PRELIMINARY STUDY OF FISH CULTURE IN ABANDONED SAND MINING POOL

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ABSTRACT

One of main problems in freshwater aquaculture development in Indonesia, especially in Java, is unavailability of developing zone. It is important to find an underutilized area that meets for industrial scale freshwater aquaculture, i.e. sufficient water supply, wide area, and located in one area or zone. The abandoned mining (sand, tin, etc.) pools distributed along the country might be the potential area for freshwater aquaculture business. For example, there are at least 13 water pools with total surface area of 250 ha at 15 km side of Citarum River in Karawang District (West Java Province). This study was conducted to obtain preliminary data about the prospect and potency of fish culture (tilapia, clariid catfish, and 'patin' catfish) in abandoned sand-mining pools in Karawang District. Mini floating net cages of 1 x 1 x 1.5 m^3 size were used for culturing fish, i.e. patin catfish (*Pangasianodon hypophthalmus*), nile tilapia (*Oreochromis niloticus*), and clariid catfish (*Clarias gariepinus*), separately. Patin catfish were stocked at a size of 2 g with a density of 300 fish per cage, tilapia were stocked at a size of 6 g with a density of 400 fish per cage, while the clariid catfish were stocked at a size of 1.4 g with a density of 980 fish per cage. A floating commercial feed (30%—32% protein, 3%—5% fat) was used at a daily rate of 9% biomass weight at the beginning and reduced gradually to 3% at the final culture period. Observed data showed that patin catfish grew from the initial size of 2.08 g to the final size 299.59 g in 5 months, nile tilapia grew from individual initial size of 5.92 g to the final size of 247.12 g in 14 weeks, and clariid catfish grew from initial size of 1.39 g to the final size of 73.10 g in 8 weeks. These three species were technically prospective for aquaculture development in the abandoned sand-mining pools.

KEYWORDS: abandoned sand-mining pool, fish culture

INTRODUCTION

One of main problems in freshwater aquaculture development in Indonesia, especially in Java, is unavailability of a developing zone. Consequently, it is difficult to develop an aquaculture industry, which integrates some fish farming and other related business units into one management level.

Abandoned sand-mining pools along 15-km-Curug-Walahar part of Citarum River in Karawang District (West Java, Indonesia) with the total area of 600 ha are still underutilized and potential for aquaculture development. Many similar reservoirs are spread through out West Java and other places in Indonesia. According to Krismono *et al.* (1998), the morphological characteristics of the abandoned sand-mining pools were sharp V-shape valley, narrow littoral zone, shallow water depth (4—12 m) with 1—2 m fluctuation, small catchments area, small draw-down, short shore line, elip or rectangular water surface shape and mostly located in the rural areas. Generally, the abandoned sand-mining pools have a moderate water quality, high availability of natural food either planktonic, benthic, or periphitic. The pH values of the bottom soil are around 4.5—7.8 representing a high level of macronutrient.

This study was aimed to obtain preliminary data about prospect and productivity of patin catfish, tilapia and clariid catfish in abandoned

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sand-mining pool in Rawabebek Reservoir in Karawang to develop aquaculture industry based on the responsible fisheries/ aquaculture principles.

MATERIAL AND METHOD

The experiment was conducted in Rawabebek Reservoir, an abandoned sand-mining pool located in Karawang District. The fish were cultured in small floating cages of 1 x 1 x 1.5 m with the mess size of 2 mm. The water depth in cages was 1 m.

Three fish species were selected for this study i.e. patin catfish (*Pangasianodon hypophthalmus*), tilapia (*Oreochromis niloticus*), and clariid catfish (*Clarias gariepinus*). Culture period applied in this study depended on the marketable size of each species. The patin catfish was cultured for 5 months, tilapia for 14 weeks and clariid catfish for 8 weeks.

The fish were fed with commercial floating feed with 30%—32% of protein, 3%—5% of lipid, 4%—6% of crude fiber and 5%—8% of ash. Daily feeding rate was 9% of total biomass at the beginning of culture period and was gradually decreased to 3% of total biomass at the end of the period.

