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ORDINARY LEAST SQUARE ANALYSIS IN ESTIMATING THE PRODUCTION FACTORS OF MILKFISH (*Chanos chanos*) NURSERY CULTIVATION IN TURI DISTRICT, LAMONGAN

Analisis Ordinary Least Square dalam Mengestimasi Faktor-faktor Produksi Penggelondongan Ikan Bandeng (*Chanos chanos*) di Kecamatan Turi, Lamongan

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ABSTRACT

Milkfish is one of the freshwater fish commodities highly favored by the community, as evidenced by the increasing market demand annually. The demand for milkfish nursery continuously rises in line with the expansion of milkfish enlargement efforts for bait and consumption sizes. Therefore, intensive engineering of milkfish nursery production technology is necessary to fulfill the nursery demand both in quantity and quality. This research aims to understand milkfish cultivation practices with the nursery production system in Turi District, Lamongan Regency, and analyze the production factors influencing milkfish cultivation with the aforementioned system. This study employs a quantitative descriptive method. Data collected include both primary and secondary data, gathered through observation, interviews, questionnaires, and documentation techniques. The research findings indicate that factors positively affecting the income of milkfish farmers with the nursery production system include seed costs, fertilizer costs, and land area. This implies that the higher the utilization of these variables, the greater the income. On the other hand, labor costs and feed costs do not positively influence the income of milkfish farmers with the nursery production system.

Keywords: Cultivation, Milkfish, Multiple Regression, Nursery System, Production

ABSTRAK

Ikan bandeng merupakan salah satu komoditas ikan air tawar yang sangat diminati oleh masyarakat, hal ini terbukti dengan permintaan pasar yang meningkat setiap tahunnya. Permintaan akan benih gelondongan terus bertambah seiring dengan berkembangnya usaha pembesaran ikan bandeng untuk ukuran umpan dan konsumsi. Oleh karena itu, diperlukan rekayasa teknologi penggelondongan bandeng secara intensif agar kebutuhan benih dapat terpenuhi baik dari segi jumlah maupun kualitas. Penelitian ini bertujuan untuk mengetahui praktik budidaya ikan bandeng dengan sistem penggelondongan di Kecamatan Turi, Kabupaten Lamongan, serta menganalisis faktor-faktor produksi yang mempengaruhi budidaya ikan bandeng dengan sistem tersebut. Penelitian ini menggunakan metode deskriptif kuantitatif. Data yang dikumpulkan meliputi data primer dan sekunder, dengan teknik pengumpulan data yang meliputi observasi, wawancara, kuesioner, dan dokumentasi. Hasil penelitian menunjukkan bahwa faktor-faktor yang memiliki pengaruh positif terhadap pendapatan petambak ikan bandeng dengan sistem penggelondongan antara lain biaya bibit, biaya pupuk, dan luas lahan. Artinya, semakin tinggi penggunaan variabel-variabel tersebut, maka pendapatan juga akan semakin meningkat. Sedangkan biaya tenaga kerja dan biaya pakan tidak memiliki pengaruh positif terhadap pendapatan petambak ikan bandeng dengan sistem tersebut.

Kata Kunci: Ikan Bandeng, Budidaya, Sistem Penggelondongan, Produksi, Regresi Berganda

INTRODUCTION

Indonesia, the largest archipelagic state in the world, occupies a strategically important geographic position. The country boasts approximately 17,504 islands with a coastline stretching over 108,000 kilometers and a total sea area of around 6,400,000 square kilometers (Yuliansyah & Ramdhayani, 2023). Based on its geographical conditions, Indonesia is well-positioned to be the world's leading supplier of fisheries products, offering promising prospects due to its vast aquatic resources. Utilization of fisheries and marine resources extends beyond fishing activities in open waters, encompassing aquaculture as well.

Aquaculture is a vital component of Indonesia's fisheries sector, playing a key role in enhancing national food security, generating employment opportunities, and increasing the country's income through exports (Direktorat Jenderal Perikanan Budidaya, 2019; Leksono & Poniran, 2014). In Indonesia, aquaculture is practiced in both saline, brackish, and freshwater environments. Among the species commonly cultured is the milkfish, known for its rapid growth, ease of cultivation, adaptability to a wide range of salinity levels, and status as a prized freshwater fish species in the aquaculture sector. According to Direktorat Jenderal Perikanan Budidaya (2019) milkfish has become increasingly popular among Indonesian communities, leading to a rise in market demand.

