



INTEGRATED MANAGEMENT OF LAGOON ACTIVITIES IMOLA PROJECT II

A REPORT ON

EVALUATION OF ECONOMIC EFFICIENCY AND ENVIRONMENTAL IMPACTS OF POLYCULTURE OF RED TILAPIA, NILE TILAPIA AND MULLET IN A POND

Hoang Van Minh Chau

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PEOPLE'S COMMITTEE OF THUA THIEN HUE PROVINCE



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AND ENVIRONMENTAL IMPACTS
OF POLYCULTURE OF RED TILAPIA
NILE TILAPIA AND MULLET IN A POND**

Written by
Hoang Van Minh Chau

Fisheries Extension Centre
Department of Fisheries of Thua Thien Hue province

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PART I: SUMMARY

1	<i>Name</i>	Polyculture of Nile tilapia, red tilapia and mullet in a pond
2	<i>Venue</i>	Village 3, Dien Hai commune, Phong Dien district, Thua Thien Hue province
3	<i>Funding agencies</i>	<ul style="list-style-type: none"> • Fisheries Extension Center of Thua Thien Hue • IMOLA Project
4	<i>Pilot farmer</i>	Cao Huu Trung
5	<i>Technical staff</i>	Hoang Van Minh Chau
6	<i>Time</i>	<ul style="list-style-type: none"> • 01/2008 – 08/2008
7	<i>Pilot objectives:</i>	<ul style="list-style-type: none"> • To diversify the farming types • To diversify the suitable cultured species for the area • To improve the environmental condition for the tiger shrimp culture that was not fruitful in the previous crops
	<i>Specific objectives</i>	<ul style="list-style-type: none"> • Carrying out the polyculture of red tilapia, Nile tilapia and mullet in a pond; • Monitoring environmental parameters such as pH, temperature, depth and salinity and so forth; • Monitoring the growth and survival rate of fish; • Cost accounting; • Evaluating the economic efficiency and environmental impacts on the pond conditions; • Finalizing lessons learnt and disseminating the pilot.

Plan vs. Outcomes

A species in the model was changed from white-spotted rabbit fish to red tilapia due to prolonged low salinity in the pond.

No.	Criteria	Required outline			Outcomes		
		Nile tilapia	Mullet	White-spot rabbit fish	Nile tilapia	Mullet	Red tilapia (replacing white-spot rabbit fish)
1	Scale (m ²)	5,000			5,000		
2	Stocking quantity (units)	7,500	2,500	25,000	7,500	2,000	1,500
3	Density (units/m ²)	5	0.5	5	5	0.5	0.33
4	Fingerling size (cm)	4-6	8	1	4-6	8-12	4-6
5	Survival rate (%)	60	50	40	58	40	70
6	Feed conversion ratio	2			1.5		
7	Productivity (kilo)	1,350	250	250	1,087	100	147
8	Average weight (g/unit)	300	200	50	250	100	140
9	Productivity (tons/ha)	3.7			2.668		

Evaluation of the pilot implementation:

The implementation process faces some difficulties as follows:

- The stocking was behind the schedule (late March-early June) due to the long lasting cold weather condition. Many hindrances occurred and prevented the productivity to reach the original target.
- The source for natural collection of mullet was difficult to find. In addition, the salinity in the pond was low (0-3ppt), which delayed the growth of mullets.
- Until May 2008, the salinity in the pond was still too low and white-spot rabbit fishes could not be stocked. Red tilapia was the replaced target.
- After 5 months of culture, the results have claimed the economic efficiency and environmental impacts of the polyculture pilot.
- Over the implementation process, Nile tilapia and red tilapia grew well and were suitable for the local environment.

Some lessons learnt:

- The polyculture of many species should be selected to have higher economic performance
- The selection of the targets and stocking density should be suitable with the environmental features and seasonal characteristics in the region.
- It is possible to claim that these are the suitable targets for the environmental conditions of the locality with the suitable temperature of 22 – 32oC, pH from 6.5 – 7.5 and water depth of 1 – 1.5 m.
- Seasonal calendar in Hue should be early March for stocking and late August for harvest.

