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Economical Analysis Of Polyculture Of Catfish And Tilapia Fish In Biofloc System

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---***ABSTRACT***---
Biofloc system is an alternative for intensive culture system for aquatic organisms because the heterotrophic bacteria in there could reutilize the nutrient waste produced as metabollites so that the water quality can be improved. In the other hand, the biofloc system could cause the nitrite concentration becomes high if the dissolved oxygen in water is too low and cause brown nitrite in the fish blood that fish could become dead. Polyculture is one of solutions that could reduce tha biofloc density in water so that brown nitrite could be avoided. The study aimed to evaluate the effect of ratio of catfish and tilapia fish in polyculture system that can reduce biofloc density so that it could improve water quality. The ratios used are 80% catfish and 20% tilapia fish (treatment A), 70% catfish and 30% tilapia fish (treatment B), 60% catfish and 40% tilapia fish (treatment C), and 100% catfish (treatment D). The study took 60 days for the fish rearing with feeding method used is restricted (feeding rate-based). The results showed that the polyculture system (treatment A) has better productivity than that in monoculture system (treatment D). The most profitable and the shortest payback period is in treatmentC.
KEYWORDS: *economical analysis, polyculture, biofloc, catfish, tilapia fish*

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I. BACKGROUND

The polyculture system has an important role in the nutrition and economic aspects (Ali et al, 2017). This is because land and high feed costs can cover the difference between demand and supply for cultivated products. The polyculture system is more profitable than the monoculture system because polyculture is a cultivation method for the maintenance of more than one type of biota.

This shows that at harvest time, more than one type of fish will be obtained with different prices so that it can boost the selling price. In addition, polyculture can help increase land productivity to be high. This is because in the same container can be maintained more than one type of biota so that it does not need a large container and large capital (Setiadi et al., 2018). The eating habits of fish kept in polyculture are different so there is no competition in nutrient consumption. That is because one type of fish will utilize waste from biota from other types that have been processed into a form that can be consumed by other biota so that the utilization of feed is more efficient (Asadujjaman et al., 2016). According to Prasetiyono&Syaputra (2018), polyculture can produce optimal profits because the potential of capital, feed and facilities resources can be minimized. In addition, production capacity is higher in polyculture maintenance systems.

II. METHODOLOGY

Time and Place of Research

The study started in August 2019 and finished in October 2019 in wet laboratory of Jakarta Fisheries University.

Data Analysis

Statistical Analysis on Fish Productivity

Data normality was tested by using Saphiro-Wilk test because the samples are less than 50 (Novianty et al., 2014). Data homogeneity was tested using Levene test to know whether data was spread evenly. Kruskal-Wallis test is a non parametricstatictical method merupakanmetodestatistika that is similar to *oneway*ANOVA test. Kruskal-Wallis test is used to test the hypothesis whether the independent samples used are from the same population (Nawangsari, 2013).

Descriptive Analysis

Financial analysis was carried out to find out the most financially beneficial treatment among the four treatments applied. Calculation of profit / loss (Umar, 2005).

$$Profit = Revenue\ (Cycle) - Production\ Cost\ (Cycle)$$

Revenue is the total revenue obtained from a business. Calculation of revenue as follows.

$$Revenue = Total\ Goods\ Produced\ x\ Selling\ Proce - Production\ Cost$$

Break even point is a parameter used to analyze the relationship between variable costs, fixed costs, sales volume, and profits (Suhartono 2018).

$$BEP\ Unit = \frac{Fixed\ Cost}{(Price\ per\ Unit - Variable\ Cost\ per\ Unit)}$$

$$BEP\ USD = \frac{Fixed\ Cost}{(Contribution\ Margin\ per\ Unit/Price\ per\ Unit)}$$

Return on Investment (ROI) is a profit ratio that aims to analyze the ability of a business to generate profits for one cycle (Wangarry et al., 2015).

