FINAL REPORT

Pilot title:

Analysis of economic outcome and environmental impact of the polyculture of grouper, white-spotted rabbit fish and red snapper in cages in Loc Binh Commune, Thua Thien Hue

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1. Background

Loc Binh is a mountainous commune of Phu Loc district, lying along Tam Giang lagoon with the water surface belonging to Cau Hai area. Therefore, the environmental condition varies a lot, especially in the flood and storm seasons. Nevertheless, the local people in the region still practice the brackish fish culture all the year round. The major cultured species depend on the fingerlings sources from the natural capture. The trash fish is used as the main feed source. From all this, the study of using industrial feed in culture has a significant meaning to improve the incomes for the fisherfolks and at the same time, reduce the environmental pollution risks for Thua Thien Hue lagoon.

2. Objective

- To establish the efficient cage culture of some brackish fishes with high economic value and fishes with available natural fingerling source such as grouper, red snapper and white-spotted rabbit fish for different pilot models including: monoculture of grouper and red snapper; polyculture of grouper and white-spotted rabbit fish; polyculture of red snapper and white-spotted rabbit fish.
- To create the condition for the people to improve their income from selecting the effective farming model and use the industrial feed source that is friendly with the lagoon environment.

3. Laborotary Design

- Cage design: the cage includes the frame, net and anchors. The frame is made of bamboo. The cage body is made of Polyten (synthetic string). Stones or concrete mass can be used as tying objects to fix the cage under the water.
- Experimenting on 4 cage pilots (cage with the size of 2 x 2 2.5 m and mesh size of 2a = 2 cm, located at the depth with the fluctuating water level of 1.5-2 m).
    - Pilot 1: monoculture of 120 groupers.
    - Pilot 2: polyculture (60 groupers + 180 white-spotted rabbit fish)
    - Pilot 3: monoculture of 120 red snappers
    - Pilot 4: polyculture (60 red snappers + 180 white-spotted rabbit fish)
- Stocking is started on August 14th 2007.
- Weight of cultured fishes:
    - Average weight of grouper: 36 g
    - Average weight of red snapper: 130 g
    - Average weight of white-spotted rabbit fish: 7.5 g

- Feeding: Starve fish after stocking for 2 days, and then make them familiar with industrial feed (for around 8 days). Feeding takes place twice everyday in the morning and afternoon. The daily feed amount is approximately 4-5 % of the fish weight.

4. Outcomes

4.1. Environmental parameters during the culture period

During the culture period, environmental parameters are frequently monitored at 2 p.m. The changes of environmental parameters are shown in the below table:

Table 1. Changes of environmental parameters during the culture period

Month	**Temperature (^{0}C)** $X_{TB} \pm m$	**pH** $X_{TB} \pm m$	**S‰** $X_{TB} \pm m$	**DO** $X_{TB} \pm m$
August	31,27 ± 0,44	7,76 ± 0,04	30,50 ± 0,60	5,80 ± 0,22
September	28,37 ± 2,19	7,64 ± 0,08	30,72 ± 0,47	6,95 ± 0,09
October	29,75 ± 0,37	7,38 ± 0,15	21,70 ± 3,40	6,71 ± 0,12
November	30,20 ± 0,42	6,76 ± 0,5	1,55 ± 0,16	6,66 ± 0,12
December	30,00 ± 0,47	6,89 ± 0,11	4,80 ± 1,67	6,62 ± 0,15
January	22,55 ± 1,76	7,03 ± 0,15	21,30 ± 1,12	6,61 ± 0,12
February	17,36 ± 0,55	7,73 ± 0,09	23,63 ± 0,63	6,58 ± 0,17

As the pilot models were conducted during the flood season, environmental parameters, especially salinity, usually fluctuates. For this reason, monitoring was done every month with 10-time frequency (except in August: 12 times and February: 5 times). During the monitoring period, we saw that the parameters in the cages were quite consistent. The fluctuations were shown as follows:

- pH: 6.4 -7.9
- S‰
    - From 15/8 to 23/10: ranges from 18 to 34,5‰
    - From 26/10 to 20/12: ranges from 0.5 to 2‰
    - From 21/12/2007 to 31/1/2008: ranges from 8 to 25‰
    - From 1/2 to 15/2/2008: ranges from 22 to 25‰
- Dissolved oxygen (O_2): ranges from 4.8 to 7.4mg/l
- NH3 was always below 0.01mg/l

After observing all the environmental parameters in the period of 15/8/2007 and 15/2/2008, we see that pH, dissolved oxygen and NH_3 lie within the suitable range for fish growth in general and the development of grouper, red snapper and white-spotted fish in particular. Only salinity showed great fluctuation. In the period from 26/10 to 20/12, the lagoon water seemed to be completely fresh (with salinity range of 0.5-2‰). This is the matter of concern for the species selection in the flood season. The temperature is low and enduring; however, the red snapper still develops well. This shows that the temperature did not have the great influence on this species.