- The quality of the fingerlings has a very important meaning: good fingerling centres should be selected for purchasing the fingerlings. For mullets, it is better to choose bluespot mullet (cá đốm còi) and avoid using mullets caught by electric gears or by gill net (lưới rê).
- The major feed is industrial feed. In addition, during the farming process, it is necessary to utilize bran, duck weed and cattle manure as supplementary feed to reduce the operation cost. However, it is necessary to use a moderate amount of feed. On one hand, this will help fish to grow fast and on the other hand, fish will use sediment organic humus in the pond to improve the pond environmental condition.
- Technical procedures should be efficiently carried out: proper feeding, periodical water replacement and vitamin and dietary minerals supplements. These will help to improve the crop outcome.

PART II: MAIN REPORT

I. Background

For the past years, the tiger shrimp culture in Dien Hai, Phong Dien district has been facing impediments due to the increasing pollution of lagoon and ponds while the investment capacity of farmers is ever more limited. Consequently, the selection of new targets to introduce to the culture is a requirement of most local farmers to improve the economic efficiency and at the same time, upgrade the pond environmental condition.

To understand such a requirement, the Centre for Agriculture, Forestry and Fisheries Extension of Thua Thien Hue in collaboration with IMOLA project conducted a pilot model namely “the Polyculture of red tilapia, Nile tilapia and mullet in a pond” in Dien Hai, Phong Dien, Thua Thien Hue province.

As the characteristics of these species is to consume the phyto-plankton, zoo-plankton and organic humus, the adaption of these targets will contribute to the pond environmental improvement.

The pilot was deployed with the aim to help beneficiaries and other farmers understand more about the polyculture techniques, have good lessons learnt and adopt them more effectively.

II. Overview

1	<i>Name</i>	Polyculture of Nile tilapia, red tilapia and mullet in a pond
2	<i>Venue</i>	Village 3, Dien Hai commune, Phong Dien district, Thua Thien Hue province
3	<i>Funding agencies</i>	Fisheries Extension Center of Thua Thien Hue and IMOLA Project
4	<i>Pilot farmer</i>	Cao Huu Trung
5	<i>Technical staff</i>	Hoang Van Minh Chau
6	<i>Area</i>	5,000 m ²
7	<i>Stocking density</i>	7 units/ m ²
8	<i>Pilot objectives:</i>	<ul style="list-style-type: none">• To diversify the farming types• To diversify the suitable cultured species for the area• To improve the environmental condition for the tiger shrimp culture that was not fruitful in the previous crops
9	<i>Specific objectives</i>	<ul style="list-style-type: none">• Carrying out the polyculture of red tilapia, Nile tilapia and mullet in a pond;• Monitoring environmental parameters such as pH, temperature, depth and salinity and so forth;• Monitoring the growth and survival rate of fish;• Cost accounting;• Evaluating the economic efficiency and environmental impacts on the pond conditions;• Finalizing lessons learnt and disseminating the pilot.

III. Outcome

No.	Criteria	PLAN			Outcomes		
		Nile tilapia	Mullet	White-spot rabbit fish	Nile tilapia	Mullet	Red tilapia (replacing white-spot rabbit fish)
1	Area (m ²)	5,000			5,000		
2	Stocking quantity (units)	7,500	2,500	25,000	7,500	2,000	1,500
3	Density (units/ m ²)	1.5	0.5	5	5	0.5	0.33
4	Fingerling size (cm)	4-6	8	1	4-6	8-12	4-6
5	Time (month)	5	4	4	5	4	3
6	Survival rate (%)	60	50	40	58	40	70
7	Feed conversion ratio	2			1.6		
8	Productivity (kg)	1,350	250	250	1,087	100	147
9	Average weight (g/unit)	300	200	50	250	100	140
10	Productivity	3.7			2.668		

IV. Monitoring

- Monitoring environmental parameters by using tests or measuring equipment
- Monitoring growth rate: by weight and length measurement of 10-20 fishes randomly caught from the pond
- Nursery and care taking: monitoring the growth rate and the capacity of using fish feed to adjust the feed amount.

