

# Analysis of Production Factors and Allocative Efficiency In Tilapia Fish Hatchery In Tanjung District, Tabalong Regency

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## Abstract.

*Tilapia fish hatchery business in Tabalong Regency has an important role as a seed provider for tilapia fish cultivation activities. The study aims to analyze the allocation of production factors in tilapia fish hatchery to achieve optimal conditions. This study was conducted in Tanjung District, Tabalong Regency, South Kalimantan Province using a purposive sampling method because the area is a center for tilapia fish hatchery, with a population of 61 farmers who met the respondent criteria, namely aged over 15 years, willing to be interviewed, and are tilapia fish farmers. The production factors of pond area, number of broodstock, feed, labor, and fertilizer significantly influence tilapia seed production in Tanjung District, Tabalong Regency. Partially, the factors with significant influences are the number of broodstock and feed, with positive elasticities of 0.633 and 0.417, respectively. The results of allocative efficiency show that the number of broodstock in tilapia fish  $NPMXi/PXi$  is  $29.583 > 1$ , so the use of the number of broodstock is not efficient and still needs to be increased, while the feed in tilapia fish  $NPMXi/PXi$  is  $0.045 < 1$ , so the use of feed is not efficient because it is excessive and needs to be reduced. Thus, optimal production can be achieved by increasing the number of broodstock appropriately and controlling feed use so that production costs are more efficient and the production results of tilapia fish seeds increase.*

**Keywords:** Allocative; Efficiency; Tilapia; Seeding and Tabalong.

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## I. INTRODUCTION

The productivity of tilapia (*Oreochromis niloticus*) cultivation plays a crucial role in supporting food security and boosting the economy of the aquaculture sector in Indonesia. Tilapia is a widely cultivated freshwater fish commodity due to its rapid growth, adaptability to environmental conditions, and relatively stable market demand. Partowijoto (2003) notes that increasing tilapia production is a crucial factor in supporting national food security. The development of tilapia cultivation is also influenced by technological mastery and sound business management systems, which can sustainably increase productivity (Primawanti & Ali, 2023). These advantages make tilapia cultivation a strategic sector that requires continued development.

Tabalong Regency, a region in South Kalimantan Province, holds significant potential for the development of the aquaculture sector. This potential is supported by the Tabalong River, approximately 75 km long and 60 m wide, which is utilized by the community for cage tilapia cultivation. Furthermore, Tabalong Regency has 7,866 hectares of potential pond land, but only about 90,819 hectares will be utilized by 2025, consisting of 88.5 hectares for tilapia fish grow-out ponds and approximately 69 hectares for tilapia fish hatchery ponds. Tabalong Regency also has 16,516 hectares of flooded land used for capture fish farming in public waters such as reservoirs, rivers, and swamps. This situation indicates that Tabalong Regency has significant potential for developing the aquaculture and hatchery business (Central Statistics Agency of Tabalong Regency, 2024).

The development of the aquaculture sector in Tabalong Regency can be seen in the increase in tilapia fish production during 2022–2024. The total production of cultivated tilapia fish in 2022 was 16,160.5 tons, increasing to 17,124.22 tons in 2023, and increasing again to 18,075.8 tons in 2024. The highest production came from tilapia fish (*pangasius*), followed by tilapia fish, catfish, carp, freshwater pomfret, climbing perch, and snakehead fish. Tilapia fish production increased from 5,546.56 tons in 2022 to 5,760.90 tons in 2023 and increased again to 5,973.08 tons in 2024. This increase in production shows that tilapia fish is one of the leading commodities that has a major contribution to the development of the cultivated tilapia fish sector in Tabalong Regency.

Increasing the production of tilapia fish for consumption must be supported by the availability of sufficient, high-quality tilapia fish fry. Based on data from Tabalong Regency's tilapia fish hatchery production for 2022–2024, tilapia fish fry production was the highest compared to other tilapia fish species. Tilapia fish fry production in 2022 reached 35,321,000, then increased to 41,416,000 in 2023 and again to 43,429,000 in 2024. Sutiah (2013) stated that optimizing tilapia fish hatchery production is crucial to the success of tilapia fish grow-out cultivation businesses. The availability of quality fry will significantly determine the growth rate, survival rate, and productivity of tilapia fish during the grow-out stage.

