# CHANGES IN NET ENCLOSURE AQUACULTURE IN PHU TAN AFTER THE CENTURY FLOOD IN 1999

Vo Thi Hong

## INTRODUCTION

The Tam Giang-Cau Hai lagoon system is the largest lagoon system in Viet Nam. This lagoon is linked to the sea through 2 openings, Thuan An and Tu Hien. In early November 1999, the largest flood in the last 100 years hit the area, with water levels reaching over 9m. Indeed, 90 % of the houses in Thua Thien Hue were flooded, over 200 inhabitants were killed, and 1000 houses were swept away. With this flood, three new openings were made into this lagoon ecosystem: Con Dau (Hai Duong); Hoa Duan (Thuan an) and the connecting opening at Vinh Hai (Thua Thien Hue gauging-station).

The opening at Hoa Duan, 800 m wide and 10 m deep, caused the most serious impact. The flood capsized 2 ships weighing over 500CV and 16 ships of 45 to 90 CV; it swept away 40 concrete houses, 1km of inter-district road and 4 shrimp fingerling enterprises; and it damaged over 1000ha of pond area and 2500ha of net enclosures. Approximately, 140 billion VND (10 million USD) worth of damage was caused by this flood. The destruction of the inter-district road stopped transportation and electrical and telecommunication services to 100 000 habitats in 13 communes, now isolated on the south-east bank of Tam Giang lagoon.

According to initial assessments, this flood was expected to damage much of the on-going aquaculture activities occurring in the lagoon. Interestingly, however, according to Department of Fishery's (DoF) statistics, it had a positive impact on aquaculture:

- In 1999 before the flood, the area under shrimp culture was 1780ha, the outputs were 600tons, and the average productivity was 337kg/ha.
- In 2000 after the flood, the area under shrimp culture was 1850ha, the outputs were 800tons, and the average productivity was 432kg/ha

However, the flood and Hoa Duan opening had a direct effect on Phu Tan fishers as it affected aquaculture by net enclosure. Before the flood, with only one opening at Thuan An, the water flowed less and many hhs lost crops to disease and polluted environment. The increased water exchange provided by Hoa Duan improved the aquaculture environment for many hhs.

When Hoa Duan opened, some hhs could not practice aquaculture but some released a small amount of fingerlings to understand the environmental condition. Many hhs had great benefits: Mr Dang Dien in Dien Truong village gained 112 million VND and remarked that “since the opening of Hoa Duan, the water exchange was better, the environment was airy, so he released many fingerlings and then got the highest economic benefit since doing aquaculture".

The purpose of this study was to understand the effect of the flood on aquaculture by net enclosure in Phu tan.

## LITERATURE REVIEW

The Tam Giang lagoon is one of many such typical basins along the central seashore of Viet Nam from 11° to 17° Latitude North. It was formed in the late stage and is rich in sediment. This area is affected by a weak tide and strong waves. Tam Giang -Cau Hai lagoon system covers an area of 21.600ha and 68km long. There are 2 openings at Thuan An and Tu Hien which are unstable and often move.

Tam Giang -Cau Hai lagoon system plays an important role to socio-economic life in Thua Thien Hue. It harmonized environment, transportation and tourism and supports over 30% of the province's inhabitants. It has appropriate natural conditions and environment for developing aquaculture, so the area of doing aquaculture has increased from 85 ha in 1990 to 1850 ha in 2000 - a 20-fold increase in the last 10 years. However, due to the fact that Tu Hien and Thuan an openings are unstable, the aquaculture has fluctuated depending on the water exchange between lagoon and sea.

When the openings were wide and the water exchange was good, aquaculture provided high yields. When the openings was covered by sand and the water exchange was poor, aquaculture was not very successful: the season was low or it was impossible to do aquaculture because there was no salt water. In 1995 -1997 when Tu Hien was closed by sediments, some ponds suffered low salinity and either could not raise shrimp or they grew slowly. The average productivity was 183.3kg/ha. In 2000, when the lagoon had 3 openings and the environment was good, over 90% hhs that practiced shrimp culture profited (DoF survey of 610 households).