V. Timeframe

Period	Procedure
01/2008 - 02/2008	Survey, household selection and pond improvement
03/2008	Stocking of Nile tilapia
03/2008 - 05/2008	Stocking of mullet
6/2008	Stocking of red tilapia
04/08 - 08/2008	Culture and care taking
08/2008 - 09/2008	Checking, harvest, workshop and report writing

VI. Procedure

a. Pond preparation

- The pond has the area of over 5,000 m² and the depth of 1.2 to 1.5 m;
- Drying the pond, harvesting all fishes and cleaning the pond;
- Repairing the pond dyke and water sewers
- Using the lime to stock over the pond with the amount of 5 kilos/ 100 m²;
- Drying the pond for 7 days (for ponds that can not be exposed under the sun, it is better to use Saponin with the amount of 10 g/m³ to kill the predators);
- Pumping the water in to the pond to the level of 1.2 to 1.5 metres; after that, stock the muck with the amount of 20-30 kilos/ 100 m².
- After 7 days, we checked the environmental parameters to start the stocking of fingerlings

b. Fingerling selection and stocking

* Fingerling selection:

- Selection of good agencies
- Selection of fish of the same size, good colors, prolonged body, no injuries and diseases
- For mullet, this species should be collected from the nature (because the growth rate is fast). Fishes are collected from the locality to avoid the shocks to the environment once they are introduced into the culture environment.

* Fingerling transportation:

- Fishes are stored in the nylon oxygen bags transported to the farming pond in the early morning;
- Fingerling stocking: Fingerlings are stocked in the early morning. Fishes are sunk in the pond for between 15 and 20 minutes. After that, the basket mouths are opened to let the water in and lowered to allow fish to gradually swim out of the bags.
- If the bags are collapsed during the transportation, the stocking should take less time.

c. Care taking and management

* Feed:

- Direct feed: During the farming process, industrial feed was mainly applied in addition to rice bran, wolffia (bèo tấm), seaweed and agricultural by-products.
- Indirect feed: Rotten muck was stocked to the pond every ten days to create the natural feed source.

* Feeding technique:

- Feeding time: feed is divided into two parts; in the morning, at 7 or 8 o'clock and in the afternoon at 5 o'clock. After every 10 days, feed should not be delivered to fishes to encourage their temptation to appetite and increase the consumption of natural feed in the pond.

* Feeding amount:

- Industrial feed is used for fishes with the weight of less than 100 g and ratio of 5 – 10 % of the fish school weight. This ratio is increased to 100-400 g with the ratio of 2 – 5 % of the fish weight.
- In addition, during the farming process, feed such as rice bran, green vegetables and agricultural by-products were used. Every 10 days, rotten muck was applied with the amount of 10 kilos/ 100 m². However, if the water color is bad and the transparency is less than 20 cm, muck should not be used any longer.
- Nevertheless, the ability of feed consumption also depends on the environment and fish health so it is necessary to monitor to adjust feed amount.

* Water replacement: It is unnecessary to replace water in the first month. Only add some amount of water so that the water level will rise to 1 m. From the second month on, it is necessary to observe the water color for replacement. When it is not nice and the transparency is lower than 30 cm, 30 % of the water in the pond should be replaced. In case the fishes' heads float in the morning and their low reaction to noise lasting for many days, replacement of water should be done more regularly.

* Fishes are daily watched so that fish symptoms can be explored to have prompt treatments.

* Every ten days, fishes are checked every ten days to identify their growth rate and development.

* Periodically 7 days, environmental parameters such as pH, temperature, transparency, NH₃ and salinity should be checked to have the best measures.

d. Disease prevention and treatment

* Prevention: synthetic measure

- Pond preparation following the technical procedure
- Selection of good fingerlings and no disease germs
- Stocking density suitable with the investment capacity and technical procedure
- Feeding fish with sufficient quality and quantity, adding vitamin C to increase fish resistance to diseases.
- Efficiently monitoring the pond water.

VII. Implementation outcomes

Fingerlings were stocked at different periods: Nile tilapia was stocked in March 2008 with 7,500 units and size of 4 – 6 cm and survival rate of 98 %. Mullet was stocked in April-May 2008 with 2,000 units and size of 8-12 cm and survival rate of 80 %. Red tilapia was stocked in June 2008 with 1,500 units and size of 4-6 cm and survival rate of 97 %.

During the farming process, environmental parameters are regularly monitored.

