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MONOSEX BARB (*OSTEOCHILUS HASSELTI*) CULTURE WITH REDUCTION FEED ON ECONOMIC EFFICIENCY AND COST REDUCTION AT NET CAGE IN CIRATA RESERVOIR

Rita Rostika[1][†] --- Achmad Rizal[2] --- Dewanti[3]

[1]*Aquaculture Department, Fisheries Study Programe, Faculty of Fisheries and Marine Science, Padjadjaran University, Kabupaten Sumedang Indonesia*
[2]*Social Economic Department, Fisheries Study Programe, Faculty of Fisheries and Marine Science, Padjadjaran University, Kabupaten Sumedang Indonesia*
[3]*Aquatic Resource Management Department, Fisheries Study Programe, Faculty of Fisheries and Marine Science, Padjadjaran University, Kabupaten Sumedang Indonesia*

ABSTRACT

One of the consequences of intensive floating net cage fish farming is that it needs large amounts of manufactured feeds for the consumption of all the primary freshwater species reared. However, in trophic-level-based fish cultures, the population of fish that feed on plankton, periphyton, and detritus is larger than that of high-trophic-level carnivorous fish. This research aims to discover the ability of barb (Osteochilus hasselti) as a water purifier biological agent in Cirata Reservoir by find the Average daily Gains of the fish, Efficiency and Cost Reduction in production. The experiment ranges from September to November 2014 at Cirata Reservoir's Floating Net Cage, starting by acknowledging the genus and the number of periphyton from week 1 to week 6. To analyze Growth Rate (GR), a Complete Randomized Design is used by applying five treatments, namely Treatment A: not fed (control), Treatment B: feeding level 1% of the fish's weight, Treatment C: feeding level 2%, Treatment D: feeding level 3%, and Treatment E: feeding level 4%. The data are then collected in Variant Analysis; if a significant difference is found, it is proceeded to F Duncan Test. The economic parameter are Efficiency and Cost Reduction in production. The results show that there are 20 kinds of periphyton from phytoplankton genus. Twenty types of periphyton of the phytoplankton were of Bacilloriophyceae, Chlorophyceae, and Cyanophiceae classes. As for periphyton of the zooplankton genera, it consisted of Euglenoidea, Rhizopoda, and Rotifer classes. The number of periphyton is not different among the treatments, the GR is not significantly different for every treatment. We found that increased efficiency in the treatment of A (not feed) and decreased production costs as 3 %.

Keywords: *Osteochilus hasselti*, Net cage cirata reservoir, Growth rate, Water Purifier, Efficiency and cost reduction in production.

Contribution/ Originality

The paper's primary contribution is finding that there are Economic Efficiency and Cost Reduction at Net Cage which Monosex Barb (Osteochilus Hasselti) Cultured With Reduction Feed in Cirata Reservoir.

1. INTRODUCTION

A freshwater fish commodity in Indonesia, barb (*Osteochilus hasselti*) is famous for its tasty meat and eggs. Locally called *nilem*, barbs are herbivores that feed on floating plankton or plankton that cling on fish culture tanks. It is commonly known that plankton is rich with enzyme and antibodies [1].

Generally, barbs are reared in semi-intensive farms. In many cases, they are even secondary to such other fish as carp (*Cyprinus carpio* L.), tilapia (*Tilapia mossambica* Peters), nile tilapia (*Oreocromis niloticus* L.) and gourami

† Corresponding author

(*Ospronemus gouramy* Lac.). In fact, low-trophic-level fish farms are actually sustainable and environmentally friendly [2]. Barbs are usually raised in in-ground ponds and even in floating net cages.

One of the consequences of intensive floating net cage fish farming is that it needs large amounts of manufactured feeds for the consumption of all the primary freshwater species reared. In fact, however, in trophic-level-based fish cultures, the population of fish that feed on plankton, periphyton, and detritus is larger than that of high-trophic-level carnivorous fish. Trophic-level-based fish farming method should be more widely adopted in open waters (dams/lakes) since, as in the case of fish cultures in Saguling, Cirata, and Jatiluhur dams, leftover feeds can be consumed by fish populating the second-layer net. Leftofer feeds will be suspended and consumed by plankton and detritus feeders. In a decomposed state, leftover feeds will serve as nutrients and can function as a fertilizer for periphyton organisms, which, in time, can be eaten by such herbivorous fish as barbs, snakeskin gouramis, and kissing gourami [3]. In trophic-level-based fish cultures, leftover feeds can also function as a water-cleaning agent or undergo a further process to become bioflocs [4, 5]. Periphyton, a complex mixture of micro-flora and micro-fauna that are attached to underwater substrates. Growing abundantly in water, periphyton is a natural food source for barbs.