In order to understand the impact of century flood creating new opening on the changes in the aquaculture on the whole lagoon as well as in Phu tan, we used the following documents:

Table 1. The aquaculture area and production of shrimp and crab for the whole province, Phu Vang district and Phu Tan commune before and after the Century flood

| Period | Province | | Phu Vang district | | Phu Tan commune | |
|---|---|---|---|---|---|---|
| | Area (ha) | Output (ton) | Area (ha) | Output (ton) | Area (ha) | Output (ton) |
| 12/1999 | 1551 | 419 | 875 | 152 | 250 | 32 (+ 35[a]) |
| 12/ 2000 | 1850 | 800 | 922 | 311 | 291 | 46 (+ 79[a]) |

[a] Output in Phu Tan includes fish production in brackets.

## METHODOLOGY

We used participatory methodologies such as group discussions: Once a month at night, we came to the fishers' patrol houses and held discussion with 3-10 aquaculturists to understand the impact of Hoa Duan on their life and their desire regarding the closing of Hoa Duan.

We interviewed 79 fishers to understand whether they supported the closure of Hoa Duan opening; how many hhs could not do aquaculture and why; how they earned living; how their life was affected when they did not do aquaculture; how were they planning to earn a living for the years to come; etc.

We surveyed aquaculturists using 86 recording sheets combined with a total 610 recording sheets (for the whole lagoon) to quantify the effects on aquaculture of the new opening. We randomly selected 10hhs/commune doing aquaculture and surveyed over 2 seasons (Season 1 in 1999 and season 1 in 2000; see Appendix) about the productivity of exploitation and fingerlings of 10 valuable species over the whole lagoon and in Phu Tan area particularly.

Changes salinity, pH, temperature and currents at the research site were monitored using scientific tools (salinity meter, pH Han device, thermometer and by observation). Table 1 summarizes the data – the annual average of some factors measured once per month from April 1999 to September 2000 in 4 sand bars in the Phu Tan lagoon area: Hop Chau, Dau, Dai and Tho. We selected these sites because they are habitat for young fingerlings and also where the area was very large. Fishers could wade in the water to drag the net.

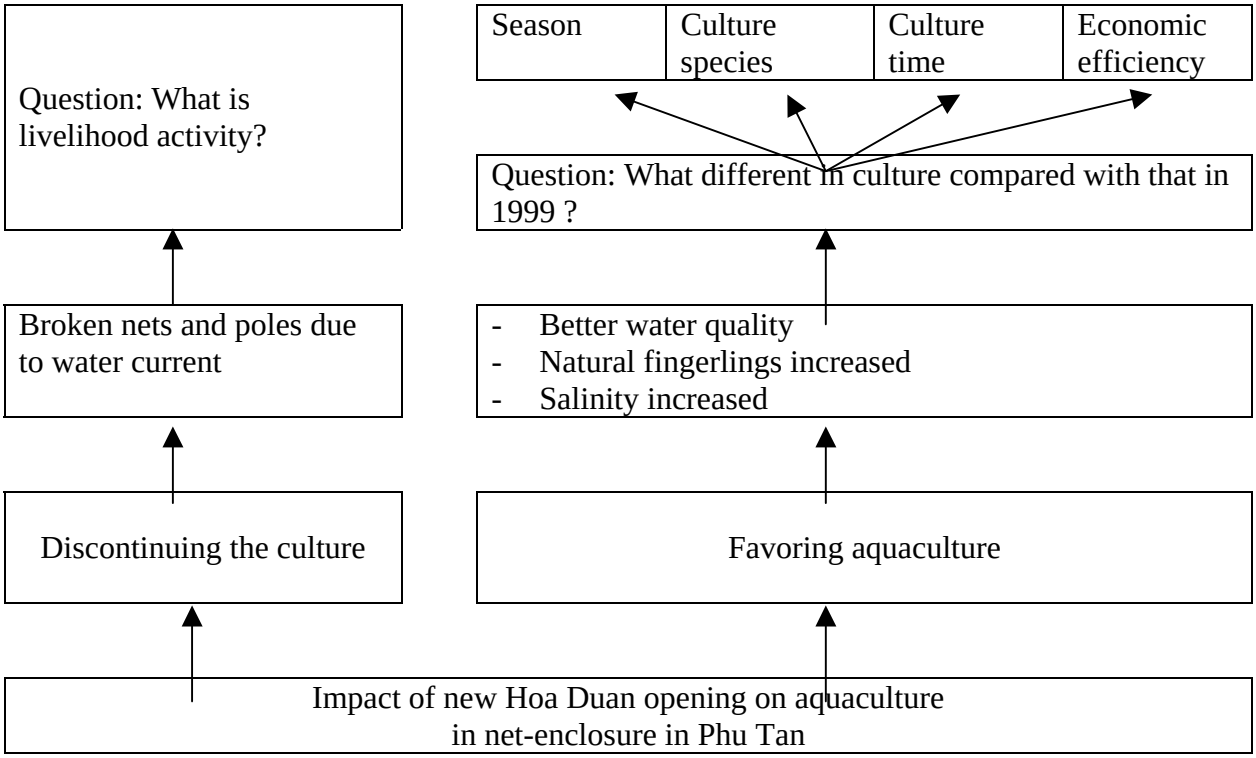
Aquatic species were classified to survey the natural fingerlings sources at the site. We surveyed the area by boat at night from 2 to 4 am with Mr. Le Van Ben and Mrs. Tran Thi Bac - fishers in Phu Tan - with a deep water push net (a triangular-shaped fishing device known as *xeo*) of 2m width. *Xeo* was dragged for 50 m, taking four samples at each of the 4 sites. Twice the *xeo* was dragged along the bottom of the lagoon and twice the *xeo* was dragged near the surface. The shrimp were brought to patrol house, analyzed and after that taken to the laboratory and identified.

