INTEGRATED MANAGEMENT OF LAGOON ACTIVITIES
IMOLA PROJECT II

A REPORT ON

EVALUATION OF ECONOMIC EFFICIENCY AND ENVIRONMENTAL IMPACTS OF POLYCULTURE OF GIANT TIGER PRAWN, MULLET, ORANGE-SPOTTED RABBITFISH, CRABS, AND SEAGRASS IN AN EARTHERN POND

Nguyen Thi Xuan Hong

Hue, 03/2009

PEOPLE'S COMMITTEE OF THUA THIEN HUE PROVINCE

A REPORT ON

EVALUATION OF ECONOMIC EFFICIENCY AND ENVIRONMENTAL IMPACTS OF POLYCULTURE OF GIANT TIGER PRAWN, MULLET, ORANGE-SPOTTED RABBITFISH, CRABS, AND SEAGRASS IN AN EARTHERN POND

Written by
Nguyen Thi Xuan Hong

Hue University of Agriculture and Forestry

03/2009

TABLE OF CONTENT

I. BACKGROUND

In line with the economic development, good steps have been made in aquaculture. Fisheries development has been considered one of the key economic sectors in the national economic development strategies, contributing to generating job opportunities for the majority of coastal fishermen, bringing about their increased income and a good source of foreign currency for the nation.

However, tiger shrimp farming has been overdeveloped; it has gone beyond the management and monitoring ability of relevant agencies. The massive death of shrimps, environmental pollution, and disease outbreak has resulted in the great loss affecting the shrimp farmers. Shrimp farmers of Thua Thien Hue province were of no exception. In 2002, most shrimp farms were affected by diseases, causing remarkable loss to the farmers and aquaculture of Thua Thien Hue province.
Recently, to limit the shortcomings of the tiger shrimp farming and increase the performance aquaculture performance, lots of new scientific and technological activities have been applied such as the polyculture or rotational culture. Polyculture is the model suitable for the farming area with the average investment and limited number of ponds and enables farmers to make use of the feed source in the ponds and get rid of effluents. In recent times, the Fisheries Extension Center of Thua Thien Hue Province has conducted many pilot polyculture models. Besides, some polyculture pilot models have been carried out in a sustainable manner; they are able to improve the environmental condition and conducted by projects on the Thua Thien Hue lagoon study such as IMOLA Project and some ministerial and provincial ones. Certain outcomes have been observed.

The biggest trouble in the polyculture model development is the inability to build models that can represent for different small ecological zones to find out the appropriate models that can be duplicated for the local people. Upon the practical needs and assistance from IMOLA project the polyculture model namely “Evaluation of the economic performance of polyculture of giant tiger prawn, white-spotted rabbitfish, mullet, seagass and crab” has been carried out.

The objectives of the pilot model are:

- To build an effective polyculture model that is sustainable and suitable with the natural conditions of Huong Phong commune.
- To diversify the culture species in aquaculture, particularly in shrimp ponds.

II. RESEARCH CONTENT AND METHODOLOGY

2.1 Research content

2.1.1 Evaluation on the economic performance of the model

The revenue and profit of the model have been evaluated. The growth and survival rate of shrimps in the polyculture pond was compared with that of the monoculture pond.

2.1.2 Evaluation of the environmental impact of the model

Environmental factors in the pond have been monitored, including temperature and amount of dissolved oxygen, pH, salinity, alkalinity and NH_3.

2.2 Research methodology

2.2.1 Data aggregation method

Preliminary data was collected through the interview or via the direct involvement of staffs in the model construction with the local people. Secondary data was aggregated through the local-based data, Department of Fisheries, libraries of schools, newspapers and websites and so on.

2.2.2 Experiment allocation method

The experiements were conducted in two ponds: one treatment and one control ponds. In the treatment pond, giant tiger prawn, white-spotted rabbit fish, mullet and crab were cultured. In the control pond, only giant tiger prawn was cultured with the area of 4,000 m^2 with similar conditions. The density of 12 units/m^2 was applied in the control pond with fingerling size of 2-2.5 cm. The stocking density in the treatment pond was as follows:

Table 1 Stocking detail fo the treatment pond

Species	Stocking density (unit/m^2)	Size of the stocked species	
		Length (cm)	Weight (g)
Tiger prawn	9	2 – 2.5	0.25
Green crab	0.25	1.0	0.2
White spot rabbit fish	1.0	2-3	1.2 – 1.3
Mullet	0.5	8 – 10	8 – 10

Care taking and monitoring:

Shrimps were stocked in the pond after pond preparation. 15 days later, fishes were stocked, then crabs. The water was periodically added (water should be added before environmental parameters are taken). Good care was taken of shrimps in the two ponds with the same level.

The method for monitoring growth rate of culture species:

The samples were collected every 15 days to monitor the growth rate of the culture species. 30-40 samples were collected for each pond at every monitoring. The samples were weighed (g/unit) and measured (cm/ unit).

