



# INTEGRATED MANAGEMENT OF LAGOON ACTIVITIES IMOLA PROJECT II

A REPORT ON

## EVALUATION OF ECONOMIC EFFICIENCY AND ENVIRONMENTAL IMPACTS OF TILAPIA CULTURE IN NET ENCLOSURE IN LOW-TIDE SHRIMP PONDS

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Hue, 08/2008



PEOPLE'S COMMITTEE OF THUA THIEN HUE PROVINCE



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AND ENVIRONMENTAL IMPACTS  
OF TILAPIA CULTURE IN NET ENCLOSURE  
IN LOW-TIDE SHRIMP PONDS**

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## PART I: SUMMARY

**Table 1. General information**

1	Name	Evaluation of economic efficiency and environmental impacts of tilapia culture in net enclosure in low-tide shrimp ponds”
2	<i>Venue and pilot farmers</i>	<ul style="list-style-type: none"> <li>Phan Bich, Quang Ngan commune, Quang Dien district</li> <li>Ngo Quang Dung, Quang Cong commune, Quang Dien district</li> </ul>
3	<i>Funding agencies</i>	<ul style="list-style-type: none"> <li>Fisheries Extension Center of Thua Thien Hue</li> <li>IMOLA Project</li> </ul>
4	<i>Technical staff</i>	Dang Nguyen Duy Ngoc
5	<i>Time</i>	<ul style="list-style-type: none"> <li>01/2008 – 08/2008</li> </ul>
6	<i>Scale and density</i>	10,000 m <sup>2</sup> (2 ponds); 5 units/m <sup>2</sup> (tilapia) and 9 units/m <sup>2</sup> (giant tiger prawn)
7	<i>Pilot objectives:</i>	<ul style="list-style-type: none"> <li>To treat the residual feed and shrimp discharge in the farming ponds in order to limit the pond pollution and disease risks to shrimps and improve the output;</li> <li>To finalize and disseminate fish farming techniques in net enclosure in the shrimp pond in Thua Thien Hue province</li> </ul>

*\* Methodology:*

- Conducting a survey of the natural condition and selecting households.
- Farming type (net enclosure culture in the polluted low-tide ponds);  
Density: tilapia: 5 units/ m<sup>2</sup> and size of 5-7 cm/ unit; tiger prawn: 9 units/ m<sup>2</sup> and size of 2-3 cm/ unit.
- Monitoring the growth and survival rate of tiger prawn, environmental quality, diseases and feed coefficient.
- Time: March 3<sup>rd</sup> 2008 to August 30<sup>th</sup> 2008

*\* Outcomes:*

**Table 2: Outcomes for giant tiger prawn**

Venues	Households	Area (m <sup>2</sup> )	Quantity of fingerlings (units)	Survival rate (%)	Harvest size (g)	Productivity (kg)
1	Phan Bich	5,000	45,000	50	20	450
2	Ngo Quang Dung	5,000	45,000	30	20	270
3	TOTAL	10,000	90,000	80	40	720

**Table 3: Outcomes for tilapia**

Venues	Households	Area (m <sup>2</sup> )	Fingerling quantity (unit)	Survival rate (%)	Harvest size (g)	Productivity (kg)
1	Phan Bich	200	1,000	82	300	246
2	Ngo Quang Dung	200	1,000	81.5	290	236
3	TOTAL	400	2,000	163.5	590	482