$$ROI = (Total\ Sales - Investment)\ Investment\ x\ 100\%$$

Revenue cost ratio (R/C) is the ratio between revenue and the cost of producing a business (Asnidar&Asrida 2017).

$$R/C = Receipt/Cost\ of\ Production$$

PP shows the period of capital return or production costs incurred at the beginning of the business in units of the year (Sari et al., 2018).

$$PP = (Initial\ Investment/Cash\ Flow)\ x\ 1\ Year$$

III. RESULTS AND DISCUSSION

Polyculture activity is the cultivation of organisms of more than one type in the same container but has different eating habits (Setiadi et al., 2018). Economically, fish of different types have a certain species selling price (Moray et al., 2014). Therefore, it can be seen that polyculture produces higher profits compared to monoculture (Husain et al., 2016). The factors that cause the polyculture system to be more profitable are because on one land optimization can be carried out by cultivating more than one type of organism. In addition, the different eating habits of the organisms that are nurtured help improve the efficiency of feeding so that it can save the input provided. The selling price of polyculture products is higher because there is more than one type of fish. The selling price of catfish consumption size is 1,46 USD/kg, while the price of consumption tilapia is 1,9 USD.

High productivity shows that the biomass of each unit of land volume is high so that the number of fish harvested is high (Muarif&Rosmawati, 2011). The results showed that polyculture cultivation resulted in higher productivity compared to control treatments. The highest productivity is treatment A with a value of 54.51 kg/m^3, while the control treatment has a lower value of 54.16 kg/m^3. According to Dewi et al. (2016), high productivity is directly proportional to high profitability so that treatment A (polyculture) is more profitable when compared to control treatment.

The observations showed that the productivity of catfish in treatment A (80% catfish and tilapia 20%) was highest at 54.51 kg/m^3, while the smallest productivity was seen in treatment C (60% catfish and tilapia) 40%) that is 42.57 ± 0.29 kg/m^3. Each treatment was tested using the Anova Test and showed significant differences ($P < 0.05$) at a 95% confidence level.