The tilapia fish hatchery business in Tabalong Regency plays a crucial role as a supplier of fry for tilapia fish grow-out cultivation activities. The tilapia fish hatchery area in Tabalong Regency covers approximately 690,000 m<sup>2</sup>, with 87 tilapia fish farming households (RTP). Tanjung District is one of the centers of tilapia fish hatchery production. This district is the administrative center of Tabalong Regency and has conditions that are quite supportive of tilapia fish farming activities. The high tilapia fish production in Tabalong Regency has led to a growing demand for tilapia fish fry, thus offering good prospects for sustainable development in the tilapia fish hatchery business in Tanjung District.

The success of a tilapia fish hatchery business is greatly influenced by the farmer's ability to optimally manage production factors. These factors include broodstock, feed, labor, pond size, medicines, and other production facilities (Widiastuti, 2013). Florenthya (2013), the appropriate use of production factors will influence the level of production in a tilapia fish farming business. Inefficient use of production factors can lead to higher production costs and suboptimal results. One common problem in tilapia fish hatchery operations is the use of broodstock that has passed its productive period, which affects the quality and quantity of fry produced. Furthermore, the use of inappropriate feed can increase production costs without significantly increasing tilapia fish production.

Allocative efficiency is a crucial aspect of production activities because it relates to the farmer's ability to allocate production factors optimally according to prevailing input and output prices. Azhari (2015) explains that allocative efficiency is achieved when the use of production factors is in accordance with the combination that can maximize tilapia fish profits. In tilapia fish hatchery operations, efficient use of production factors is crucial for tilapia fish because production costs are relatively high, particularly for broodstock procurement, feed, and labor. Putra et al. (2014) and Rewanda et al. (2021) found that production factors such as feed, labor, and pond size influence the production level of tilapia fish cultivation. Efficient management of production factors is necessary for tilapia fish hatchery businesses to generate optimal profits for farmers (Jaya, 2020).

The research aims to analyze the factors that influence the production of tilapia fish seeds and analyze the allocation of the use of production factors in tilapia fish seed production to achieve optimal conditions.

## II. METHODS

The research was conducted in Tanjung District, Tabalong Regency, South Kalimantan Province. The location was purposively sampled, considering that the area is a center for tilapia fish hatcheries in Tabalong Regency. The study population consisted of 61 tilapia fish fry farmers in Tanjung District, Tabalong Regency. The criteria for selecting respondents were as follows:

- Respondents were over 15 years old and were deemed capable of objectively raising tilapia fish.
- Willing to be interviewed using the provided questionnaire.
- Tilapia fish hatchery farmers in Tanjung District.

### Cobb-Douglas Production Function Analysis

Soekartawi (2002), the Cobb-Douglas function is a production function involving one dependent variable (output) and one or more independent variables (inputs). This function is widely used because it can be easily transformed into a linear form using logarithms, simplifying the regression analysis process. Furthermore, its regression coefficients directly indicate the production elasticity of each factor of production.

Rachmawati's (2010) research used the Cobb-Douglas approach to analyze the influence of

production factors on Indonesia's economic growth. The results showed that capital and labor significantly influence long-term economic growth. The regression model used in this study is:

$$\ln(Y) = \beta_0 + \beta_1 \ln(X_1) + \beta_2 \ln(X_2) + \beta_3 \ln(X_3) + \beta_4 \ln(X_4) + \beta_5 \ln(X_5) + e$$

Description:

- $Y$  = Tilapia fish seed production
- $X_1$  = Pond area
- $X_2$  = Number of broodstock
- $X_3$  = Feed
- $X_4$  = Labor
- $X_5$  = Fertilizer use
- $\beta_0$  = Constant
- $\beta_1 - \beta_5$  = Production elasticity (Cobb-Douglas coefficient)
- $e$  = Error/residual

#### Allocative Analysis

Allocative efficiency analysis occurs when a farmer is able to create a tilapia fishery whose marginal product (NPM) for an input is equal to the price of the input (Px):

$E_p = dy/dx \cdot x/y$ , Marginal Product (PM) =  $dy/dx$ , while the average product (PR) =  $d/x$

Soekartawi (2002), the marginal product of Tilapia fish is the product of the marginal product and the price of the product, using the formula:  $NPM = PM \cdot P_x$

