
GDP (current price)	Million	4007784	5963307	6604699	7631719	8871662	9902000
In which: Fishery – Agriculture – Forestry	Million	2540907	3534431	3825000	4403487	5029205	5359000
Proportion: Fishery – Agriculture – Forestry	%	63.4	59.3	57.9	57.7	56.7	54.1

## ANNEX 2

### Changes in land use in Cai Nuoc district (ha)

Form of land ownership	1968	1997			2003		
		Status	Increase compared with 1968	Decrease compared with 1968	Status	Increase compared with 1997	Decrease compared with 1997
One-crop rice	43,555	21,424		22,131	-		21,424
Rice –farm produce	6,167	28,415	22,248		-		28,415
Settlement area - garden	6,676	16,676	10,000		15,352		1,324
<i>Sonneratiaceae</i>	286	-		286	-		
Rhizophora	5,641	-		5,641	-		
Avicennia	487	-		487	-		
Mangrove Forests	11,652	834		10,816	1,191	357	
Rhizophora-Shrimp	-	7,640	7,640		5,103		2,537
Specialized shrimp	-	5,034			59,684	54,650	
Bare land	2,900	1,016		1,884	-		1,016

## ANNEX 3

### Changes in supplying services of ecosystem caused by development of shrimp aquaculture

Ecosystem	Supplying services	Before developing shrimp aquaculture		After developing shrimp aquaculture	
		Status	Role in local livelihood	Status	Role in local livelihood
<b>Mangrove Forest</b>	Wood and firewood	Abundant, large volume	As main source of income and subsistence for local people	Significantly reduced in quantity and quality	Less important to local people's income, less opportunity for local people to harvest
	Non-timber forest products (including honey, medicines, food)	Diverse, providing large volume	Provide food and additional income for local people	Reduced quantities caused by the area, biological diversity, decline of environmental quality. Chances for access have been limited.	Less important to local people's livelihood
	Wild catch in near-shore fisheries	Diverse, providing large volume	Main source of nutrients and the main livelihood for some local people	Reduced in volume and diversity due to loss of habitat	Influence on income and livelihoods of fishermen
	Shrimp aquaculture	Little developed	Not important	Shrimp farming rapidly expanded and replacing forest and rice paddies	Became a major livelihood of local people and additional livelihoods for people involving in forest production and exploitation, other groups
	Environment and supporting functions	Good, ensure the functions of ecosystem	Advantage of catching fish	To be locally polluted, major changes to water quality, supporting functions of ecosystem have declined	Loss of many species of sea-fishes, risks in shrimp aquaculture, influence on local people's income
<b>Land producing coastal agriculture</b>	Rice cultivation	Major crops	Major livelihood of majority of people	Transform mostly cultivated surface into rice-shrimp aquaculture	Still the main livelihood of some farmers, increase in income of producers
	Fruit trees	-	Additional income or major livelihood of local people	Transformed part of cultivated surface into garden-shrimp model	New livelihood and income created for gardeners
	Livestock	-	Additional income	To be less influence by shrimp aquaculture	Less influenced by shrimp aquaculture
	Water and land	Fairly good quality	Created the high capacity and sustainability of agriculture production	Rice land and forest land has been reformed into specialized shrimp aquaculture and rice-shrimp	New livelihoods for local people but a lack of sustainability