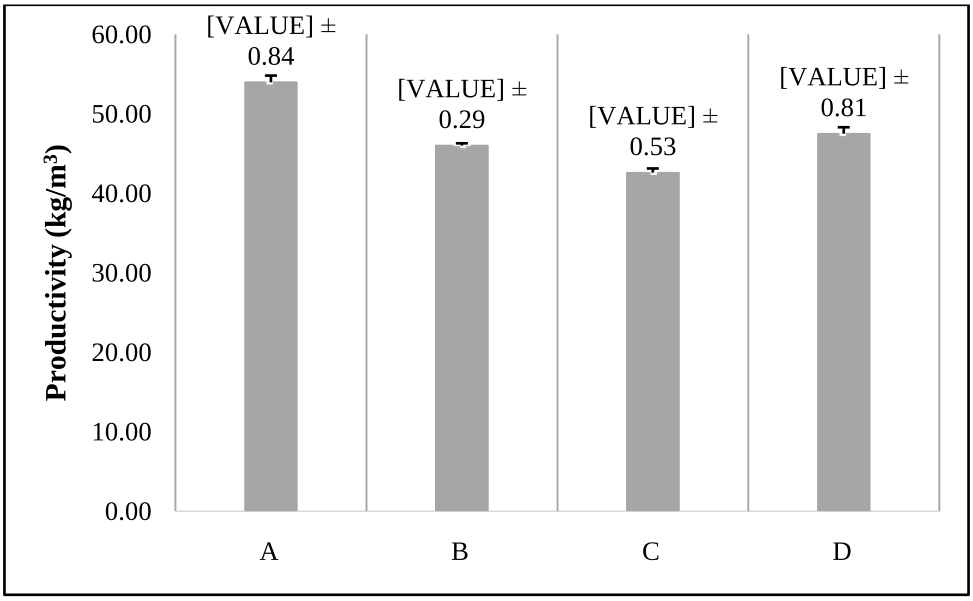


Figure 1. Productivity value of catfish culture in every treatments

High productivity shows that the biomass of each unit of land volume is high so that the number of fish harvested is high (Muarif&Rosmawati, 2011). The results showed that polyculture cultivation resulted in higher productivity compared to control treatments. The highest productivity is treatment A with a value of 53.94 ± 0.84 kg/m^3, while the control treatment has a lower value of 47.47 ± 0.81 kg/m3 can be seen in (Figure 1). According to Dewi et al. (2016), high productivity is directly proportional to high profitability so that treatment A (polyculture) is more profitable when compared to monoculture or control treatment.

Economic feasibility analysis for all treatments was calculated using business assumptions. The business assumptions are arranged based on the number of compositions at the time of the study with the assumption of using a container with a diameter of 3 meters totaling 10 ponds, water volume of 7 m3 with a cultivation cycle of 4 times in one year.

Parameter	Treatment			
	A	B	C	D
Total of Catfish	112,000	98,000	84,000	140,000
Total of Tilapia	5,600	8,400	11,200	-