4.2. Outcome of each pilot

4.2.1. Result of the monoculture of grouper and polyculture of grouper and white-spotted rabbit fish

The results of the two above pilots are shown table 2.

Table 2: Growth rate and survival rate of grouper and white-spotted rabbit fish

Period	Species	M_{TB} (monoculture) g	Survival Rate (%)	M_{TB} (polyculture)g	Survival Rate (%)
14/8/07	Grouper	36		36	
	White-spotted rabbit fish			7.5	
14/9	Grouper	90	91.1	90	100
	White-spotted rabbit fish			11	90
14/10	Grouper	150	83.3	153	100
	White-spotted rabbit fish			16.5	85.6
4/11	Grouper	202	70	205	70
	White-spotted rabbit fish				0
14/12	Grouper	235	1.67	240	3.3

As can be seen from table 2, the growth rates of grouper in both monoculture and polyculture pilots were remarkably fast. After 4 months of culture, fish reached the weight of 199g – 204 g. However; its adaptability to the water freshness must be considered. According to the fishermen in the lagoon, grouper still survives in the freshness condition. Nevertheless, if this condition lasts too long, they will die. From our research results, growth rate of grouper is at 70 % if the freshness lasts for 8 days. This rate reduces to 2 – 3 % if the freshness extends to 48 days. This is also true for all the groupers in the cage culture conducted by fish farmers in Tam Giang lagoon. In the meanwhile, white-spotted rabbit fish has a rich natural fingerling source. Additionally, they feed in aquatic vegetation and humus so they are the ideal species for the polyculture. However, its adaptability to the salinity is very low. This shows clearly on the monitoring date of November 4th when the fishing survival rate is only at 0%.

4.2.2. Result of the monoculture of grouper and polyculture of grouper and white-spotted rabbit fish

The result is illustrated in table 3.

Table 3: Growth and survival rate of grouer and white-spotted rabbit fish

Period	Species	M_{TB} (monoculture) g	Survival Rate (%)	M_{TB} (polyculture)g	Survival Rate (%)
14/8/07	Red snapper	130		130	
	White-spotted rabbit fish			7.5	
14/9	Red snapper	210	100	210	100
	White-spotted rabbit fish			11.5	91.1
14/10	Red snapper	300	100	308	100
	White-spotted rabbit fish			16.8	83.3
4/11	Red snapper	330	90	339	90
	White-spotted rabbit fish		0		0
14/12	Red snapper	360		367	90
14/1/08	Red snapper	425	90	430	90
14/2/08	Red snapper	500	90	508	90

As can be seen from table 3, the growth rate of red snapper when fed with industrial feed Cargill was quite fast from the fingerlings of 130 g/ unit after 6 culture months with the weight of 500-508g/ unit. There is no big difference of the growth rate between the monoculture and polyculture pilots. White-spotted rabbit fish normally dies early in the polyculture and partly because the above-mentioned stocking density does not influence remarkably on the growth. The growth speed of red snapper after 6 culture months is 90 %. This shows that red snapper has the ability to adapt to the freshness over a long period and low temperature. This result proves that red snapper is the suitable species for the culture over the year in Thua Thien Hue lagoon.

4.2.3 Feed conversion ratio and economic performance of the model

Among the 4 conducted pilots, the model of monoculture of red snapper has the highest performance. Therefore, we only count the food conversion ratio and the economic performance of the pilot.

Food conversion ratio:

Fish weight gained is 108 units x 0.5 kg = 54 kg.
Fish weight increase is 54 kg – 15.6 kg = 38.4 kg.
Amount of feed used for the monoculture of red snapper is 150 kg

Food conversion ratio is therefore 150/38.4 = 3.9. This means to gain one kilo of fish weight, 3.9 kilos of feed are required.

Economic performance:

Cost:

- Fingerlings: 120 units x 10,000 VND/ unit = 1,200,000 VND
- Cage cost: 500,000 VND/2 years = 250,000 VND
- Feed: 150 kilos x 10,000 VND/kg = 1,500,000 VND

Sales:

- Money from fish sale: 54kg x100,000 VND = 5,000,000 VND

If labor cost is excluded, the net profit from the monoculture of red snapper is 5,400,000 VND – 2,950,000 VND = 2,450,000 VND.

5. Conclusion

- It is advisory to apply the monoculture model of red snapper in cages. If the polyculture is considered, it is better to select species that are able to live in the freshness condition and in harmony with the red snapper to bring about profit.
- If one is interested in the monoculture of grouper, solutions must be made when the salinity happens over a long period.

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