Growth observation for tilapia and clariid catfish was conducted biweekly, while observation for patin catfish was conducted every month. The specific daily growth rate was calculated by the following formula:

$$SGR = 100\ [(\ln Wt - \ln Wo)/t]$$

(Wester, 2001)

where:

SGR = specific daily growth rate (%/day)
Ln = natural logarithm
Wt = final weight (g)
Wo = initial weight (g)
t = culture period (day)

Water quality parameters were generally observed biweekly, except daily maximum-minimum water temperature. Measurement methods for water quality parameters were detailed in Table 1.

Fish Stocking

The total and size of fish seed stocked in the cages were shown in Table 2. Numbers of stocked fish were calculated from the maximum carrying capacity or the expected production of the floating cage, i.e. 100 kg/m^3 (Schmitou, 1991).

RESULT AND DISCUSSION

Fish Growth and Production

Patin catfish

Patin catfish were cultured for 20 weeks (5 months). With initial size of about 2.08 g, the fish reached the final size of about 299.60 g (Figure 1). Specific daily growth rate of patin catfish in the cage was about 3.23% per day or equal to 1.93 g/fish per day. Yuliati *et al.* (1993) observed that patin catfish with individual size of 71.43 g grew at a rate of 1.1% per day or equal to 1.55 g/fish per day in floating cage. Bigger initial size at stocking results in slower

Table 1. Water quality parameters measurement methods

Parameters	Methods/ Equipments	Observation period
Water temperature (min-max)	Min-Max Thermometer	Daily
Transparency	Metric	biweekly
Chlorophyll-a	Spectrophotometry	biweekly
Dissolved Oxygen (DO)	DO-meter	biweekly
pH	pH meter	biweekly
NH_4, NO_2, NO_3	Spectrophotometry	biweekly
PO_4	Spectrophotometry	biweekly
Hardness	Titrimetric	biweekly
Free-CO_2	Titrimetric	biweekly

Table 2. Total number and size of the stocked fish in the cage

Species	Stocking individual weight (g)	Stocking density per cage
Patin catfish	2.0–2.17	300 fish
Tilapia	5.6–6.13	400 fish
Clariid catfish	1.3–1.45	980 fish

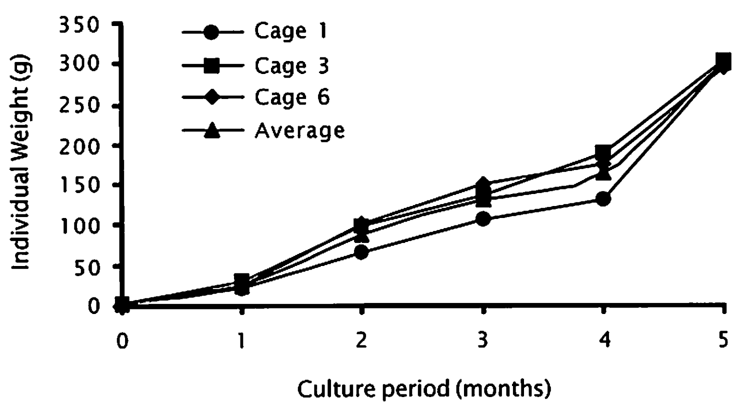

Figure 1. Individual growth rate of patin catfish (*P. hypophthalmus*) in the mini floating cage in abandoned sand-mining pool, Rawabebek Reservoir (Karawang District, Indonesia)

specific growth rate than that of smaller one. Generally, growth rate of fish decreases following fish age and size. With a smaller initial size, i.e. 20—22 g per fish, Umar *et al.* (2000) found that the specific growth rate of patin catfish was 3.33% per day or equal to 1.89 g/ fish per day for 55 days. In their natural habitat in Jatiluhur Reservoir, 5 km upper Rawabebek Reservoir, patin catfish grow at a rate of 1.18 g per day (Krismono, 2000).