Rifiana et al. (2010) and Magdanid kk (2010), to determine the level of allocative efficiency of production factor use, a ratio analysis is used between the marginal product of Tilapia fish and the price of the production factor the formula used is:

$$\frac{NPM_{X_i}}{P_{X_i}} = \frac{b_i \cdot Y \cdot P_y}{X_i \cdot P_{X_i}}$$

$$\frac{NPM_{X_i}}{P_{X_i}} = \frac{b_i \cdot Y \cdot P_y}{X_i \cdot P_{X_i}}$$

Description:

- $\beta_i$  = regression coefficient of variable  $X_i$
- $Y$  = average production
- $X_i$  = average input usage
- $P_y$  = output price
- $P_{X_i}$  = input price

Soekartawi (1990) in Warsana (2007) divides the criteria for allocative efficiency as follows:

- $\frac{NPM_{X_i}}{P_{X_i}} = 1$  means the allocation of production factors is efficient
- $\frac{NPM_{X_i}}{P_{X_i}} > 1$  means the use of production factors is inefficient and needs to be increased
- $\frac{NPM_{X_i}}{P_{X_i}} < 1$  means the use of production factors is inefficient and needs to be reduced

### III. RESULT AND DISCUSSION

#### Cobb-Douglas Production Function Analysis

##### Classical Assumption Test

##### Linearity Test

A linearity test is performed to determine whether the relationship between the independent and dependent variables is linear. In this study, the linearity test was used to determine whether production factors such as pond area, number of broodstock, feed, labor, and fertilizer use have a linear relationship with tilapia fish seed production. The linearity test was performed using the Test for Linearity

(Deviation from Linearity) in SPSS. The test was conducted at a significance level of  $\alpha = 0.05$ . Hypothesis:

- $H_0: \mu=0$  (data has a linear relationship)
- $H_1: \mu \neq 0$  (data has a non-linear relationship)
- Hypothesis  $H_0$  is rejected if tilapia fish Sig. < 0.05

Linearity

Table 1. Linearity Test Result

Variable	Linearity Test			Test Result
	Statistic	df	Sig.	
LN Seed Production * LN Pond Area	1,188	19	0,314	Meets Linearity Assumption
LN Seed Production * LN Number of Broodstock	1,235	4	0,307	Meets Linearity Assumption
LN Seed Production * LN Feed	1,714	13	0,090	Meets Linearity Assumption
LN Seed Production * LN Labor	0,383	3	0,766	Meets Linearity Assumption
LN Seed Production * LN Fertilizer Use	-	-	-	Categorical Variable

Interpretation:

Based on the linearity test results, the variables pond area, number of broodstock, feed, and labor meet the linearity assumption because they have tilapia fish with a significant Deviation from Linearity greater than 0.05. However, the variable fertilizer use was not tested for linearity because it is a categorical (dummy) variable.

**Normality Test**

A normality test was performed to determine whether the residuals of the regression model were normally distributed. The normality test was performed using the Shapiro-Wilk and Lilliefors test. The test was conducted at a significance level of  $\alpha=0.05$ . Hypothesis:

- $H_0: \mu=0$  (data has a normal distribution)
- $H_1: \mu \neq 0$  (data has a non-normal distribution)
- Hypothesis  $H_0$  is rejected if tilapia fish Sig. < 0.05

Table 2. Normality Test Result

Test	Normality Test			Test Result
	Statistic	df	Sig.	
Kolmogorov-Smirnov	0,083	61	0,200	Meets Normality Assumption
Shapiro-Wilk	0,975	61	0,243	Meets Normality Assumption

Interpretation:

Based on the results of the normality test using the Kolmogorov-Smirnov and Shapiro-Wilk tests, the residuals of the regression model meet the assumption of normality because the tilapia fish significance level is greater than 0.05.

**Heteroscedasticity Test**

A heteroscedasticity test was conducted to determine whether there was inequality in the residual variances in the regression model. The heteroscedasticity test was conducted using the Breusch-Pagan Test. The test was conducted at a significance level of  $\alpha=0.05$ . Hypothesis:

- $H_0: \mu=0$  (Data does not experience heteroscedasticity (homogeneous))
- $H_1: \mu \neq 0$  (Data experiences heteroscedasticity)
- Hypothesis  $H_0$  is rejected if tilapia fish Sig. < 0.05

Table 3. Heteroscedasticity Test Result

Test	Heteroscedasticity Test			Test Result
	Statistik	df	Sig.	