In Saguling dam, such a natural water-cleaning agent is widely used because the process is easy, cheap, low in risk, and because it gives wide positive impacts to people. The barbs farmed in Cirata dam consume large amounts of periphyton. To grow into a weight of 100 grams, a 5-gram barb needs 6,373 grams of periphyton that clings to a 19 m² floating net substrate since periphyton is 0.46% protein and 97.06% water [6].

1.1. Aim and Objective

1) To measure the cleaning capacity of barbs as natural water-cleaning agents by means of identifying the types and population of periphyton in the floating net cages used in Cirata dam.

2) To measure the efficiency and cost-reducing potentials of barbs that grow in farmed floating net cages in Cirata dam and are given a sub-normal feed level.

2. METHOD

The research was conducted from September to November 2014 in floating net fish farms in Cirata Dam, Cianjur Regency, West Java and the Aquaculture Laboratory at the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Sumedang Regency, West Java.

The equipment and tools needed in the research were: 1x1x1 m nets with a 4-milimeter mesh size, water quality measurement tools (DO meter, pH meter, thermometer and other tools to measure ammonia, nitrite, and nitrate level), a fishing net, plastic bottles, a knive, monocular and binocular microscopes, a hand-held counter, identification log book, a secchi disk, writing utensils, and a digital camera. The materials used were: female bonylip barb seeds, fish feeds, formaldehyde.

The research used the following treatments.

- Treatment A : no feed only natural feed (control)
- Treatment B : 1 % feeding kevel
- Treatment C : 1 % feeding kevel
- Treatment D : 1 % feeding kevel
- Treatment E : 1 % feeding kevel

2.1. Measured Parameters

Periphyton was observed every week during the total seven-week observation period. The parameters measured were:

PERIPHYTON DENSITY, measured by means of the Inverted Microscope Counting Method [7] using the following equation [8].

$$N = \frac{n \; x \; At \; x \; Vt}{Ac \; x \; Vs \; x \; As}$$

Notes :

N = the number of the periphyton (Ind/cm²)

n = the number of the counted periphyton (ind)

At = the area of the cover glass (50x20mm²)

Vt = the concentrate volume in the sampling bottle (25ml)

Ac = the observed area (50x20x1mm²)

Vs = the volume in the cover glass (1ml)

As = the scraped substrate area (10x10cm²)

DAILY GROWTH RATE

Measured by using the following equation [8].

$$DGR \; = \frac{\ln Wt - \ln Wo}{t} \; x \; 100 \; \%$$

DGR = daily Growth Rate (% /day)

Wt = Fish biomass at the end of research (gram)

Wo = Fish biomass at the initial of research (gram)

t = duration (day)

Nicholson [9] classifies efficiency into three categories, namely technical efficiency, price efficiency, and economic efficiency. Economic efficiency is the result of technical efficiency and price efficiency.

In economics, however, technical efficiency and economic efficiency are recognized. Economic efficiency implies a wider macro scope as compared to the micro scope of technical efficiency. Technical efficiency measurement tends to be limited to the technical and operational correlations in the process of converting input into output. Thus, efforts to improve technical efficiency simply need a more internal micro policy to optimize control and resources allocation.

With regard to economic efficiency, price is not given as it is subject to macro policy [9].

Efficiency is the ratio between physical output and input. The higher input ratio, the higher the economic efficiency. Efficiency can also be defined as the effort to obtain a maximum output from the use of certain resources. The higher the output as compared to the resources needed, the higher the efficiency level.

Economic efficiency consists of technical and allocative efficiency. While technical efficiency is a combination of the ability and capacity of an economic unit to process a certain amount of input to produce the maximum output by using a certain technology, allocative efficiency refers to the ability and availability of an economic unit to operate at the same marginal value level as that of the marginal cost,

According to Rizal [10] measuring efficiency serves three purposes. First, it serves as a benchmark to obtain a relative efficiency, making it easier to compare one economic unit to another. Second, in a case where the efficiency level varies among a number of business units, further analysis can be done to investigate what factors cause such a variation and find an appropriate solution. Third, information about efficiency has a policy impact because it can help policy makers decide the right policy.

Efficiency is achieved when either of the following occurs: first, when the same amount of input yields a bigger amount of output; second, when a smaller input yields the same amount of output; and three, when bigger input yields even bigger output. If efficiency is to be defined in terms of input-output ration, then it can be expressed by the following equation.