Fixed Cost (USD)	3.526,03	3.526,03	3.526,03	3.526,03
Variable Cost (USD)	17.183,78	14.029,49	12.435,75	15.925,04
Invested Cost (USD)	15.715,47	15.715,47	15.715,47	15.715,47

Table 1. Business assumption for economical analysis

Fixed costs are costs that do not change even though the amount of input used changes (Winarko&Astuti, 2018). This is shown in (Table 1) that there is no difference in the fixed costs for all treatments, namely 3.526,03 USD Fixed costs in this study include the cost of land rent.

Polyculture has a lower catfish density than monocultures. However, the variable costs in monoculture systems are lower compared to polyculture systems. Variable costs are costs that amount in accordance with the volume of activities (Winarko&Astuti, 2018). This is indicated by the amount of density of organisms used and the need for lower pellet feed. Tilapia maintenance activities indicate that the use of feed because tilapia can eat biofloc grown on media and biofloc formed is the result of the conversion of catfish residual waste so it shows the existence of feed efficiency.

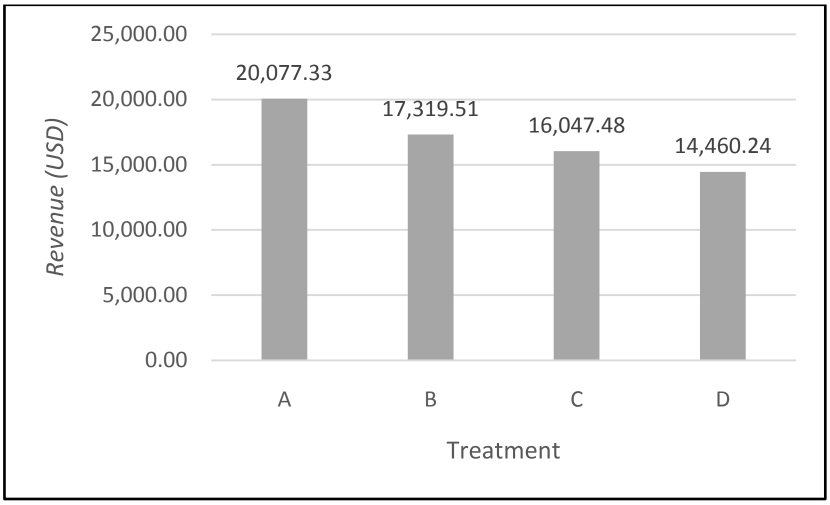
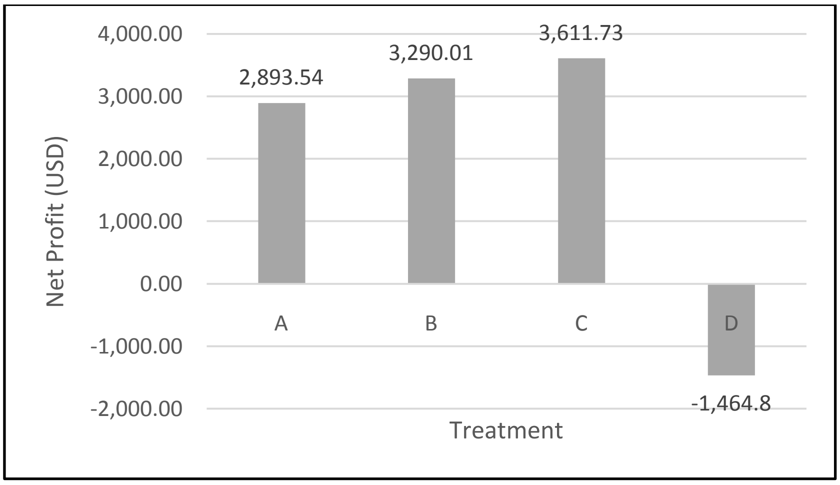