The establishment of milkfish farming enterprises offers several benefits, including increased income and improved livelihoods for pond farmers from an economic standpoint. Additionally, it creates new job opportunities, particularly in trade-related activities. Therefore, milkfish production contributes significantly to economic development as part of the national development agenda. Over time, however, national milkfish production has experienced a decline. In 2022, national milkfish production recorded 784,941.13 tons, reflecting a 3.97% decrease compared to the previous year's production of 817,366.56 tons, valued at Rp15.37 trillion (KKP, 2022).

The decline in national milkfish production can also be observed in specific regions, such as Lamongan Regency. Milkfish farming is a predominant commodity in Lamongan due to the significant number of farmers involved in milkfish cultivation and suboptimal utilization of production factors. Data from the Lamongan Fisheries Office for the year 2022 indicates that milkfish production in the regency amounted to 22,007.09 tons, a decrease of 326.39 tons compared to the previous year (2021), which recorded a production of 22,333.48 tons.

Essentially, the goal of milkfish pond farming is to meet daily needs and serve as the primary or supplementary source of income for families. Various steps can be taken by farmers to develop milkfish pond farming, including intensification, extensification, and other measures, aimed at increasing production over time. Intensification and extensification efforts, such as optimizing pond areas, stocking fingerlings, balanced fertilizer application, and ensuring adequate labor, are continuously undertaken to enhance production.

There are several researchers have conducted studies on milkfish cultivation using Multiple Linier Regression (Haikal E *et al.*, 2024; Sumartin, 2017; Astari *et al.,* 2017;

Marhawati & Ma'ruf, 2018; and Machmudin *et al.,* 2019). This study highlights the importance of not observing mature or market-ready milkfish, but rather focusing on milkfish nursery production, which is a critical stage aimed at reducing nursery mortality. Nursery production is considered the most critical phase of cultivation. Meanwhile, previous studies have not yet examined the production factors in the milkfish nursery production system.

In efforts to improve production outcomes, milkfish farmers in Lamongan, particularly in the Turi District, have implemented various innovative milkfish farming practices, such as nursery production. Nursery production activities aim to reduce nursery mortality rates, as the nursery production stage is critical. Nursery is a crucial production factor in milkfish farming. Therefore, this research aims to evaluate the utilization of production factors and provide recommendations for effective and efficient utilization of production factors to enhance the income of milkfish nursery farmers in Lamongan Regency.

METHODS

Sampling Method

This research utilizes primary data with a cross-sectional approach during the milkfish cultivation season in 2023 in 17 villages in the Turi District, Lamongan Regency, selected using purposive sampling method. The sample size for the study is 100 farmers, as this research employs a census method, which involves taking an entire population group as a sample and utilizing structured questionnaires as the primary data collection tool to obtain specific information.

Data Analysis Method

1. Descriptive Analysis

Descriptive analysis is utilized to describe the data obtained from the research respondents' questionnaires. In this case, descriptive statistics are employed, including mean, median, mode, range, standard deviation, and variance. Additionally, the income of milkfish farmers is calculated using the formula:

$$\pi = TR - TC$$

where:

π = Income
TR = Total Revenue
TC = Total Cost

2. Classic Assumption Tests

A good regression model should have normally distributed data or approximately normal and be free from classic assumptions consisting of normality test, multicollinearity test, and heteroskedasticity test. In this study, autocorrelation is not used because it uses cross-sectional data, while autocorrelation tests are used in time series data. After the researcher successfully collects the data, testing is first conducted to observe any deviations from classic assumptions. The stages are as follows:

✓ Normality Test

This test is conducted to determine whether the residual values are normally distributed or not. A good regression model is one with normally distributed residual values. The data spread on the diagonal source in the Normal PP Plot of regression standardized graph is observed as the basis for decision-making. If the spread is around the line and follows the diagonal line, then the regression model is considered normal and suitable for predicting the independent variable and vice versa. Another way to test normality is through the One Sample Kolmogorov-Smirnov test method. The testing criteria are as follows: - If the

Significance value (Asym Sig 2 tailed) > 0.05, then the data is normally distributed. - If the Significance value (Asym Sig 2 tailed < 0.05, then the data is not normally distributed.