We compared our results on the quantity and the species of fingerlings of economically important aquatic species in the sand bars of Phu Tan commune before and after flood to the topic: "Survey of hatching and nursery areas of the aquatic species of high economy (1999-2000)" of the Oceanographic Institute in Hai Phong.

Statistics and matrix were used to understand problems and to process the results of discussion. For example, to know the fluctuation in fingerling sources of economically important aquatic species and the effectiveness of doing aquaculture by net enclosure before and after flood, we held 4 meetings with 86 aquaculturists in Phu Tan. We were facilitators and gave topic*: " What do we need to discuss about the aquaculture situation after flood"*. The participants made a problem tree. We selected the important problems to solve in advance and step by step all other problems were solved in the discussion.

The map of aquaculture by net enclosure in Phu Tan was drawn by fishers and researchers in 1998, 1999 and 2000. It indicated the changes in area and location of pond and which ponds could not be used due to the impact of Hoa Duan opening.

Figure 1. Problem tree of aquaculturists




For each problem that fishers discussed to seek impacts, we used the matrix and regulated marks from 1 to 10 (using 10 peanuts for the most important element, 1 peanut for the least important one) then summed up and discussed to understand their desire.

## RESEARCH RESULTS

Characteristics of the lagoon environment in Phu tan before and after opening Hoa Duan

The environmental changes were monitored at 4 sites within Phu Tan opposite Hoa Duan opening: Hop Chau, Dai, Dau[1] and Tho from May 1999 to September 2000 (Table 2).

Table 2: Environmental changes in Phu Tan lagoon before (1999) and after (2000) the flood which created Hoa Duan opening.

| Location | **Salinity (‰)** | | **Temperature (°C)** | | **pH** | | **Current Strength** | |
|---|---|---|---|---|---|---|---|---|
| | **1999** | **2000** | **1999** | **2000** | **1999** | **2000** | **1999** | **2000** |
| Hop Chau | 0- 22 | 8-29 | 14-28 | 14-28 | 7-8 | 7-8 | weak | strong |
| Dai | 0-19 | 10-30 | 14-27 | 14-28 | 8-9 | 7-8 | weak | strong |
| Dau | 0-19 | 10-32 | 14-30 | 14-28 | 8-9 | 7-8 | Very weak | strong |
| Tho | 0-17 | 8-27 | 15-30 | 14-28 | 8-9 | 7-8 | Very weak | mediu m |

[1] Dau in this case means 'oil'. The American's pumped sand from the Huong River estuary to this area to make an oil station (which was unsuccessful).

Table 2 indicates the following points:

- The average salinity after the flood was higher than before flood.
- The current after flood was much stronger than before flood.
- The temperature was more stable.