Figure 1 also shows that growth of patin catfish tends to increase and have not reached its maximum rate meaning that patin catfish would proceed in a good growth if the culture period is extended to the point where the growth rate become negative.

The average production of patin catfish in the cage in Rawabebek Reservoir was 44,24 kg/m^3, almost one-half of the previous experiment, i.e. 84,96 kg/m^3 (Yuliati *et al.*, 1993). It inferred that the productivity of patin catfish culture in Rawabebek Reservoir have a potential to be enhanced, in line with the fact that the growth of patin catfish did not reach the maximum rate as shown in Figure 1. By the improvement of culture technology and management, production of patin catfish in Rawabebek Reservoir would be able to be raised up to the maximum carrying capacity of the cage, i.e. 100 kg/m^3 (Schmitou, 1991).

Tilapia

After 14 weeks culture period, tilapia with average initial size of 5.92 g grew to the final size of 247.12 g (Figure 2). The average of specific daily growth rate (SGR) was 3.81%/day, equaled to 2.46 g/day. This value was higher than that of tilapia cultured in pond, i.e. 0.35-0.45%/day (Mundriyanto, *et al.*, 1996). In previous experiment, Yunus & Jangkaru (1986) found that the male tilapia with initial size of 10.40 g grew to 302.65 g in the floating cage

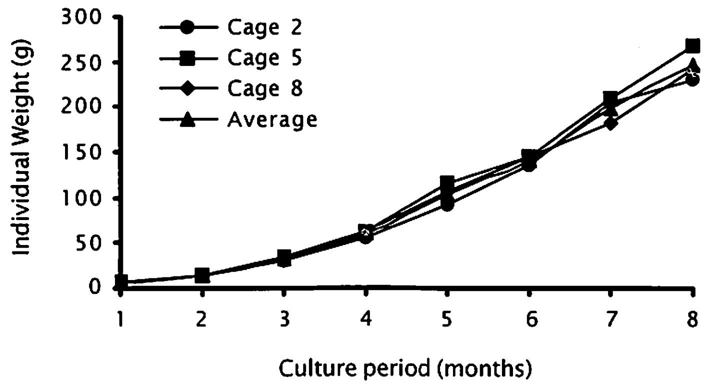

Figure 2. Individual growth of tilapia (*O. niloticus*) culture in floating cage in Rawabebek Reservoir, Karawang.

for 20 weeks. Its SGR was 2.09 g/day. With a bigger initial size, i.e. 25—40 g, all-male tilapia cultured in floating cage grew at a SGR of 1.26—1.51 g/day (Yuliati *et al.*, 1988; Yuliati *et al.*, 1989).

After the period of 12 weeks, mortalities of tilapia started to occur. It indicated that fish size and density seem to reach the critical or maximum level although the fish still can grow.

Tilapia production in cage was around 63.96—81.23 kg/m^3 with the average of 70,57 kg/m^3. This result was higher than that of the previous experiment i.e. 11.56 kg/m^3 (Yunus & Jangkaru, 1986). Ignoring the genetical quality of fish and culture management applied in this experiment, the result showed that Rawabebek Reservoir was suitable for tilapia culture in floating cage.

Clariid Catfish

The clariid catfish (*Clarias gariepinus*) were raised in the floating cage for 8 weeks with average SGR of 7.07%/day, equaled to 1.28 g/day. With average initial size of 1.39 g, the catfish grew to the average final size of 73.10 g (Figure 3).

Total production of clariid catfish ranged from 18.1 to 30.6 kg/m^3. High early mortality rate during adaptation period and cannibalism might be the main factor of low survival rate and its production as well. The average final size of clariid catfish was 70—75 g, close to the expected size of 100 g.

Clear water in Rawabebek Reservoir with transparency about 75 cm might trigger cannibalism of clariid catfish. Mortality of clariid catfish in this study was 56.94%—75.51%. This condition does not appear in pond culture system with turbid water (low transparency).