- ✓ Multicollinearity Test

  Multicollinearity is a condition where there is a perfect or near-linear relationship between independent variables in a regression model. A regression model is said to have multicollinearity if there is a perfect linear function on some or all independent variables in the linear function. Symptoms of multicollinearity include examining the Variance Inflation Factor (VIF) and its Tolerance values. If the VIF value < 10 and Tolerance > 0.1, then multicollinearity is considered not to occur.
- ✓ Heteroskedasticity Test

  Heteroskedasticity is a condition where there is inequality of variance in the residuals for all observations in a regression model. The testing is performed using the Glejser Test. The test is conducted by regressing independent variables against the absolute residual values. The residual is the difference between the Y variable value and the predicted Y variable value, and the absolute value is the absolute value (positive value of all). If the significance value between the independent variable and the absolute residual > 0.05, then heteroskedasticity is considered not to occur.
- ✓ Partial Test (t-test)

  The t-test is conducted to determine the partial influence of independent variables (Land Area, Labor, Fertilizer, Seed, Feed, Farmer Group Participation Dummy) on the dependent variable (income of milkfish farmers in the ponding system). The significance of this influence can be estimated by observing the significant value. If the significant value < 0.05, then the independent variable individually influences the dependent variable, otherwise if the significant value > 0.05, then it can be said that the independent variable partially does not influence the dependent variable.
- ✓ Simultaneous Test (F-test)

  The F-test is used to determine the simultaneous influence of independent variables on the dependent variable. If the significance value < 0.05, then the independent variables together have a significant influence on the dependent variable, meaning that the changes that occur in the dependent variable can be explained by changes in the independent variables.
- ✓ Coefficient of Determination Test (R2)

  The coefficient of determination is a measure that indicates the amount of variation in the dependent variable explained by the independent variables. In other words, this coefficient is used to measure how far the independent variables explain their dependent variables.

3. *Multiple Linear Regression Analysis*

Multiple linear regression analysis is a robust research analysis that can analyze multiple variables simultaneously to address complex research questions. Essentially, we can trust its results if it meets the requirements of Ordinary Least Squares (OLS). OLS regression assumes a linear relationship between the variables. If the relationship is not linear, OLS regression is not an ideal tool for research analysis, and modification of variables or analysis is required. OLS regression is also commonly used for parameter estimation of different functional relationships (Masruoh & Subekti, 2016; Walpole, 2006; Iswati *et al.*, 2014). Multiple linear regression analysis aims to perform generalizations that include estimation and hypothesis testing based on data. In this study, hypothesis testing is conducted using multiple linear regression analysis. Before performing multiple linear regression analysis, classic assumption tests are conducted. According to Mudrajad (2001) and Pavelescu (2004), Classic assumption tests are analyses performed to assess whether there are classic assumption problems in an OLS linear regression model. The general equation for multiple linear regressions is:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + e$$

In this study, the regression equation is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e$$

Where:

Y = Income
X_1 = Land Area
X_2 = Labor Cost
X_3 = Fertilizer Cost
X_4 = Seed Cost
X_5 = Feed Cost
e = Error or Residual

RESULT

Respondents Characteristic

The characteristics of respondents in this research include several key aspects that can influence the results and interpretation of the data. The measured characteristics include in Table 1.

Table 1. Respondents Characteristic

Variable	Mean	Percentage (%)
Age	53.5	-
Gender		
Male	-	97
Female	-	3
Education		
No School	-	17
Elementary School	-	40
Junior High School	-	22
Senior High School	-	18
Undergraduate Student	-	3
Occupation		
Housewives	-	3
Teacher	-	3
Entrepreneurs	-	94
Farmer's Experience	35.2	-

Based on the table above, the respondents in this study are generally of productive age. According to Mardani *et al*. (2017), in developing countries, the productive working age typically ranges from 15 to 55 years. Individuals over the age of 55 are considered non-productive as they fall into the elderly category, which may affect their productivity in aquaculture. In addition, the majorities of respondents are male and hold the status of head of household. The most common educational level attained by the respondents is elementary School (SD). Maramba (2018) argues that an individual's level of education will influence their behavior in adopting an innovation. Someone with a higher level of education tends to be more open to accepting something new compared to someone with lower education, or in other words, they are more likely to rely on information from their ancestors. Most respondents have more than 10 years of experience in aquaculture, indicating a high level of skill and knowledge in milkfish farming. Furthermore, most respondents are entrepreneurs and also have diverse additional sources of income, such as trading and working as laborers, which help supplement the family income.