To understand the reason why some hhs could not practice the aquaculture after having the new opening and their present and future solution, we interviewed a random sample of 78 hhs from a total of 327 hhs doing aquaculture in Phu Tan. Fourteen (14) hhs could not practice aquaculture in 2000 accounting for 4,28% of total aquaculture hhs in Phu Tan.

These hhs had their nets located on the margin of the culture area (refer to map of aquaculture area in Phu Tan) facing the opening Hoa Duan and were directly affected by tide and wind from the sea. Nets and poles could not tolerate such strong currents and shrimp escaped, and the salinity was very high at 21-32 ‰ (see the index). These hhs continued to harvest aquatic species by natural fishing in their net enclosure area and became hired labour to supplement their earnings. Their lives were very difficult with an income of only 60 -70% of what they earned from aquaculture. Their income now covered their daily life – they could not save.

Mr.Nguyen Dan in Tan My village was one of 14hhs who could not practice the aquaculture due to Hoa Duan. He said:

> *"The water flows strongly, no poles can tolerate, so how can I practice aquaculture when there is no bottom of net. This year, at night, I put fish corral in my net enclosure to supply the family with daily food. During the daytime, I become hired labor. The money I earn only covers the family costs - it is lucky. There is not enough to save. The amount of money from fish corral is about 10-15 000 VND. I can fish for only 15-17 days per month. The money from hired labour is about 30 000 VND but it is not frequent and I only work for 10-15 days per month. Thus all I only cover the family expenses."*

In the future, if the opening is closed, these households will continue to do aquaculture and if it is not closed, they will still practice natural fishing and become hired labour.

**Survey of 86 aquaculture households**

In order to understand the season, species outputs and the efficiency of the culture in 2000, we did a survey and interviewed 86 hhs doing aquaculture in 6 villages of Phu tan commune.

*Season*

Based on data recording sheets distributed to 86 aquaculture households, 79 hhs started aquaculture by stocking fingerlings in January 2000, one month sooner than during the season in 1999. They were impelled to try stocking earlier as salinity increased sooner – in December the salinity was 12-19‰). It helped fishers harvest the main season sooner and made use of the area to start a second season to increase their income.

*Species Cultured*

Table 3. The major species cultured before and after the Century Flood in Phu Tan from a survey of 86 households.

| Species | 1999 | | 2000 | |
|---|---|---|---|---|
| | **No.hhs** | **%[a]** | **No.hhs** | **%[a]** |
| *Penaeus monodon* | 86 | 100 | 86 | 100 |
| *Scylla serrata* | 86 | 100 | 85 | 98.8 |
| *Siganus guttatus* | 60 | 69.8 | 51 | 59.3 |
| *Siganus oramin* | 68 | 79 | 86 | 100 |
| *Oreochromis niloticus* | 30 | 34.9 | 0 | 0 |
| *Gracilaria verrucosa* | 32 | 37.2 | 14 | 16.3 |

[a] Percentage was calculated from 86 households – the total number of surveyed hhs.

Table 3 indicates that *Tom su* (Tiger prawn or *Peneaus monodon*), Cua (mud crab or *Scylla serrata*) and Ca Kinh (Rabbitfish or *Siganus oramin*) are the main species and bring high incomes for hhs in Phu tan. They were the economic species favorable for the brackish water. Naturally occurring in the net, Natural *Siganus oramin* developed much and contributed to increasing the benefit from culture.

*Culture Efficiency*

Table 4. Changes in aquaculture area, production and income among 86 surveyed hhs in Phu Tan before and after the new opening

| Information | Particulars | 1999 | 2000 | % change |
|---|---|---|---|---|
| Area (ha) | **Total Aquaculture area** | **177.31** | **175.31** | **-1.1** |
| | Net enclosure | 168.66 | 166.66 | -1.2 |
| | Earth pond | 8.56 | 8.56 | 0 |
| Yield (tons) | **Total yield** | **63.942** | **77.415** | **21.1** |
| | *Penaeus monodon* | 22.585 | 29.690 | 31.5 |
| | *Scylla serrata* | 16.475 | 19.930 | 21.0 |
| | Other products | 24.882 | 27.795 | 11.7 |
| Income (Million VND) | Gross revenue | 3668.5 | 4.563 | 24.4 |
| | Net revenue | 1019 | 1653 | 62.2 |
| Number of Households (from 86 surveyed hhs) | Profited | 65 | 66 | 1.5 |
| | profit > 30million VND | 9 | 23 | 155.6 |
| | profit 20-30mil | 17 | 20 | 17.7 |
| | profit 10-20mil | 22 | 10 | -54.6 |
| | Breaking even | 5 | 1 | -80 |
| | Loss | 16 | 19 | 18.8 |