Breusch-Pagan	0,384	5	0,857	No Heteroscedasticity Occurs
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Interpretation:

Based on the results of the heteroscedasticity test using Breusch-Pagan, the significance value for tilapia fish was  $0,857 > \alpha(0,05)$ , thus failing to reject  $H_0$  which means the regression model does not experience heteroscedasticity.

**Autocorrelation test**

An autocorrelation test was conducted to determine whether there was a correlation between the residuals in the regression model. The autocorrelation test was performed using the Durbin-Watson Test. The test was conducted at a significance level of  $\alpha=0.05$ . Hypothesis:

- $H_0: \mu=0$  (Data does not experience heteroscedasticity (homogeneous))
- $H_1: \mu \neq 0$  (Data experiences heteroscedasticity)

With the following test criteria:

- If  $d < dL$  or  $d > 4-dL$  then reject  $H_0$
- If  $dU < d < 4-dU$  then accept  $H_0$
- If  $dL < d < dU$  or  $4-dU < d < 4-dL$  means there is no conclusion
- With tilapia fish  $dU = 1,7671$  and  $dL = 1,4146$

Table 4. Autocorrelation Test Result

Autocorrelation Test				
DW Calculate	dL	dU	4-dU	Test Result
1,641	1,4146	1,7671	2,2329	No Conclusion

Interpretation:

Based on the results of the Durbin-Watson test, the tilapia fish DW was 1.641 with tilapia fish  $dL=1.4146$  and  $dU=1.7671$ . The tilapia fish was in the region of  $dL < d < dU$ , namely  $1.4146 < 1.641 < 1.7671$ , so the test results were in the inconclusive area. However, the tilapia fish Durbin-Watson was close to 2 so the regression model did not show any serious autocorrelation problems.

**Multicollinearity test**

A multicollinearity test is conducted to determine whether there is a strong relationship between the independent variables in the regression model. The multicollinearity test uses the Variance Inflation Factor (VIF) of tilapia fish.

Test criteria:

- If the VIF of tilapia fish is  $<10$ , then multicollinearity is absent.
- If the VIF of tilapia fish is  $>10$ , then multicollinearity is present.

Table 5. Multicollinearity Test Result

Multicollinearity test			
Variable	Tolerance	VIF	Test Result
LN Pond Area	0,811	1,234	No Multicollinearity
LN Number of Broodstock	0,633	1,579	No Multicollinearity
LN Feed	0,767	1,304	No Multicollinearity
LN Labor	0,830	1,204	No Multicollinearity
Fertilizer Use	0,946	1,058	No Multicollinearity

**Estimation of the Cobb-Douglas Production Function with Multiple Linear Regression**

**F-Test (Simultaneous Test)**

The F-test is used to determine the effect of independent variables simultaneously or jointly on the dependent variable. In this study, the F-test was used to determine whether pond area, number of broodstock, feed, labor, and fertilizer use collectively affected tilapia fry production in Tanjung District, Tabalong Regency, South Kalimantan Province. The test was conducted at a significance level of  $\alpha=0.05$ .

The hypotheses used are as follows:

- $H_0$  : Pond area, number of broodstock, feed, labor, and fertilizer use simultaneously have no significant effect on tilapia fish fry production.

- $H_1$  : Pond area, number of broodstock, feed, labor, and fertilizer use simultaneously have a significant effect on tilapia fish fry production.

Test criteria:  $H_0$  is rejected if the significance (Sig.) is  $<0.05$ .

Table 6. F-Test Results

Source of Variation	Degree of Freedom	JK (Sum Sq)	KT (Mean Square)	Tilapia fish F	Sig.
Regression	5	11,628	2,326	7,183	<0,001
Residual	55	17,806	0,324		
Total	60	29,434			

Interpretation:

Based on the F-test results, the significance value for tilapia fish is  $<0.001 < \alpha(0.05)$ , so  $H_0$  is rejected. This indicates that pond area, number of broodstock, feed, labor, and fertilizer use simultaneously have a significant effect on tilapia fish seeds production.

### T-Test (Partial Test)

The T-test is used to determine the partial effect of each independent variable on the dependent variable. In this study, the T-test was used to determine the effect of pond area, number of broodstock, feed, labor, and fertilizer use on tilapia fish fry production.