Descriptive Statistic

The data for this empirical research have been taken from interviewed 100 farmers in 2023. Descriptive statistics are utilized to depict the data employed in research. Descriptive statistics provide an overview or description of data, considering measures like mean, standard deviation, variance, and maximum value. Descriptive analysis delineates quantitative data processed into qualitative data (Ghozali, 2018).

Table 2. Descriptive Statistic

Variables	N	Mean	Standard Deviation
Income (Rp)	100	3.836.250	2681639,72
Land Area (m^2)	100	1.869	605,65
Labor Cost (Rp)	100	1.363.500	436142,12
Fertilizer Cost (Rp)	100	323.000	39657,63
Seed Cost (Rp)	100	1.273.500	409819,81
Feed Cost (Rp)	100	190.995	60678,01

Table 2 show the distribution of data variables. The average of farmer's income 3.836.250, it indicates that these farmers have a relatively high income compared to others in their profession or region. It could indicate successful agricultural practices, favorable market conditions, or additional sources of revenue beyond traditional farming activities. Such income levels may enable farmers to meet their basic needs comfortably and potentially invest in further agricultural development or diversify their livelihoods. Cost of labor, fertilizer, seed, and feed relatively low related to the average of land area 1.869 m^2. With a land area of 1.869 m^2, the farming operations are likely to be small-scale or backyard farming rather than large-scale commercial agriculture. This size of land is typically manageable by individual farmers or households without the need for extensive machinery or labor force. Despite the relatively small size, the land can still contribute significantly to the livelihood of the farmers and their families. It may serve as a source of food, income, and livelihood security, especially in rural areas where agriculture is a primary economic activity.

Data Analysis

The OLS analysis was conducted using SPSS 26 to examine the factors influencing the income of milkfish farmers utilizing the nursery cultivation system. The results are presented in the table 3 below:

Table 3. Ordinary Least Square Analysis

Variables	Coefficient	t-value	p-value	VIF
Constanta	-561105,48	-3,030	0,030	
X1 Land Area	-1405,07	-2,770	0,028*	3,081
X2 Labor Cost	7,734	8,241	0,000*	1,054
X3 Fertilizer Cost	0,228	0,424	0,673	1,013
X4 Seed Cost	0,259	2,770	0,007*	2,983
X5 Feed Cost	0,387	0,246	0,806	1,030
F-Value = 3101,062				
R^2 = 0,993 (99,3%)				
@ = 5% (0,05)				
* = Significant at a confidence level of 0.05 (95%)				

F-Table on df 1 = 5 and df 2 = 95 = 2,31
t-table on df 2 = 1,630

- ✓ Normality Test

  This test indicates that the regression model follows a normal distribution, as seen from the residual results with Kolmogorov-Smirnov, showing a value of 0.000 (< 0.005).

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		100
Normal Parameters[a,b]	Mean	,0000000
	Std. Deviation	500318,90223312
Most Extreme Differences	Absolute	,128
	Positive	,114
	Negative	-,128
Test Statistic		,128
Asymp. Sig. (2-tailed)		,000[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Figure 1. Kolmogorov-Smirnov Test

- ✓ Multicollinearity Test

  This test indicates that the independent variables mentioned above do not display multicollinearity issues. Multicollinearity occurs when independent variables in a regression model are highly correlated with each other, which can cause instability in the estimation of the regression coefficients. The Variance Inflation Factor (VIF) is a measure used to detect multicollinearity, and a VIF value of less than 10 is often considered acceptable. In Table 3, the VIF values for the independent variables are all below 10, indicating that multicollinearity is not a concern in the regression analysis.
- ✓ Heteroskedasticity Test

  The Heteroskedasticity Test indicates that there is no heteroskedasticity present in the variables used in the regression model. This conclusion is drawn from the scatter plot graph, which illustrates that the data points are evenly distributed across all ranges. Heteroskedasticity refers to the situation where the variability of a variable differs across the range of values of another variable. In regression analysis, heteroskedasticity can lead to biased and inconsistent estimates of the regression coefficients, affecting the reliability of the model's predictions. Therefore, the absence of heteroskedasticity ensures the robustness and validity of the regression analysis results.