**Table 4: Plan vs. outcomes**

No.	Items	Planned	Outcome
1	Scale	10,000 m <sup>2</sup>	10,000 m <sup>2</sup>
2	Stocking density	Shrimp: 9 units/m <sup>2</sup> Tilapia: 2.5 units/m <sup>2</sup>	Shrimp: 9 units/m <sup>2</sup> Tilapia: 5 units/m <sup>2</sup>
3	Size	Shrimp: 4-6 cm/unit Tilapia: 5-7cm/unit	Shrimp: 4-6 cm/unit Tilapia: 5-7 cm/unit
4	Fingerling quantity	Shrimp: 90,000 units Tilapia: 1,000 units	Shrimp: 90,000 units Tilapia: 2,000 units
5	Feed conversion ratio	3.0	2.2
6	Average weight at harvest time	Shrimp: 20 g/unit Tilapia: 300g/unit	Shrimp: 20 g/unit Tilapia: 300g/unit
7	Survival rate	56%	40%
8	Harvest productivity	Shrimp: 1.26 ton/ha Tilapia: 10.5 tons/ha	Shrimp: 0.72 ton/ha Tilapia: 12 tons/ha
9	Productivity	Shrimp: 1.26 tons/ha Tilapia: 10.5 tons/ha	Shrimp: 0.72 ton/ha Tilapia: 12 tons/ha
10	Price	30,000 VND/kilo (fish) 80,000 VND/kilo (shrimps)	25,000 VND/kilo (fish) 60,000 VND/kilo (shrimps)
11	Total revenue		<b>55,250,000 VND</b>
12	Economic performance		<b>12,825,000 VND</b>

\* *Outcome evaluation:*

- The pilot was conducted according to the schedule, in line with the requirements and plan.
- During the farming process, shrimps grew well with the nice color and had no signs of disease infection. The growth and survival rate of tilapia were high (average weight of tiger prawn was 40g/ unit and the survival rate was 70 %; the average weight of tilapia was 300 g/unit and the survival rate was 90 % in comparison with the estimation).

*\* Conclusion:*

- The tilapia culture in the net enclosure in shrimp ponds in Quang Cong and Quang Ngan enabled farmers to grasp techniques and apply them successfully in production, bringing about economic efficacy, opening a new direction for them, diversifying the cultured species and limiting the diseases.
- Over the implementation process, tilapia was claimed to be the culture target that cleaned the environment, was suitable for the farming area contaminated by organic matters and apposite with the natural conditions, investment capacity and apt techniques.

*\* Proposals:*

- The pilot should be duplicated in polluted low-tide and deserted areas because farmers do not have sufficient operation cost. Additionally, this pilot should be conducted to improve the bottom condition of polluted ponds where the harvest yield was low.
- I kindly request the Fisheries Extension Centre to create the favorable conditions to organize training courses on farming culture techniques of those species and assist tilapia fingerling source for farmers in polluted regions and areas that have experienced the constant harvest loss.

## PART II: CONTENT OF THE REPORT

### I. Introduction

Diversifying farming species is one of the most important measures in aquaculture. Though the farming of tiger prawn in the past time has been common and this species becomes the major species in fisheries exportation. The exportation of aquatic species has its competitive position in the global market. However, the shrimp farmers are facing increasing risks such as the occurrence of shrimp diseases and the uninsured water quality that have negative impacts on the environment and the yield tends to be reduced. Many farmers are facing loss in continuous years and can not return debts to banks, especially in communes such as Quang An, Quang Thanh and Quang Phuoc of Quang Dien district; Phu An, Phu Dien and Phu Thuan of Phu Vang district.

Finding a farming type and culture target that have the capacity to improve the bottom water environment and economic performance to recover weak points of environmental pollution in low-tide farming areas, an aquaculture model namely “Polyculture of tilapia net enclosure culture in the pond in the low-tide shrimp farming area” was conducted to create the new farming direction and convert a part of polluted low-tide area in Quang Dien district with the hope to bring about better effectiveness.

#### \* Necessity of the model:

- The rotation of one-crop shrimp farming or the polyculture of many culture fishes such as tilapia, red snappers, groupers or white-spot rabbit fishes, spotted Babylon, blood cockle (*Anadara granosa-sò huyết*), *Gracilaria (rong câu)*, and *Kappaphycus alvarezii<sup>1</sup> (rong sun)* were applied instead of the monoculture of shrimps in infected ponds over continuous years.
- Among the above-mentioned species, tilapia culture in net enclosure in the polluted shrimp ponds is a good direction to clean the pond environment.
- Tilapia has a wide range of salinity and temperature adaptation and omnivorous on vegetation. It feeds on industrial, processed feed and organic humus. Therefore, it is convenient for the poly-culture of tilapia and tiger prawn in the brackish and saline water in Thua Thien Hue province to improve the productivity.