Note: One hh in the 86 hhs surveyed, could not engage in aquaculture in 2000.

After the Century flood, aquaculture in Phu Tan had a bumper crop. In an area of 168.66 ha, production increased by 13 473 kg to 77 415 kg from before flood – the best culture season in Phu Tan. Tiger prawn production increased the most by 31.5%. Total net profit of 1 653 million VND for 86 hhs amounted to an increase of 62 % compared to that before flood.

Number of hhs which profited from aquaculture also increased – some hhs profited over 100 millions VND.

*Source of Fingerlings*

Based on monthly samples from January to September 2000 in 4 sand bars of Phu tan (Hop Chau, Dai, Dau and Tho) and on interviews with 86 hhs, the amount of fingerlings found in the waters of Phu Tan are presented in Table 5.

Table 5. The number of individual fingerling of valuable species caught before (October, 1999) and after flood (July 2000) in 4 sand bars around Phu Tan. Samples were collected using *xeo* and are recorded as the number of individual fingerlings per sample.

| Species | **Hop Chau** | | **Dau** | | **Dai** | | **Tho** | |
|---|---|---|---|---|---|---|---|---|
| | **1999** | **2000** | **1999** | **2000** | **1999** | **2000** | **1999** | **2000** |
| *Metapenaeus ensis* | 36 | 140 | 20 | 123 | 23 | 106 | 12 | 102 |
| *Penaeus monodon* | 2 | 41 | 1 | 30 | 3 | 26 | 0 | 4 |
| *Scylla serrata* | 0 | 6 | 0 | 4 | 0 | 7 | 0 | 1 |
| *Caridina sp* | 270 | 0 | 163 | 0 | 170 | 0 | 200 | 0 |
| *Siganus guttatus* | 0 | 3 | 0 | 5 | 0 | 4 | 0 | 0 |
| *Siganus oramin* | 8 | 45 | 5 | 38 | 6 | 39 | 2 | 38 |

The density of fingerlings of most surveyed species was much higher after flood that before flood. Especially some economically valuable aquatic species adapted to brackishwater developed well such as *tom rao* (Greasybacked shrimp or *Metapenaeus ensis*), *ca kinh* (Rabbitfish or *Signus oramin*). Because these species come from the sea, when the opening opened largely, the water exchanges was good, their larva follow the currents into the lagoon more easily. Some species that prefer less saline water such as *tom riu* (FW Atyidae or *Caridina*) were fewer. Caridina were quite common when the salinity was under 10‰.

To validate the changes in the quantity of valuable species in lagoon before and after flood, we collected catch data on 10 valuable aquatic species from 610 fishers in 31 communes in Thua Thien Hue (1998- 2000). Table 5 summarizes the catches of Phu Tan fishers (3 fish corrals, 3 gillnets and 3 mobile gear) before and after the Century flood.

Table 5. Catch data of 10 valuable species by 3 fish corral, 3 gillnet and 4 mobile gear in Phu Tan which compares catches from 1999 and 2000.