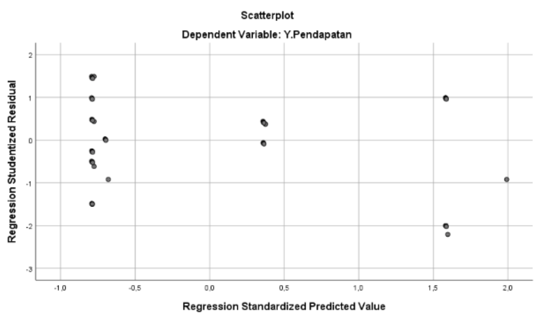

Figure 2. Scatter Plot of Heteroskedasticity Test

- ✓ Coefficient of Determination Test (R2)

  From the R-squared test results, it is evident that the independent variables (seed cost, fertilizer cost, labor cost, feed cost, land area) can explain the dependent variable (income) by 99.4 percent, while the remaining 0.6 percent is explained by other variables outside the model. This is confirmed by the R-squared value of 0.994 percent as shown in Table 3 R-squared, also known as the coefficient of determination, measures the proportion of the variance in the dependent variable that is predictable from the independent variables in the regression model. A higher R-squared value indicates that a larger proportion of the variance in the dependent variable is explained by the independent variables, suggesting a better fit of the regression model to the data. Therefore, with an R-squared value of 0.994 percent, it can be inferred that the independent variables in the model have a strong explanatory power for the variation in the dependent variable.

✓ Simultaneous Test (F-test)

From the F-test results, it can be concluded that statistically, the seed cost and labor cost significantly influence the income of tilapia farmers using the ponding system. This is evidenced by the value of F calculated being greater than the critical F-value (3101.062 > 2.31) at a confidence level of 95%, as shown in Table 3. The F-test is used to determine whether there is a significant overall effect of the independent variables on the dependent variable in a regression model. In this case, since the calculated F-value exceeds the critical F-value, it indicates that at least one of the independent variables has a significant effect on the dependent variable. Specifically, the seed cost and labor cost have been identified as significant predictors of the tilapia farmer's income using nursery system.

DISCUSSION

Table 3 indicates that the variables obtaining significant regression coefficients are the seed cost and labor cost, while the variables that do not obtain significant regression coefficients are the fertilizer cost, feed cost, and land area. The explanation for these variables can be outlined as follows:

✓ Land Area (X1)

The land area variable has a negative effect on the income of milkfish farmers using the nursery system, with a regression coefficient value of -1405.069 and a t-value < t-table (-2.230 < 1.630) at 0.05 significance level. This means that for every increase of 1 square meter in land area, the income of milkfish farmers using the ponding system decreases by -1405.069 units. This indicates that in the research area, an increase in land area can decrease the income of milkfish farmers using the nursery system.

The results of this study are consistent with Pratiwi (2022), which stated that labor has a negative effect on the income of milkfish farming. The hypothesis testing results on the land area variable in this study differ from the findings of Pezi *et al*. (2021), which explained that there is a significant influence between land area and income, while this study states that land area does not show a significant influence on income. Further research is needed on the quality of soil or land in the study area to determine the land's ability to support the production process.

The negative coefficient for the land area variable suggests that an increase in land area has a detrimental effect on the income of milkfish farmers using the nursery system. This finding contradicts the initial assumption that a larger land area would lead to higher income. However, it's essential to delve deeper into the context and potential reasons behind this observation. One plausible explanation could be related to the management capacity of farmers. With a larger land area, farmers may face challenges in effectively managing their operations, including maintaining water quality, monitoring fish health, and controlling environmental factors. This could result in decreased productivity and ultimately lower income. Additionally, environmental factors such as soil quality, water availability, and climate conditions may vary across different land areas, influencing the suitability for milkfish farming. Farmers with larger land areas may encounter more significant variability in these factors, affecting overall productivity and income.

✓ Labor Cost (X2)

The variable labor cost has a significant positive effect on the income of milkfish farmers using the nursery system, with a regression coefficient of 7.734 and a calculated t-value greater than the critical t-value (8.241 > 1.630) at the 0.05 significance level. This indicates that each increase in labor cost by 1 unit will increase the income of milkfish farmers using the nursery system by 7.734 rupiah. Therefore, any increase in the number of workers in the research area can enhance the income received by milkfish farmers using the nursery system.