### II. Summary

1. Pilot name: Tilapia culture in net enclosure in organic polluted ponds.
2. Responsible agency: Fisheries Extension centre of Thua Thien Hue province

- Time: March 20<sup>th</sup> to September 20<sup>th</sup> 2008

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<sup>1</sup>

<http://dictionary.bachkhoatoanthu.gov.vn/default.aspx?param=1607aWQ9MjQ1NTUmZ3JvdXBpZD0ma2luZD1zdGFyZCZrZXI3b3JkPXI=&page=3>

**Table 5.**

No.	Time	Content
1	3/2008	Survey, pond improvement and fingerling stocking
2	4-8/2008	Culture and care taking
3	9/2008	Final checking and report writing

- Venue: Household of Mr. Phan Bich, Quang Ngan commune and Household of Mr. Ngo Quang Dung, Quang Cong commune, Quang Dien district, Thua Thien Hue province.
- Area: 10,000 m<sup>2</sup>/ 2 ponds.
- Stocking density:

**Table 6.**

No.	Stocking species	Density (unit/m <sup>2</sup> )
1	Tilapia	5
2	Tiger prawn	9

- Technical staff: Mr. Dang Nguyen Duy Ngoc.
- Objectives:
  - To treat the residual feed and shrimp discharge in the farming ponds in order to limit the pond pollution and disease risks to shrimps and improve the output;
  - To finalize and disseminate fish farming techniques in net enclosure in the shrimp pond in Thua Thien Hue province

### III. Methodologies

#### 1. Survey

- Conducting a survey of the natural condition, bottom matters and farming area that is suitable for the pilot implementation;
- Understanding the improvement of polluted ponds via biological features of unisex tilapia;
- Monitoring the growth rate and development of tilapia and tiger prawn;
- Conducting the poly-culture in which tiger shrimp is the major species for every farming pond of 0.5 ha.

## **2. Household selection**

Farming area is the shrimp pond that has been used for many years where there was much organic humus and frequent disease risks.

Household selection: Pilot farmer should be a person who has experience in aquaculture, pledges to share experience, commits to follow the pilot from the beginning till the end and has sufficient facilities for production.

## **3. Pond improvement**

- The pond is dried; clearance and weed depletion is made; lime is stocked from 5-7 kg/ 100 m<sup>2</sup> for acid dehydration with soil pH > 5, so the pond surface has a fertile mud layer and free of seaweed.
- The micro-organic fertilizer is applied with the amount of 0.1 kilo/ m<sup>2</sup> of the pond area.
- Water input: the clean water source with S‰ = 5 – 20‰, pH = 7.4 – 8.5. High transparency and sufficient water to the pond with 1.3 m

## **4. Net enclosure location**

- The net enclosure is made of monofilament net with size of 10 m x 10 m, height of 1.6 m (4 net enclosures for 2 ponds).
- The net is woven with 5 layers and the cover layer is completely open.
- The four corners are fixed with four bamboo poles and net enclosures are stretched up to the water surface.
- The net enclosure bottom is fixed by bamboo sticks that are 30 cm in intervals. Each pond has two net enclosures located across and 25 meters from the shore.

## **5. Fingerling selection and stocking**

\* Fish selection and stocking: Fishes were stocked on April 26<sup>th</sup> 2008. Fingerlings were purchased from Lien Minh Limited Company.

- Quality of tilapia fingerlings: The quality has to meet the technical requirements such as healthy fishes, no disease infection, no descaling and no loss of viscosity during the transportation. Stocking size is 4 – 6 cm. Survival rate is over 99 %.
- Stocking density: 5 units/m<sup>2</sup>; size: 4-6 cm
- Stocking manner: after pond improvement, net enclosure is located; when the net enclosure net and environmental parameters are suitable, fishes are then stocked

\* Shrimp selection and stocking: shrimp fingerlings were purchased from Hai Tien hatchery and stocked in April 30<sup>th</sup> 2008;

- Quality of shrimp fingerlings: Shrimps are healthy, no signs of disease infection, bright color, and full body parts and checked with PCR before stocking.
- Density: 9 units/m<sup>2</sup>; size: 3cm

- Stocking manner: shrimps are stocked in the early morning; soak the bags in the water for 15 minutes and gradually open the bags to release shrimps slowly (with the wind direction)

## 6. Care taking and management

\* For tilapia:

Major floating pellet feed was used for fish consumption. In addition, fishes can feed on natural feed and available organic humus in the pond. In the beginning months, feeding was given only once everyday in the evening. When they reached the weight of 15-20 g, floating industrial pellet feed was added twice a day in the early morning and afternoon. During the farming process, no checking was taken, only harvest was carried out after shrimps had been collected. The shrimp productivity was the background to evaluate the process of cleaning the environment of polyculture species. Fish growth speed was checked every 15 days by using casting nets.