The hypotheses used are as follows:

- $H_0$ : Pond area, number of broodstock, feed, labor, and fertilizer use have no significant partial effect on tilapia fish fry production.
- $H_1$ : Pond area, number of broodstock, feed, labor, and fertilizer use have a significant partial effect on tilapia fish fry production.
- Test criteria:  $H_0$  is rejected if the significance (Sig.) is  $<0.05$ .

Table 7. T-Test Results

Variable	Regression Coefficient (B)	Std. Error	Tilapia fish t	Sig.	Description
Constant	8,161	1,210	6,806	<0,001	Significant
LN Pond Area	0,092	0,098	0,933	0,355	Not Significant
LN Number of Broodstock	0,633	0,190	3,338	0,002	Significant
LN Feed	0,417	0,188	2,218	0,031	Significant
LN Labor	-0,012	0,172	-0,067	0,947	Not Significant
Fertilizer Use	-0,105	0,264	-0,398	0,692	Not Significant

Interpretation:

The tilapia fish pond area variable has a regression coefficient of 0.092, with a significance level of  $0.355 > \alpha(0.05)$ , thus failing to reject  $H_0$ . This indicates that pond area does not significantly affect tilapia fish fry production. This condition indicates that increasing the size of the pond used does not always increase tilapia fish fry production. This is suspected because some ponds are too large for hatchery activities, resulting in suboptimal fry management, particularly in water quality monitoring, feeding, and fry control.

In tilapia fish hatchery activities, the recommended pond size is generally not too large for more effective management. Spawning ponds typically have an area of around 50–100 m<sup>2</sup>, while nursery ponds range from 100–200 m<sup>2</sup> with a water depth of around 30–100 cm. With standard pond sizes, the fry rearing process can be carried out more optimally, resulting in improved growth and survival rates of tilapia fish fry.

For tilapia hatchery operations, the required size of the broodstock pond is usually determined by the stocking density. In spawning ponds, a common density is 2–4 broodstock per m<sup>2</sup>, depending on the rearing system and air quality.

- If there are 300 tilapia broodstock, the ideal pond size can be calculated as follows: If using a density of 4 broodstock/m<sup>2</sup>, the required pond area is approximately:  $300 \div 4 = 75 \text{ m}^2$
  - If using a density of 3 broodstock/m<sup>2</sup>, the required pond area is approximately:  $300 \div 3 = 100 \text{ m}^2$
- Therefore, the ideal pond size for 300 tilapia broodstock ranges from 75–100 m<sup>2</sup> with an air depth of approximately 80–120 cm to ensure optimal spawning and broodstock maintenance.

The variable of the number of broodstock has a regression coefficient of 0.633 with a significance of  $0.002 < \alpha (0.05)$ , thus rejecting  $H_0$ . This indicates that the number of broodstock has a significant effect on the production of tilapia fish seeds. The positive regression coefficient indicates that the increasing number of broodstock tends to increase the production of tilapia fish seeds, with an adequate number of broodstock increasing the production capacity of eggs and larvae of tilapia fish. Female broodstock that are ready to spawn are able to produce eggs in sufficient quantities, while the presence of balanced male broodstock helps the fertilization process to take place optimally. Therefore, the more productive broodstock used, the higher the production of tilapia fish seeds will be. In addition to the number, the quality of the broodstock also affects the success of the hatchery. Healthy, active, and appropriately sized broodstock will produce seeds with better quality and a higher survival rate. With a sufficient number of broodstock and good broodstock conditions, the spawning process can take place continuously so that seed production can increase optimally.

The feed variable has a tilapia fish regression coefficient of 0.417 with a tilapia fish significance of  $0.031 < \alpha(0.05)$ , thus rejecting  $H_0$ . This shows that feed has a significant effect on the production of tilapia fish seeds. Tilapia fish positive regression coefficient indicates that the increasing amount of feed, the production of tilapia fish seeds tends to increase. These results indicate that the variable amount of feed partially has a significant effect on the production of this fish seeding because feed has an important role because it is a source of energy and nutrition for fish, especially protein, fat, vitamins, and minerals needed for growth, maturation of broodstock gonads, spawning process, and survival of larvae and seeds. Broodstock tilapia fish that receive sufficient and good quality feed will have a healthier body condition, a higher reproductive rate, and are able to produce more eggs and larvae.