The findings are consistent with the research conducted by Isfrizal & Bobby (2018) and Nugraha & Maria (2021), indicating that labor significantly influences the income of farmers These results align with the initial hypothesis, which suggests that the labor variable has a positive effect on the income of milkfish farmers. Drawing parallels between their findings and the current research on milkfish farming, it suggests that the role of labor in enhancing income is a consistent trend across different agricultural sectors. Specifically, in the context of milkfish farming with the nursery system, the positive influence of labor on income aligns with the results obtained in the present study.

The similarity in findings between the two studies underscores the importance of labor in agricultural activities and its direct impact on farmers' income. It also highlights the broader applicability of research findings across different agricultural contexts, providing valuable insights into the factors influencing farmers' livelihoods.

✓ Fertilizer Cost (X3)

The variable of fertilizer cost does not have a significant impact on the income of milkfish farmers using the nursery system, with a regression coefficient value of 0.228 and a t-value less than the t-table value (0.424 < 1.630) at a 0.05 significance level. This indicates that for every increase in fertilizer cost by 1 unit, the income of milkfish farmers using the nursery system decreases by 0.228 rupiah. Therefore, any increase in fertilizer cost leads to a decrease in income. According to economic theory, if production costs increase, the income received by farmers tends to decrease, assuming other factors remain constant.

The findings of this study align with Purwati (2019), who observed that fertilizer costs do not significantly influence the income of milkfish farmers. This could be attributed to several factors. First, the cost of fertilizers might be relatively small compared to other production costs, such as labor, feed, and land maintenance, thus having a minimal impact on overall income. In aquaculture, particularly in milkfish farming, feed costs and labor tend to dominate the expense structure. Consequently, even significant changes in fertilizer costs might not substantially alter the total cost or income.

Second, the effectiveness of fertilizers in enhancing productivity may vary. If the fertilizers used are not significantly improving the quality or quantity of the yield, then any expenditure on them would not translate into higher income. This could be due to factors such as the type of fertilizer, its application method, or the specific conditions of the aquaculture environment that limit its effectiveness.

Additionally, it is possible that farmers in the study area have optimized the use of fertilizers to a level where further increases do not yield proportional benefits. This phenomenon is known as diminishing marginal returns, where each additional unit of input results in progressively smaller increases in output.

Overall, these insights highlight the importance of a holistic approach in aquaculture management. While fertilizers are a crucial input, their impact on income must be considered alongside other factors. Further research could explore the interactions between various inputs and how they collectively influence productivity and profitability in milkfish farming.

✓ Seed Cost (X4)

The variable of seed costs has a significant positive effect on the income of milkfish farmers using the nursery system, with a regression coefficient value of 0.259 and a t-value greater than the critical T-value (2.270 > 1.630) at the 0.05 significance level. This means that for every 1 unit increase in seed costs, the income of milkfish farmers using the nursery system increases by 0.259 rupiah.

The findings of this study align with Nur (2022), who observed that seed costs significantly influence the income of milkfish farmers. In the research area, this indicates that increasing seed costs can still enhance income. The additional expenditure on purchasing more seeds is smaller than the additional revenue generated, leading to an increase in income. This implies that the more money spent on purchasing high-quality seeds, the higher the income that will be received by milkfish farmers using the nursery system.

This relationship can be explained by the fact that high-quality seeds tend to have better growth rates, higher survival rates, and ultimately result in a higher yield. Therefore, investing in quality seeds can lead to increased production efficiency and profitability.

Moreover, the positive impact of seed costs on income underscores the importance of selecting superior seed varieties. Farmers who invest in better seeds are likely to see a return on their investment through improved production outcomes. This finding aligns with broader agricultural principles where the quality of initial inputs significantly affects the final output.

✓ Feed Cost (X4)

The variable of feed costs has a negative effect on the income of milkfish farmers using the nursery system, with a regression coefficient value of -0.387 and a t-value less than the critical t-value (0.246 < 1.630) at the 0.05 significance level. This indicates that for every unit increase in feed costs, the income of milkfish farmers using the nursery system decreases by 0.387 rupiah. The findings of this study align with Hafizah (2020), who observed that feed costs do not significantly influence the income of milkfish farmers. This finding suggests that in the research area, an increase in feed costs leads to higher production costs, thereby reducing the income received by the milkfish farmers. According to economic theory, when production costs increase, the income tends to decrease, assuming all other factors remain constant.