**Table 7. Results of the growth and survival rate of fishes and shrimps**

No.	Farming type	Average weight of tilapia (gr/unit)	Survival rate of tiger shrimp %	Shrimp average weight (gr/unit)	Survival rate of tilapia %
1	0-15 days	70	99	2	99
2	30 days	90	98	8	90
3	45 days	115	97	9	86
4	60 days	130	95	12	80
5	75 days	150	92	14	70
6	90 days	175	90	17	50
7	105 days	210	89	18	46
8	120 days	250	85	20	40
9	135 days	300	82		

## 7. Management of environmental parameters

Water replacement: To ensure the good growth and development of tiger prawn and tilapia; the water level in the pond always reaches 1.3 meters up.

- Monitoring environmental parameters: during the farming season, parameters including pH, salinity, transparency and alkalinity were checked every 15 days; NH<sub>3</sub>

was checked to evaluate the impacts of the polyculture of tilapia and tiger shrimps on improving the environmental condition and finding the prompt measurements.

- Through the monitoring diary, it was possible to collect data on environmental parameters presented in the following table.

**Table 8.**

No.	Farming type	pH	Salinity (‰)	Alkalinity	Transparency	NO <sub>3</sub>	PO <sub>4</sub>	NH <sub>3</sub>	Depth (m)
1	1-15 days	7.5-8.5	10-15	80-100	30-40	0	0.01	0.05	1.30
2	15-30 days	7.5-7.8	14-15	90-100	40-50	0	0	0.05	1.40
3	30-45 days	7.7-8.0	13-15	100-110	30-45	0.01	0	0.03	1.35
4	45-60 days	7.5-8.0	15-17	90-100	35-50	0	0	0.003	1.25
5	60-75 days	7.9-8.2	16-18	80-100	40-50	0.01	0.01	0.03	1.30
6	75-90 days	7.2-7.8	14-16	80-100	30-40	0	0	0.00	1.40
7	90-105 days	7.5-8.0	12-16	90-110	30-45	0	0.01	0.00	1.40
8	105-120 days	7.6-8.5	14-17	88-110	30-40	0.01	0	0.003	1.35
9	120-130 days	7.5-8.0	15-18	100-110	35-45	0	0	0.00	1.30

As can be seen from the table, the water in the pond have little changes such as NO<sub>3</sub>, NH<sub>3</sub>, PO<sub>4</sub>; transparency and alkalinity were always within the permitted limit for fish growth and development. Regarding the salinity, there was some difference on some days (June 15<sup>th</sup>, July 30<sup>th</sup>, and August 15<sup>th</sup>). Climate had changed those days due to the freshness of water inside and outside the pond that had impacts on the shrimp and fish development. Water was replaced every 15 days; 25 – 35 % of the water amount was replaced once. During the farming process, no environmental diseases were detected; culture species developed with the high survival rate.

During the polyculture, no diseases occurred and there was high feed competition so the feed surplus in the pond was low, creating the good environmental conditions and fishes had high resistance capacity. Over the pilot results, environmental conditions in the pond were quite stable.

During the culture process, the pilot model was developing well; the growth speed and survival rate of tilapia and tiger prawn were high. After 3 months of culture, partial harvest of tiger prawn reached an average of 20gr/ unit and tilapia of 290-300gr/ unit.

## 8. Disease treatment and prevention

For tiger prawn, during the farming period, no diseases occurred, especially diseases caused by the environment such as yellow gill, black gill and moss aggregation.

1. For tilapia, it is an easy culture target, no disease infection, not shocked by the environment when the weather changed. To enable tiger prawn and tilapia to grow and develop well, increasing the water level in hot days was a solution.