Eficiency = I / O [10].

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E = Eficiency

O = Output

I = Input

Periphyton was identified by using the descriptive method suggested by Sachlan [11]. Tables and charts were used to present growth rate and water data, based on which their variants were analyzed. F. Duncan Test was used in cases where the variants were significant.

3. RESULT AND DISCUSSION

3.1. Periphyton Density

Based on the data obtained from both the field and the laboratory, the types of plankton that adhered to the floating fish net cages were of Bacillariophyceae, Chlorophyceae, Cyanophyceae types. In addition, zooplankton of Euglonoidea, Rhizopoda, and Rotifer types. This condition according to Farashi, et al. [12].

Table 1 below presents information about the types and population of periphyton on the floating net cages in Cirata reservoir.

Table-1. Type and Density of Perifiton (individu) on week 1st and Week 6th.

	Type of Periphyton	1st week	6th week	% Periphyton consumed
	Fitoplanton			
class	Bacillariophyceae			
1	Cyclotella	152.93	68.01	55.53
2	Navicula	585.47	136.66	76.66
3	Nitzschia	315.53	146.33	53.62
4	Synedra	149.53	45.99	69.24
5	Diatome	286.47	34.33	88.02
6	Pinularia	98.67	-	100
7	Asterionella,	11.33	5.34	52.87
8	Symbella	92.60	-	100.00
Class	Chlorophyceae			
1	Ankistrodesmus	110.67	23.67	78.61
2	Coelastrum	200.53	25	87.53
3	Spyrogyra	15.78	-	100.00
4	Zygnema	9.00	-	100.00
5	Crucigenia,	1.00	-	100.00
Class	Cyanophyceae			
1	Oscilatoria	1,078.00	198.01	81.63
2	Merismopedia	82.67	-	100.00
3	Spyrulina	2.00	-	100.00
	Sum of Phytoplankton	3,192.18	125.57	
	Zooplankton			
Class	Euglenoidea			
1	Euglena	44.27	19.66	55.59
Class	Rhizopoda			
1	Arcella	387.27	68.01	82.44
Class	Rotatoria			
1	Diurella	10.17	-	100.00
2	Brachionus	13.89	-	100.00
	Sum of zooplankton	455.6	17.56	
	Sum of Periphyton	3,616.67		

The following figure shows that high consumption of periphyton occurred as can be seen in the very low periphyton density (30 individuals/cm²) found in the 6th week during treatments A, B, C, D, and E.
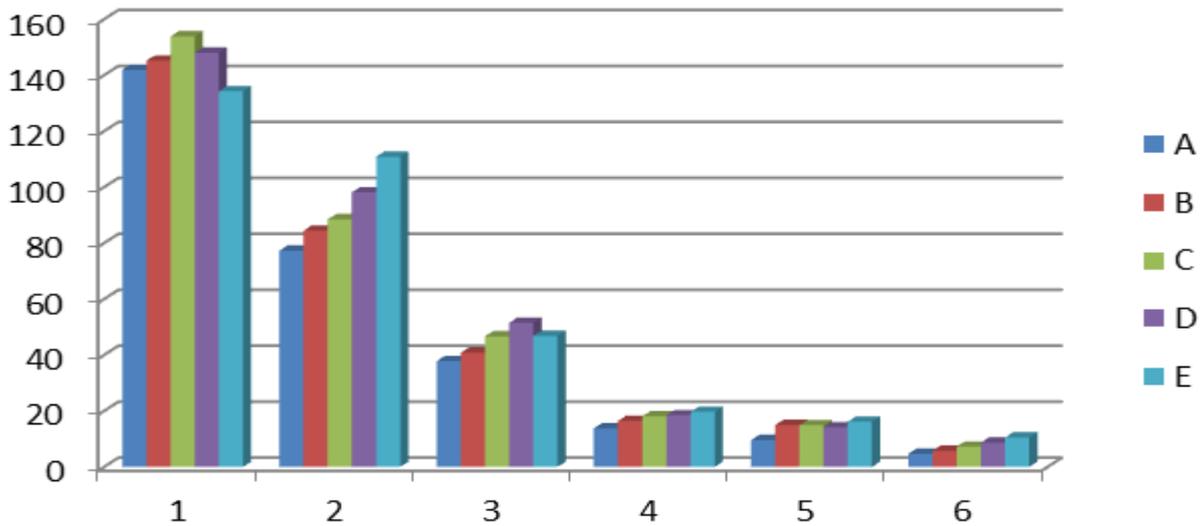
Figure-1. Sum of Perifiton / week / Cm² in treatment A, B, C, D and E

3.2. Barb Daily Growth Rate

Growth is a major factor in fish culture. High growth rates ensure higher profits. Daily growth refers to the daily increase of weight within a certain rearing period.