Several factors could explain this negative impact of feed costs on income. One possibility is that the cost of feed might be disproportionately high relative to its contribution to growth and yield. If the quality or efficiency of the feed is low, farmers may not see a proportional increase in fish growth, leading to inefficiencies and higher costs without a corresponding increase in revenue.

Another factor could be related to the overall feed management practices. Poor feed management, including overfeeding or underfeeding, can lead to wastage and higher costs without improving fish growth rates. Additionally, high feed costs can strain the financial resources of farmers, limiting their ability to invest in other critical inputs such as labor or equipment, further reducing overall productivity.

Furthermore, environmental conditions and water quality play a crucial role in the efficiency of feed utilization. If these conditions are sub-optimal, the effectiveness of the feed can be compromised, resulting in higher costs without the desired increase in fish growth and yield. This observation aligns with broader economic principles where managing input costs is crucial for maintaining profitability. High feed costs can erode the profit margins of farmers, making it essential to optimize feed use and seek cost-effective alternatives.

In conclusion, the negative effect of feed costs on income highlights the importance of efficient feed management practices and the need for farmers to balance feed costs with other inputs to maintain profitability. Addressing these issues through better feed quality, improved management practices, and optimizing environmental conditions can help mitigate the negative impact on income.

CONCLUSION

Turi District, located in Lamongan Regency, is part of the Bonorowo area, which encourages the local community to engage in milkfish farming using the nursery system. This system is considered the most effective method for cultivating milkfish. Additionally, the majority of the income of milkfish farmers in this area comes from the sale of nursery milkfish.

The production factors that positively influence the income of milkfish farmers using the nursery system include the cost of seedlings, labor costs, and land area. In contrast, fertilizer costs and feed costs do not positively affect the income of milkfish farmers utilizing this system. Overall, the findings suggest that while certain costs, such as labor and seedlings, are crucial for enhancing income, managing other input costs effectively remains essential for maintaining profitability in milkfish farming using the nursery system. Further research is needed to explore strategies for optimizing these production factors to improve the economic outcomes for farmers in Turi District.

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REFERENCES

Astari, T. D., Abubakar, A., & Sulandjari, K. (2023). Pengaruh faktor produksi terhadap produksi ikan bandeng di Kecamatan Tirtajaya Kabupaten Karawang. *Jurnal Ilmiah Mahasiswa AGROINFO GALUH*, *10*(3), 2052-2063.

Direktorat Jendral Perikanan Budidaya. (2019). *Profil Investasi Perikanan Budidaya: Investasi yang Prospektif*. Jakarta: Direktorat Jenderal Perikanan Budidaya.

Ghozali, I. (2018). *Aplikasi Analisis Multivariate dengan Program IBM SPSS 25*. Semarang: Badan Penerbit Universitas Diponegoro.

Hafizah, E. (2020). *Analisis usaha budidaya tambak dan pemasaran ikan bandeng (Chanos chanos) (Kasus: Desa Tanjung Rejo, Kecamatan Percut Sei Tuan, Kabupaten Deli Serdang)* (Disertasi Doktor, Universitas Sumatera Utara).

Haikal, E., Hanisah, H., Isma, M. F., & Mastuti, R. (2024). Analisis efisiensi faktor produksi pada usaha budidaya ikan bandeng di Kecamatan Seruway Kabupaten Aceh Tamiang. *Jurnal Perikanan Unram*, *13*(3), 659-673.

Isfrizal, & Bobby, R. (2018). Pengaruh luas lahan persawahan, modal, dan tenaga kerja terhadap pendapatan petani sawah pada Kecamatan Syamtalira Aron Kabupaten Aceh Utara. *Jurnal Akuntansi dan Pembangunan, 4*(1).

Iswati, H., Syahni, R., & Maiyastri. (2014). Perbandingan penduga ordinary least square (OLS) dan generalized least squares (GLS) pada model regresi linier dengan regresor bersifat stokastik dan galat model berautokorelasi. *Jurnal Matematika UNAND*, *3*(4), 168-176.

Kementerian Kelautan dan Perikanan. (2022). *Hasil Produksi Perikanan Budidaya di Indonesia*. Diakses pada 20 Mei 2024 dari https://www.kkp.go.id/

Leksono, P. D. C., & Poniran. (2014). Penggelondongan ikan bandeng di tambak dengan kepadatan berbeda. *Buletin Teknik Litkayasa Akuakultur, 14*(2), 119-122.