Table 1: Average environmental parameters in the farming months

No.	Criteria	Month 1	Month 2	Month 3	Month 4	Month 5
1	Water temperature (⁰ C)	27	28.5	29.5	30	30.5
2	pH	6.8	7.0	7.0	7.0	7.3
3	Water level (m)	1.1	1.3	1.2	1.3	1.3
4	Transparency (cm)	60	50	40	40	35
5	Salinity (‰)	0	0.5	1	2.5	3
6	NH ₃ (mg/litre)	0.009	0.009	0.01	0.01	0.01

Comments:

- Environmental parameters during the farming process in fact lie in the suitable range for species growth and development. Nevertheless, the salinity is low over a long period so white rabbit fishes were not stocked as planned in the draft.
- Water temperature fluctuates over the months from 27 – 32°C.
- pH ranges from 6.8 – 7.7 with the water level of 1.0 – 1.6 m suitable for fish development. The temperature ranges over the month between 27 and 32°C.
- pH from 6.8-7.7 with the water level of 1.0 – 1.6 m and suitable for fish development. The venue for the pilot has a convenient drainage system so the farming process is constantly changed according to the demand. The pond water should be clean and has a transparency of 30-65 cm.

Table 2: Monitoring the growth rate, survival rate, average weight, total weight and percentage over the testing periods.

Testing date	Weight (unit/kg)			Survival rate (%)	Fish weight (kg)	Feed weight (% of fish weight)	Used feed weight (kg)
	Nile tilapia	Mullet	Red tilapia				
31/3/08	250			95	28		30
08/4/08	150			90	45		65
21/4/08	50			80	120		170
06/5/08	30	130		78	205		280
15/5/08	20	100		75	295		430
26/5/08	17	80		72	340		470
5/6/08	13	60	200	72	455		610
16/6/08	10	50	150	70	540		820
25/6/08	8.8	41	100	68	600		955

04/7/08	8	35	60	68	682		1,165
15/7/08	7	29	41	58	760		1,267
25/7/08	6	23	23	58	810		1,400
05/8/08	5.2	18	17	58	958		1,558
18/8/08	4.5	14	11	56	1,120		1,710
29/8/08	4	10	7	56	1,334		1,948

Over the monitoring process, though technical procedures were strictly followed, fish growth and development was still slow because the quality of fingerlings was not ensured. Nile tilapia; in the beginning period, grew fast; however, the growth speed was slowed down. For mullet, this species was captured from the nature so the size of fish was not the same and the survival rate was low.

Table 3: Summary of industrial feed and rice bran assumed by fishes

No.	Feed type	Feed amount (kg)
1	Rice bran	500
2	Industrial feed	1,448
Total		1,948

VIII. Disease prevention

* Disease prevention: prevention measurements have been figured out.

* Treatment: during the farming process, hemorrhage occurred in Nile tilapia with the symptoms including fish swimming sluggishly in the water; small hemorrhage spots appeared on fish bodies; serious hemorrhage on gill and anus as signals for serious infection; fish lose or stop appetite. The disease agent is *Pseudomonas* sp. Treatment: oxytetracycline added to feed with the dose of 6 g out of 1 kg of feed; in addition, vitamin C (2-6 g/ kilo) can be added to the feed to treat the disease.

IX. Harvest

- Partial harvest of Nile tilapia was conducted with the weight of 250 g/ unit.
- Other species were harvested to avoid the flood season. Red tilapia and mullet did not reach the commercial size so the price was low.

X. Cost accounting

1. Direct cost:

Pond preparation	1,500,000 VND
Fingerlings:	
+ Nile tilapia:	4,500,000 VND
+ Mullet:	2,000,000 VND
+ Red tilapia:	1,250,000 VND

Feed: + Industrial feed: + Rice bran:	10,900,000 VND 2,500,000 VND
Disease prevention:	1,000,000 VND
Depreciation (pond and equipment):	500,000 VND
Care taking	1,000,000 VND
Total: (In words: Twenty-five million, one hundred and fifty thousand dong)	25,150,000 VND

2. Cost accounting:

No.	Targets	Survival rate (%)	Size (g/unit)	Productivity (kg)	Unit price (VND)	In money (VND)
1	Nile tilapia	58	250	1,087	20,000	21,740,000
2	Mullet	40	100	100	50,000	5,000,000
3	Red tilapia	70	140	147	20,000	2,940,000
	Total			1,334		29,680,000

Total earning: 29,680,000 VND

In words: Twenty-nine million six hundred and eighty thousand dong.