| Species | 1999 | | 2000 | |
|---|---|---|---|---|
| | Catch rate (kg/month) | % of catch | Catch Rate (kg/month) | % of catch |
| *Cyprinus centralus* | 5 120 | 11.3 | 1 507 | 1.7 |
| *Metapenaeus ensis* | 1 375 | 3.0 | 9 167.5 | 10.2 |
| *Mugil* sp. | 640 | 1.4 | 5 1146 | 5.7 |
| *Scylla serrata* | 576 | 1.3 | 3 589 | 4.0 |
| *Penaeus semisulcatus* | 533 | 1.2 | 3 735 | 4.2 |
| *Siganus guttatus* | 478 | 1.1 | 3 332 | 3.7 |
| *P. monodon* | 171 | 0.38 | 12 495 | 13.9 |
| *Epinephelus* sp. | 110 | 0.24 | 835 | 0.9 |
| *Cyrena sp* | 21 780 | 47.8 | 32 547 | 36.3 |
| Other fish | 12 950 | 28.4 | 8 713 | 9.7 |
| Other shrimp | 941 | 2.1 | 6 206 | 6.2 |
| Other species | 860 | 1.9 | 2 443 | 2.7 |
| **Total** | **45 434** | **100** | **89 718** | **100** |

The number of hhs surveyed are estimated at 3 to 5% of the total fishing hhs in the whole lagoon and are used as reference for fishing productivity. Each hh's data was reliable because they were assured that the tax department would not have access to the information.

Since the new lagoon opening, salt and brackishwater species are more dominant. The number of fingerlings of valuable aquatic species has increased in 2000 in the lagoon. This is advantageous for aquaculture as they serve as sources of fingerlings.

According to the results, Hoa duan opening should remain open to allow for more natural fingerlings migrating into the lagoon, for better water exchange and for more suitable environment.

**CONCLUSIONS**

- The ecological system of lagoon generally and in Phu tan particularly has been become more saline. It was very suitable for aquaculture in 2000.
- Not many hhs suffered losses due to the effect of Hoa Duan (14hhs out of a total of 327hhs doing aquaculture by net enclosure opposite Hoa Duan). The other net enclosure aquaculturists had much work and hired those hhs, so it was easy to solve their problems (demands of life).
- The big flood made Hoa Duan open. It had a positive impact on the aquaculture by net enclosure due to the fact that the environment was airy, the water exchange with the sea was better, the salinity appeared sooner so the culture season was longer; the shrimp grew rapidly and got less disease; and the economic efficiency was high.
- The fingerlings of aquatic species of high value, which are adapted to brackishwater and salt water, migrated into the lagoon at higher rates that that before flood. This contributed to increasing the efficiency of the culture area in Phu Tan. Therefore, aquaculture by net enclosure produce higher yields with the Hoa Duan opening and aquaculturists hope the water exchange will always be as good as the present situation.

*However, for this research we only paid attention to the impact of flood and Hoa Duan opening on aquaculture by net enclosure, so only their views was presented. There are other views – advantages to closing the Hoa Duan which have not been reviewed in this study.*

## APPENDIX

The Oceanographic Institute in Hai Phong
Topic "Fingerling sources in lagoon in Hue

SURVEYED SHEET OF THE PRODUCTS FISHED AND CULTURED

1) fisher's name (owner) Address

2) Fishing gear (type of culture)

3) Time for fishing (culture) month from month to month No.days

4) Main fishing products Kg/per day (month)

5) Accompanied products

6) In which month got the highest productivity? What kind of species were highest?

7) The season that species (ca day *carp*, ca dia *rabbitfish*, ca doi *mullet*, ca mu *grouper*, tom su *Tiger prawn*, tria *clam*, cua *crab*...) appeared in quantities

8) Estimating the products of each species (Kg/month)

Date
Informants

**Data sheet of to record fishers' opinions in Phu tan about the culture environment after Hoa Duan Opened**

Date

Full name:
Type of culture: Earth pond Net enclosure
Location:
Area:
How long:
The table synthesized the species before and after having opening

| Species | Before flood | | | | After flood | | | |
|---|---|---|---|---|---|---|---|---|
| | Stocking | | Harvesting | | Stocking | | Harvesting | |
| | Amount | money | Amount | money | Amount | money | Amount | money |
| *P.monodon*<br>*M. ensis*<br>*S.guttatus*<br>*S. oramin*<br>*O.niloticus*<br>*Scylla serrata*<br>*Gracilaria verrucosa* | | | | | | | | |

Time of culture month.
Way of harvest: harvesting big-releasing small; harvesting big; harvesting all
According to individual's opinion: how many hhs did not do aquaculture when having the new opening
Why:
Way of overcoming:

Natural fingerling source was little or much after the new
Which species
Which species were the most.
Capital for production: million dong /ha.
Desire