Machmudin, N., Sulistyo, A., & Purwati, Y. (2019). Efisiensi produksi budidaya ikan bandeng (*Chanos chanos*) di Kota Tarakan. *J-PEN Borneo: Jurnal Ilmu Pertanian*, *2*(1).

Maramba, U. (2018). Pengaruh karakteristik terhadap pendapatan petani jagung di Kabupaten Sumba Timur (Studi kasus: Desa Kiritana, Kecamatan Kambera, Kabupaten Sumba Timur). *Jurnal Ekonomi Pertanian dan Agribisnis (JEPA), 2*(2), 94-101.

Mardani, M., Nur, T. M., & Satriawan, H. (2017). Analisis usaha tani tanaman pangan jagung di Kecamatan Juli Kabupaten Bireuen. *Jurnal Sains Pertanian, 1*(3).

Marhawati, M., & Ma'ruf, M. I. (2018). Analisis faktor-faktor yang memengaruhi produksi ikan bandeng di Kecamatan Ma'Rang Kabupaten Pangkep. *JEKPEND: Jurnal Ekonomi dan Pendidikan, 1*(2), 50.

Masruroh, M., & Subekti, R. (2016). Aplikasi regresi partial least square untuk analisis hubungan faktor-faktor yang mempengaruhi indeks pembangunan manusia di Kota Yogyakarta. *Media Statistika, 9*(2), 75-84.

Mudrajad, K. (2001). *Metode Kuantitatif (Teori dan Aplikasi untuk Bisnis dan Ekonomi)* (Edisi Pertama). Yogyakarta: UPP AMP YKPN.

Nugraha, C. H. T., & Maria, N. S. B. (2021). Analisis faktor-faktor yang mempengaruhi pendapatan petani padi (Studi kasus: Kecamatan Godong, Kabupaten Grobogan). *Diponegoro Journal of Economics, 10*(1).

Nur, Q. M. (2022). *Analisis Efisiensi Penggunaan Faktor-Faktor Produksi Pada Usahatani Tambak Ikan Bandeng (Studi Kasus Kecamatan Woha Kabupaten Bima)*. (Disertasi Doktor, Universitas Mataram).

Pavelescu, F. M. T. H. (2004). Features of the ordinary least square (OLS) method implications for the estimation methodology. *Romanian Journal of Economic Forecasting, 1*(2), 85-101.

Pezi, J., Januardy, U., & Dian Novita, U. (2021). Faktor-faktor yang mempengaruhi pendapatan petani tambak ikan bandeng (*Chanos chanos*) di Dusun Sungai Mas Desa Sebatuan Kecamatan Pemangkat. *Nekton: Jurnal Perikanan dan Ilmu Kelautan, 1*(1), 9-17.

Pratiwi, P. A. N., & Abadi, S. (2022). Pengaruh faktor produksi terhadap pendapatan pembudidaya ikan bandeng di Desa Pantai Sederhana Kecamatan Gembong. *Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agri Bisnis*, *9*(1), 72-81.

Purwati, Y. (2019). Analisis efisiensi teknis produksi ikan bandeng (*Chanos chanos*) di Kota Tarakan (Skripsi). Diakses dari https://repository.ubt.ac.id/?p=show_detail&id=/index.php?p=show_detail&id=9855&keywords= pada 20 Mei 2024.

Sumartin. (2017). Analisis efisiensi faktor produksi usaha budidaya ikan bandeng (*Chanos chanos*) (Studi kasus pada alumni peserta pelatihan budidaya ikan di BPPP Banyuwangi). *Journal of Aquaculture Science, 2*(1), 43-60.

Wahyuni, T. D., Sasongko, S., & Muljaningsih, S. (2019). Analisis efisiensi dan faktor-faktor produksi komoditas sektor basis Kabupaten Pati (Studi kasus budidaya ikan bandeng Kabupaten Pati, Jawa Tengah). *Jurnal Sosial Ekonomi Kelautan dan Perikanan, 14*(1), 59-72.

Walpole, E. R. (2006). *Probability and Statistics for Engineers and Scientists* (8th ed.). New Jersey: Prentice Hall.

Yuliansyah, L. F. A., & Ramdhayani, H. G. (2023). Penyuluhan kesehatan kedokteran kepulauan di daerah pesisir. *Jurnal Pengabdian Magister Pendidikan IPA, 6*(1).