2.2.3 Method for evaluating the model economic performance

Evaluation of the revenue of the model:

Net profit = total income – total expenses

Evaluation of the profit of the model:

Profit (net income) is the money remained after subtracting the total expenses from the total revenue (including the fixed cost and mobile cost).

Profit = (total income + remained cost) – (total expenses + preliminary value + depreciation)

2.2.4 Data treatment method

Collected data was treated on the Excel software based on the biological statistic method.

III. OUTCOME AND DISCUSSION

3.1 Evaluation of the economic performance

The economic performance of the two culture pilots are shown in Table 2.

Table 2 Summary of the economic performance of the two culture pilots models

Criteria	Monoculture ($4000m^2$)	Polyculture ($4000m^2$)
I. Total expenses	**27,273,000**	**30,856,000**
Pond improvement cost	2,700,000	2,500,000
Shrimp fingerlings	2,020,000	1,400,000
Mullet fingerlings	0	1,000,000
White-spot rabbit fish fingerlings	0	200,000
Crab seeds	0	1,200,000
Feed cost	17,397,000	19,060,000
Materials – manure	2,656,000	2,496,000
Labor force	2,500,000	3,000,000
II. Total income	**31,503,000**	**37,385,000**
Tiger shrimp	31,503,000	20,000,000
Mullet	0	9,440,000
White-spot rabbit fish	0	1,365,000
Crab	0	6,580,000
Glacilaria	0	0
Profit = II – I	**4,230,000**	**6,529,000**

The economic performance of the polyculture pond was higher than that of the monoculture. The profit per ha of the polyculture model is 16,322,500VND/ha. This is a high profit compared with the other conducted production activities such as agriculture and husbandry. However, the investment level around 30 million dongs/4,000 m^2 will be a big investment and is beyond the economic ability of many farmers. Therefore, they have to get a loan from the bank or private renders to be able to invest in their production. In addition, they often have to get fingerlings and feed from creditors in the commune. For this reason, at the harvest time, their products are normally sold to middlepersons assigned by those companies with lower price than in the market. This is the reason that reduces the profit margin of culture activities.

However, given the current difficulties of the shrimp culture, polyculture is an important orientation, contributing to income increase and livelihood improvement. In the meanwhile, the monoculture of shrimps does not bring about high economic performance and involve high risks.

3.2 Evaluation of environmental changes

In general, environmental parameters of the treatment and control ponds are in the suitable threshold for culture species, and there were no big differences between these in the two ponds.

The little variation would be due to the impact of the water source and exterior environmental factors.

Temperature:

The fluctuation of temperature in the experiment ponds is not remarkable; the fluctuation ranges between 24 – 35^{o}C. This is the optimal level for the cultured species. The season calendar of this year is later than that of previous years due to the inconvenient conditions (lasting coldness). Therefore, the culture season drops to the dry season. Sometimes the temperature goes up to 34-35^{o}C. However, the time period when the temperature is high does not take long; that's why it does not have much impact on the growth and development of cultured species.

pH:

The results from the experiment ponds show that the changes of pH are unremarkable and lie in the suitable threshold of the cultured species in both ponds. The difference of pH is noticeable but significant. As glacilaria grows naturally in the pond so the photosynthesis of this species absorbs CO_2 and increase pH.

Salinity:

During the culture period, the salinity ranges from 7 to 21 ‰, and on average from 13 to 14 ‰. This is the suitable salinity range for the culture species. During the time when the experiment is conducted, salinity in the pond decreases suddenly; occasionally due to the heavy rain (occasionally to 7 ‰). This is not an optimal salinity range for the development of cultured species; especially has increased the mortality rate of fishes. There is no difference of the salinity in the monoculture and polyculture ponds.

Alkalinity:

The alkalinity in the experiment ponds ranges from 56 to 126 mg $CaCO_3$/ l, on average 94.73 mg $CaCO_3$/l. In general, the value of the alkalinity lies in the suitable range for the cultured species. At times, the alkalinity does not decrease in line with the rule. The reason is due to heavy rain and farmers can not drain water in the pond.

NH_3

The amount of NH_3 during the research time is between 0.2 and 0.7 mg/l in the control pond, and that in the polyculture pond is between 0.1 and 0.3 mg/l. In general, the amount of NH_3 lies in the tolerant threshold of the shrimps and in the permissible limit for the shrimp pond.

The amount of NH_3 in the monoculture shrimp pond and polyculture pond is statistically different ($P<0.05$). This can be explained by the polyculture species (mullet, white-spot rabbit fishes and crabs) that consume the remained feed of shrimps. Besides, the amount of feed in the polyculture pond is less so the amount of Nitrogen decreases.

This result is in line with research results released by Nguyen Thi Xuan Thu (2003), Nguyen Thuc Tuan (2007) and Nguyen Ngoc Phuoc (2007).