2. Harvest:

After 2.5 – 3 months of culture, tiger prawn reaching the commercial weight of over 20g could be harvested for sales (price was normally higher than in occasion of festivals, moony days and heavy sea, the price was higher).

## IV. Cost accounting

A. Direct cost:

1. Fingerling cost (including the transportation cost):

Tilapia : 2,000 units x 500 VND/ unit = 1,000,000 VND

Tiger prawn : 9,000,000 units x 50 VND/ unit = 4,500,000 VND

2. Feeding cost :

**Table 10.**

<b>Synthetic feed : 1,200 kilo x 18,900 VND/ kg :</b>	<b>22,680,000 (VND)</b>
Shrimp feed (FCR=1.3) : 936kgxVND18,900/kg	17,690,000
Fish feed (FCR=0.9) : 430kg x VND8,500/kg	3,655,000
Treatment medicine and chemical:	500,000
Pond preparation :	2,100,000
Lime for pond improvement : 1,000kgxVND500/kg	500,000
Net enclosure net : 4 units x VND1,000,000/unit	4,000,000
Pond repairment : 2 pondsxVND500,000/unit	1,000,000
Fuel : 80 litres x VND13,500/litre :	1,080,000
Care taking : <b>4 months x VND800,000/month x 2 households :</b>	6,400,000
<b>Total :</b> <b>In words :</b>	42,425,000 Forty-two million, four hundred and twenty-five thousand dong

B. Estimated harvest after more than 3 months:

- Survival rate of tilapia: 82 %.
- Average harvest size: 290-300g/ unit
- Tiger prawn: 40 % (both two ponds)
- Average harvest size: 20g/ unit
- Estimated revenue:
  - i. Fish yield: 482 kg
  - ii. Shrimp yield: 720 kg
  - iii. Price: VND25,000/kilo of fish; VND60,000/kilo of shrimps
  - iv. Tilapia: 482 kilos x VND25,000/kilo = VND12,050,000
  - v. Tiger shrimp: 720 kilos x VND60,000/kilo = VND43,200,000

**Total revenue: VND55,250,000**

*(Fifty-five million, two hundred and fifty thousand dong)*

C. Cost accounting after four months of culture:

Estimated profit: VND 55,250,000 – VND 42,425,000 = VND12,825,000

*(Twelve million, eight hundred and twenty-five thousand dong)*

## V. Evaluation of the pilot model after 6 months of culture

**\* General evaluation:**

After four months of culture, the pilot model has the potential on the productivity and the survival rate as well as growth rate. Beneficiaries followed strictly technical procedures provided by technical staffs.

**\* Evaluation of the implementation process:**

The pilot model was carried out according to the plan.

**\* Evaluation on environmental impacts:**

- The environmental condition was suitable for fish growth. During the farming process, environmental parameters did not change remarkably; fishes developed and there were no signs of disease infection caused by the environment.

**\* Evaluation on the growth development**

- After three months of culture, fishes and tiger prawn developed well.
- Fishes developed normally during the first and second months.
- From March on, the weather was cool and pH was stable so tilapia and tiger shrimp developed faster.

**\* Evaluation on the socio-economic meaning:**

- Contributing to creating the source of high-economic valued food for people and enable farmers to improve their household economy.

- The pilot brought about the economic efficiency and helped local fish farmers to invest in and speed up the farming of new species in the locality.
- The good consumption market would encourage the farmers to make more investment, making use of the idle labor force in the locality to improve the economic life for the family and society.

## **VI. Conclusion and Proposal**

### **1. Conclusion:**

The pilot of tilapia net enclosure culture in the shrimp ponds in Quang Cong and Quang Ngan communes enable fish farmers to understand the techniques and apply them successfully in their production to limit the disease risks in the polluted shrimp farming, bringing about the economic efficiency, opening a new direction and creating more job opportunities, contributing remarkably to the economic development and motivation for the farming movement in the locality.

The pilot has positive economic performance and opens a new tendency suitable for the local condition, encouraging the involvement of more farmers for expanding the pilot in the area.

### **2. Proposals:**

To expand the pilot to the whole province, requiring agencies of all levels pay due attention to the technical support and provision of tilapia in poor localities that have few opportunities to advanced science so that they can develop the fisheries farming in the locality