Figure 2. *Revenue* in polyculture selling in each treatments



Fugure 3. Net profit of catfish selling in each treatments

The combination of the amount of catfish and tilapia used in polyculture systems with biofloc systems shows that the total income is higher than the income from maintenance products with a monoculture system. This is due to the presence of tilapia which is kept together with catfish, thereby increasing the total value of income with a higher selling price of tilapia by 0,44 USD compared to the selling price of catfish. This is also shown by the large net profit from catfish and tilapia polyculture activities with higher biofloc systems compared to monoculture systems can be seen in Figure 3. This is in accordance with Ponomban (2013) that profit is determined by sales volume, production costs and product selling prices.

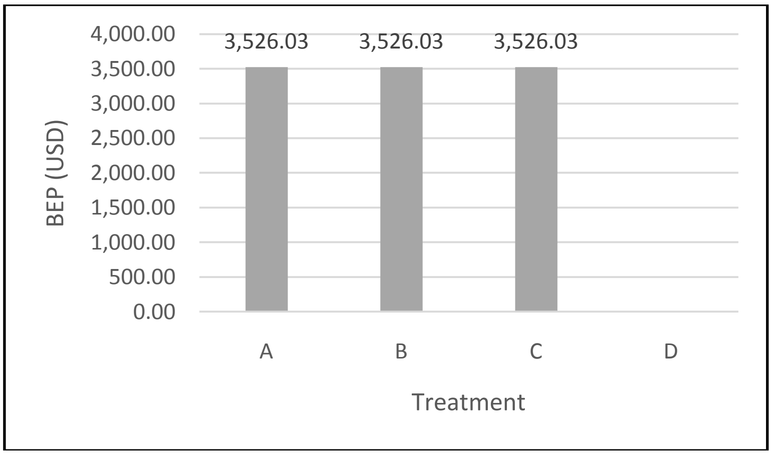


Figure 4. BEP (USD) of catfish selling in each treatments

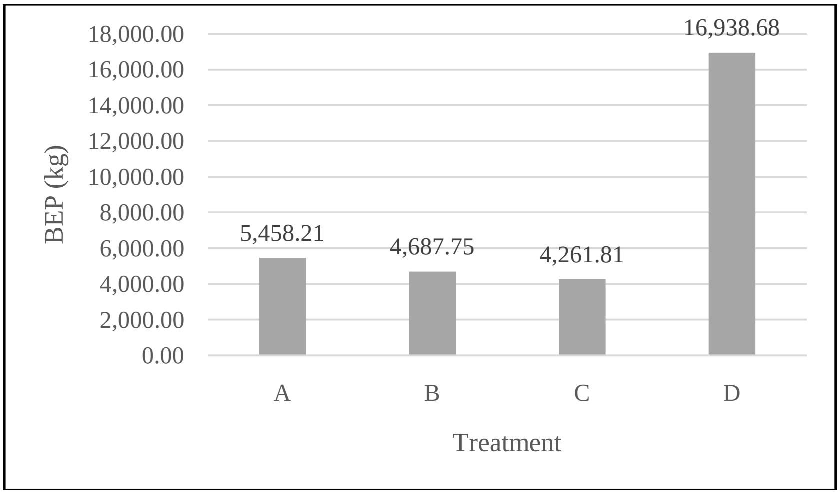


Figure 5. BEP (kg) of catfish selling in each treatments

Breakeven point (BEP) is a parameter used to analyze the relationship between variable costs, fixed costs, sales volume, and profits. The BEP value indicates the lowest level of sales that must be achieved to break even or not lose (Suhartono, 2018). The value of BEP can be seen in terms of selling prices and terms of sales volume. BEP treatment C shows the lowest value in terms of sales volume. This shows that from the harvests with treatment C, it must be sold as much as 4261.81 kg in order to break even. This value is the lowest because the variable cost of treatment C is the lowest and the sales volume and profit of treatment C are the highest.

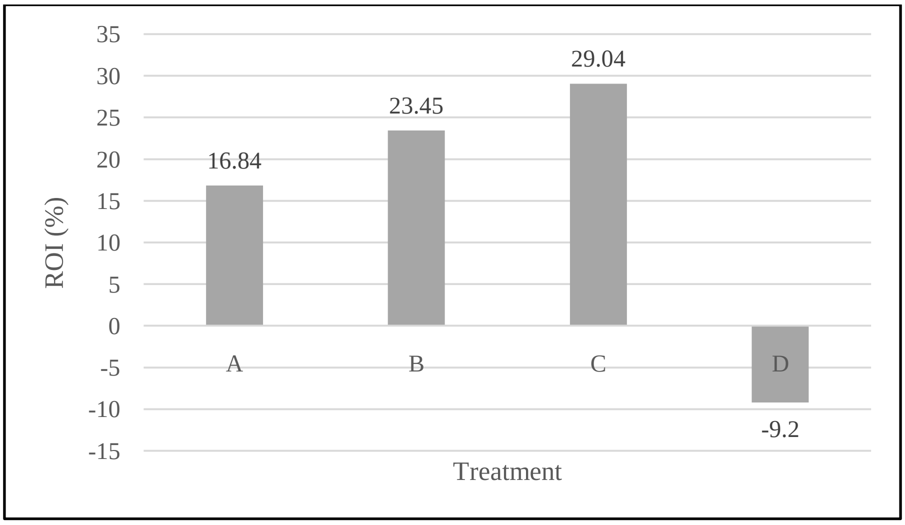


Figure 6. ROI of catfish selling in each treatment

Return on Investment (ROI) is a profit ratio that aims to analyze the ability of a business to generate profits for one cycle (Wangarry et al., 2015). Therefore, if the ROI value is high then an effort is said to be in good condition. ROI value of the highest in a row that is treatment C, treatment B, treatment A, and treatment D. ROI value of treatment C is the highest because the profit from treatment C is also the highest, while the lowest treatment D ROI because treatment D has lowest profit because it reaches a loss.