Changes of NH_3 amount in the farming pond

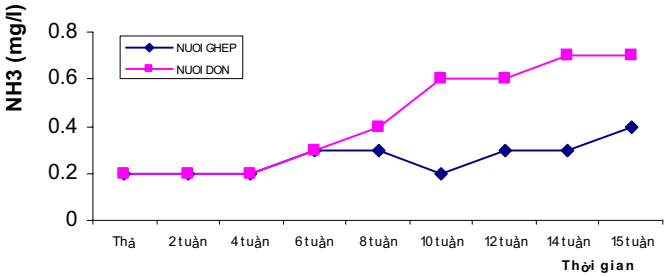

Figure 1 The change of NH3 in the pond

3.3 Growth rate of shrimps in the experiment ponds

Growth rate and length of shrimps are shown in Figure 2.

Shrimp growth rate in length

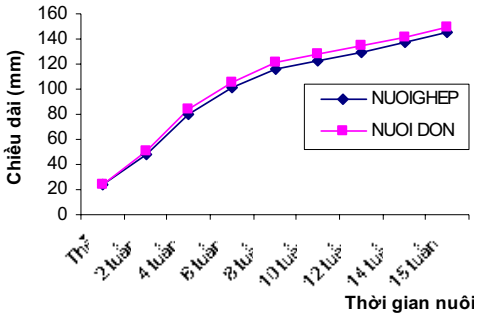

Figure 2 Shrimp growth rate in length

The graph shows that the growth rate in two ponds is not significantly different ($p>0.05$). In general, the growth rates of shrimps in the two ponds are quite good during 15 culture weeks.
The growth rate in weight is illustrated in Figure 3.

Shrimp growth rate in weight

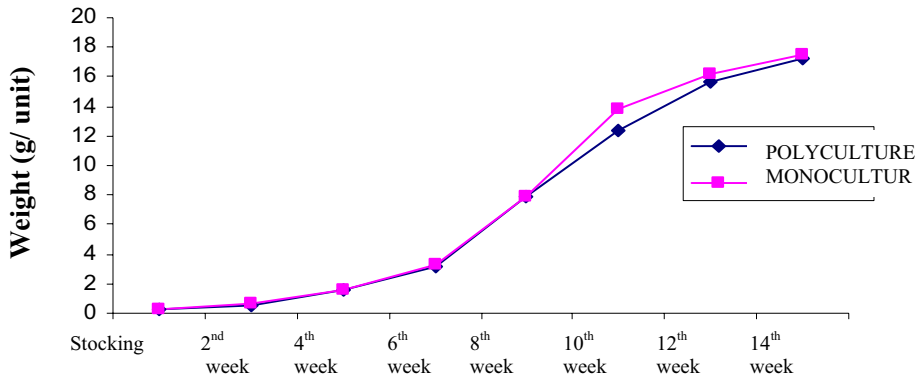

Figure 3 Shrimp growth rate in weight

Shrimp growth rate is periodic and depends on the nutrient and environmental condition, and the growth of microorganisms. In the first period, shrimps develop fast in length. Then the length speed slows down. Meanwhile, shrimp weight is slow at the beginning and faster in the later period. This goes in accordance with the development rule of creatures in general and tiger shrimp in particular.

Shrimp growth rate in the two ponds is quite good; 14 weeks after the culture time, the average weight is 17.2 g/ unit in the polyculture pond and 17.5 g/ unit in the monoculture shrimp pond. The comparison shows that growth rate of shrimps in two ponds does not show significant statistical difference ($p>0.05$).

IV. CONCLUSION

- The evaluation on the economic performance of the polyculture and monoculture ponds shows that the polyculture model brings about better economic performance.
- The polyculture does not change normal water parameters (temperature, salinity, and alkalinity). Only NH_3 is different between the two ponds. The polyculture has reduced the amount of NH_3 ($p<0.05$).
- Growth rates of shrimps in the two ponds were quite good. In the 14^{th} week, shrimps reach the average weight of 17.2 g/ unit in the polyculture pond and 17.5 g/ unit in the monoculture pond. The growth rate of shrimps in the two ponds is not much different ($p>0.05$).
- The survival rate of tiger shrimps in the polyculture pond reaches 68% after 14 months of culture. Meanwhile, it reaches only 57 % in the monoculture pond. This proves that the polyculture increases the survival rate of tiger prawn.

V. REFERENCES

1. Nguyen Phi Nam, experiment on the polyculture of some high economic value species that are able to improve the water condition in Thua Thien Hue province, Provincial thesis, 2007

2. Nguyen Tai Phuc, study on the aquaculture development in the coastal area of Thua Thien Hue province, Economics doctor thesis, 2005

3. Nguyen Thi Xuan Thu, research on seacucumber culture *(Honothuria scabra)* in the tiger prawn to improve the environmental condition; report on the scientific thesis of FSPS – SUMA component.

4. Research and agriculture development centre of Huong Phong commune, final report on the socio-economic development, national security and defense and directions as and socio-economic, national defense and security duties and responsibilities in years 2002 – 2003, 2003 – 2004, 2004 – 2005, 2005 – 2006, 2006 – 2007.