Profit = Total revenue – total expenditure = 29,680,000 – 25,150,000 = 4,530,000 VND

(In words: Four million five hundred and thirty thousand dong)

XI. Evaluation

Some impediments occur during the implementation process:

- The stocking was behind the schedule due to the long-lasting cold weather. The productivity was not as high as planned in the draft.
- In May 2008, the salinity in the pond was still low so it was impossible to stock white-spot rabbit fishes and red tilapia was the replacement species.
- Nevertheless, after 5 months of culture, the economic efficiency and environmental impacts have claimed the effectiveness of the polyculture pilot.
- The implementation of the pilot shows that Nile tilapia and red tilapia grow and develop well and are the suitable species for the local environment.

XII. Socio-economic significance

** Economic meaning:*

- The productivity was 2.668 tons/ ha and profit was 9 million VND/ ha show that the outcome was high compared with the tiger prawn farming in the past years in the area, contributing to mounting the income for the beneficiaries.

** Social meaning:*

- The visit and learning of farmers in the adjacent region on this pilot model was quickly expanded; pre-pilot training and preliminary workshop are implemented. Therefore, this polyculture pilot and conference have had good impacts on the selection of culture species that are suitable with the local environmental conditions. This helps to create more job opportunities for farmers, increase livelihoods and contribute to poverty reduction and hunger alleviation. In addition, a large amount of fresh feed was produced in the society and helps to improve the livelihood of the community.
- Almost no chemicals and antibiotics were used in the polyculture, which reduced the impacts of aquaculture on the environment and lagoon.

** Potential for expanding the pilot:*

- The inability to reach efficiency in tiger prawn culture in the past years in the locality in contrast with the efficiency from the polyculture will encourage the polyculture selection of farmers in the years to come.

** Difficulties:*

- With the weather and topographic conditions of the region, only one crop per year was practiced, normally between March and September.
- The consumption market for commercial fish was limited, mainly at the local market and unstable price.
- In contrast, local people were not used to red tilapia consumption. If this species is stocked in a large scale, there must be a good consumption market.
- Regarding mullets, they were mainly collected from the nature so the survival rate was low and the growth rate was not good.

XIII. Conclusion and proposal

** Conclusion:*

Many lessons learnt have been drawn from the reality:

- It is better to select many species for the polyculture to have higher economic efficiency.
- With the local environmental and seasonal conditions and characteristics, it is necessary to select the suitable targets and stocking density.
- It is possible to claim that this is the culture targets suitable for the local climatic conditions with the appropriate temperature of between 22 – 32°C, pH between 6.5 – 7.5 and water depth between 1 – 1.5 m.
- Seasonal calendar in Thua thien Hue province: early March for stocking and late August for harvest.

- The quality of fingerlings have an important role to play: it is necessary to select prestigious agencies and centers. For mullets, they should be from the natural capture and it is advisory not to choose mullets harvested from electric fishing or gill net.
- The major feed source is industrial feed. In addition, during the farming process, it is necessary to add rice bran, duckweed and muck to reduce the operation cost. Nevertheless, fishes should be given a moderate amount of feed to help them grow well and enable them to use the sediment humus in the pond to improve the pond condition.
- Technical procedures should be efficiently carried out: proper feeding, periodical water replacement and vitamin and dietary minerals supplementary. These will help to improve the efficiency for the crop.

****Proposals:***

- The market for species such as Nile tilapia and red tilapia will be a challenge if we culture them in a large scale. If the market for these species is no more a hinder, it will be a big encouragement for the farmers.
- Local agricultural by-products should be made use of to reduce the feeding cost.
- Grass carps should be stocked with a low density because the source of seaweed in the locality is abundant.
- Mullet should be gathered by the time of farming.
- Other species should be introduced for piloting to diversify the products, especially those that have high economic values such as climbing perch. Moreover, it is also good to pilot the rice field fish culture in the locality.