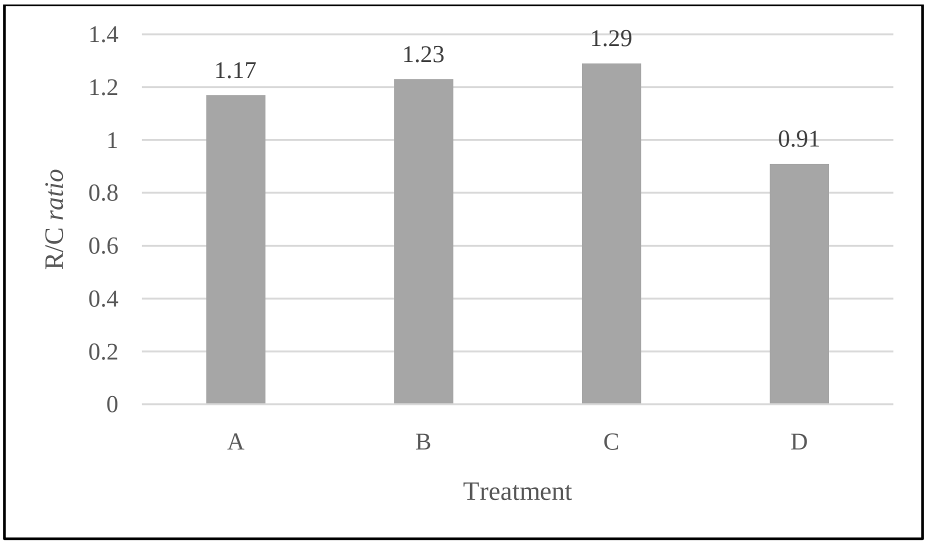


Figure 7. R/C ratio of catfish selling in each treatment

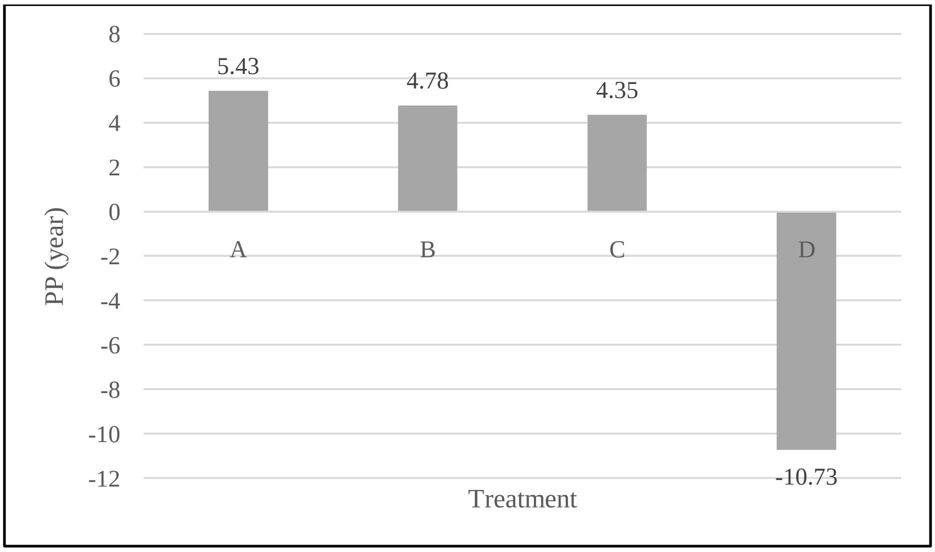


Figure 8. *Payback period* on catfish selling in each treatment

Revenue cost ratio (R/C) is a ratio of revenue and production cost of a business.If an R/C ratio is more than 1 then the business is considered profitable (Anidar and Asrida, 2017). The R/C ratio value from the highest value constituently are treatment C, B, A, and D. The R/C ratio is in linear similarity with ROI because the revenue of treatment C is the highestbecause the selling volume is also the highest. It could be concluded that treatment C (polyculture) is more profitable than treatment D (monoculture). It is also shown by the *Payback Period* (PP) of treatment C was the lowest. PP shows period of when production cost in the beginning of the business is paid back in a yearly matter (Sari et al., 2018). The value of PP of treatment C is the lowest that is 4,35years. It is shown that in 4,35 years the production cost of the business that is spent in the beginning period will be paid off.

IV. CONCLUSION

The results showed that polyculture cultivation activities tended to produce higher productivity compared to monocultures (treatment D, 100% catfish). This research shows that the highest net profit and the shortest payback period is in treatment C (60% catfish: 40% tilapia).

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