The highest growth rate (11.92%) was achieved during the first week of treatment B. However, the best daily growth rate (4.62%) was achieved during treatment D, in which a feed level of 3% of the fish biomass was administered. The lowest growth rate (3.83%) occurred towards the end of treatment A, in which 0% of feed (no manufactured feed) was given. During treatment A, barbs only consumed natural feeds or periphyton. During treatment E (feed level = 4%), growth rate did not reach a peak level because, as Suryanti, et al. [13] the optimum feed level for carps (Cyprinidae) is 3%. The barbs that were given treatment E might have consumed a sufficient amount of manufactured feeds and thus left the periphyton available uneaten. As a result, oxygen circulation was affected and growth rate was hindered.

Based on the data, the barbs farmed in floating net cages in Cirata dam could actually grow only by eating periphyton. However to support their growth, additional manufactured feeds were still needed. As the results of the research suggest, the best barb growth rate was achieved during treatment D, in which feed level was 3% of fish biomass.

Tabel-2. Average Growth Rate of Barb

Treatment	GR (%)
A (Without feed)	3,53 ± 0,17a
B (Feed 1 %)	4,05 ± 0,15b
C (Feed 2 %)	3,96 ± 0,13b
D (Feed 3 %)	4,22 ± 0,27b
E (Feed 4 %)	4,11 ± 0,14b

Note: The same letter shows no significantly different (Duncan at 5%)

Source: Dima [14]

A study by Dima [14] revealed that the highest growth rate was achieved during treatment D (feeding level = 3%). The Duncan test results indicated that growth rate during treatment A (without manufacture feeds) was significantly different from those occurring during treatments B, C, D, and E, whereas treatment B did not yield any significant difference as compared to treatments C, D, and E. A feeding level of 1 - 4 % of fish biomass could be given since it would not yield any significant difference as compared to that achieved with a feed level of 3%.

3.3. Benefit Cost Analysis

Indicators	Each	Treatment				
		A (0%)	B (1%)	C (2%)	D (3%)	E (4%)
Amount of feed given / kg fish	Kg	0	0.01	0.02	0.03	0.04
Amount of feed given for 49 days	Kg	0	0.18	0.28	0.45	0.58
Jumlah Biaya pakan yang dikeluarkan	Rp	0	1,360	2,104	3,385	4,382
Amount of Fry cost	Rp	18,000	18,000	18,000	18,000	18,000
Amount of medicine and labour	Rp	10,000	10,000	10,000	10,000	10,000
Total cost /research unit	Rp	28,000	29,360	30,104	31,385	32,382
Total cost / floating net unit	Rp	1,372,000	1,438,640	1,475,096	1,537,865	1,586,718
Total harvest	Kg	3.14	3.84	3.71	4.10	3.93
Revenue	Rp	62,866	76,891	74,288	82,022	78,670
Margin / research unit (1m x1m x1m)	Rp	34,866	47,530	44,184	50,637	46,288
margin/ floating net unit (7m x 7m x1m)	Rp	1,708,434	2,328,970	2,165,016	2,481,213	2,268,112
Efisiency = Benefit/cost		1.25	1.61	1.50	1.46	1.43

The benefit ratio of each treatment indicated an optimum level at a 3% feed level. In general, however, all the different feed levels yielded better economic efficiency and cost reduction levels as compared to treatments where fish consume only natural feeds without additional manufactured feeds.

Biologically, growth rates did not vary significantly among the different feed level treatments. However, in terms of economic costs, the different treatments yielded different economic benefits.

4. CONCLUSION

Twenty types of periphyton of the phytoplankton genera were identified. They were of Bacilloriophyceae, Chlorophyceae, and Cyanophiceae classes. As for periphyton of the zooplankton genera, it consisted of Euglenoidea, Rhizopoda, and Rotifer classes. The population of periphyton varied between treatments. Growth rate did not vary significantly between each fish group.

The benefit ratio of each treatment indicated an optimum level at a 3% feed level. In general, however, all the different feed levels yielded better economic efficiency and cost reduction levels as compared to treatments where fish consume only natural feeds without additional manufactured feeds.

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