With improvement of its culture technique, e.g. the addition of suitable shelter and application of appropriate size grading, catfish production in the floating cage would be able to be augmented.

Water Quality

Generally, observed water quality parameters in the Rawabebek Reservoir especially at the top layer (less than 2 m) showed suitable value for fish life and growth (Table 3).

Although there was a channel to the Citarum River, it might be claimed that Rawabebek Reservoir was stagnant. Water temperature stratification did not exist. Stratification appeared with dissolved oxygen (DO) level in the water column. On the surface, dissolved oxygen water frequently rose beyond the saturation level (up to 10 mg/L) in the afternoon or dusk. However, at 3 m depth the DO level dropped to less than 1 mg/L. Based on the DO level, the most suitable layer for fish culture is the top 2 m layer.

It is important to consider this condition to decide the cage depth and fish species to be cultured. The depth of most common floating

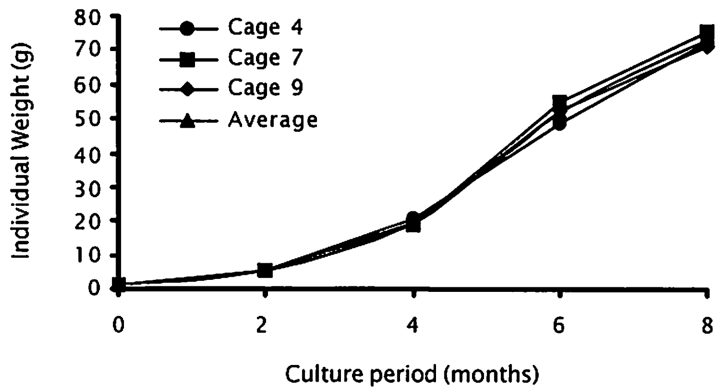

Figure 3. Individual growth of clariid catfish (*C. gariepinus*) raised in floating cage in Rawabebek Reservoir, Karawang

Table 3. Observed water quality parameters in Rawabebek Reservoir, Karawang

Parameters		Date of observations							
		31/7/02	14/8/02	28/8/02	10/9/02	9/10/02	23/11/02	5/11/02	26/11/02
Transparency (cm)		65	70	55	50	50	55	60	28
Chl-a (mg/m^3)		10.69	5.35	13.37	8.02	8.02	34.75	8.02	5.35
NO_2 (mg/L)		0.047	0.065	0.023	0.08	0.219	0.065	0.091	0.318
NH_4 (mg/L)		0.209	0.1	0.045	0.236	0.222	0.29	0.218	0.509
PO_4 (mg/L)		0.14	0.039	0.042	0.088	0.082	0.03	0.146	0.149
NO_3 (mg/L)		0.037	0.01	0.018	0.024	0.023	0.017	0.017	0.085
Hardness (mg/L)		38.3	74.4	74.4	74.4	91.46	63.81	70.19	76.572
pH		8.5	8.5	9.5	9.5	9.5	9	8.5	7.5
Free-CO_2 (mg/L)		3	1	0	0	0	0	3	5
DO 1-m (mg/L)	*Dawn*	6.8	5.15	5.6	5.86	12	8.5	5.67	na
	Dusk	9.2	9.5	8.3	8.61	17.9	13.3	8.1	4.91
Temperature 1-m (°C)	*Min*	28	28	27	25	28	27	30.5	26
	Max	30	30	30	30	29	31	33	30

Note: na = not available data

cage was about 4—7 m with the outer double floating cage is usually more than 7-m depth. This floating cage type is not suitable in Rawabebek Reservoir.

CONCLUSION

Patin catfish (*P. hypophthalmus*), tilapia (*O. niloticus*), and clariid catfish (*C. gariepinus*) -- with improvement of its culture technique -- were technically appropriate for aquaculture species in abandoned sand-mining pool in Rawabebek Reservoir in floating cage system.

Due to the dissolved oxygen level stratification, appropriate layer for fish culture in the Reservoir was down to 2 meter depth.

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