The labor variable has a tilapia fish regression coefficient of -0.012 with a tilapia fish significance of  $0.947 > \alpha (0.05)$ , thus failing to reject  $H_0$ . This indicates that labor does not have a significant effect on tilapia fish seed production. This can be explained rationally because an increase in the number of workers is not always followed by an increase in production results. In fish hatchery businesses, the production process is more influenced by technical factors such as broodstock quality, feed availability, water conditions, hatchery technology, and labor skills than the number of workers itself. In addition, the number of workers used by farmers is relatively sufficient to carry out the production process, so that additional labor does not provide significant additional output. This condition can cause the existing workforce to be less productive or there is a suboptimal division of labor. Thus, the size of the workforce is not the main factor that determines the high or low production of fish hatchery.

The variable for fertilizer use has a regression coefficient of -0.105 for tilapia fish, with a significance level of  $0.692 > \alpha(0.05)$ , thus failing to reject  $H_0$ . This indicates that fertilizer use does not significantly affect tilapia fish seed production. These results indicate that the fertilizer variable has no significant partial effect on fish seed production. Fertilizer use in seed production does not significantly affect tilapia fish seed production.

This condition may occur because in tilapia fish seed production, the primary need for seeds is met more by feeding than by the availability of natural food produced through pond fertilization. Fertilizer is generally used to increase water fertility and grow plankton as natural food, but in modern seed production, farmers tend to rely more on artificial feed, whose nutritional content is more guaranteed and easier to control.

Furthermore, using fertilizer in inappropriate doses or not routinely can result in less than optimal production. In some conditions, the water quality of ponds in Tanjung District may be sufficient to support natural plankton growth so that additional fertilizer does not make a significant difference to the production of tilapia fish seeds.

### Model Goodness-of-Fit

Model goodness-of-fit is used to determine the regression model's ability to explain the dependent variable using the tilapia fish coefficient of determination ( $R^2$ ). The higher the tilapia fish  $R^2$ , the better the model's ability to explain the dependent variable.

Table 8. Model Goodness-of-Fit Results

R	R Square	Adjusted R Square	Std. Error of the Estimate
0,629	0,395	0,340	0,56899

Interpretation:

Based on the Cobb-Douglas production function estimation results using multiple linear regression, the tilapia fish correlation coefficient (R) is 0.629, indicating a strong relationship between the independent variables and tilapia fish fry production. The tilapia fish coefficient of determination (R Square) of 0.395 indicates that 39.5% of the variation in tilapia fish fry production can be explained by the variables of fertilizer use, feed, pond area, labor, and number of broodstock. Meanwhile, the remaining 60.5% is explained by other factors outside the research model. Tilapia fish Adjusted R Square of 0.340 indicates that after adjusting for the number of independent variables, the model's ability to explain variations in tilapia fish seed production is 34.0%. Meanwhile, tilapia fish Std. Error of the Estimate of 0.56899 indicates the level of error in predicting the Cobb-Douglas production function model.

### The Developed Model

Based on the results of estimating the Cobb-Douglas production function using log-linear multiple linear regression, the following model was obtained:

$$\ln(Y) = 8,161 + 0,092\ln(X_1) + 0,633\ln(X_2) + 0,417\ln(X_3) - 0,012\ln(X_4) - 0,105(X_5)$$

Description:

$Y$  = Tilapia fish seed production

$X_1$  = Pond area

$X_2$  = Number of broodstock

$X_3$  = Feed

$X_4$  = Labor

$X_5$  = Fertilizer use (dummy)

0 = No fertilizer use

1 = Fertilizer use

Model Interpretation:

- The tilapia fish constant (intercept) of 8.161 is the natural logarithm of the technological efficiency parameter (A) in the Cobb-Douglas model, which indicates the baseline production level when all input variables are set at one unit.
- The tilapia fish production elasticity of pond area ( $\beta_1$ ) of 0.092 indicates that every 1% increase in pond area will increase tilapia fish fry production by 0.092%, assuming other variables remain constant. However, the effect of pond area is not statistically significant.
- The tilapia fish production elasticity of broodstock number ( $\beta_2$ ) of 0.633 indicates that every 1% increase in broodstock number will increase tilapia fish fry production by 0.633%, assuming other variables remain constant. The variable number of broodstock has a positive and significant effect on tilapia fish fry production.
- Tilapia fish feed production elasticity ( $\beta_3$ ) of 0.417 indicates that every 1% increase in feed will increase tilapia fish fry production by 0.417%, assuming other variables remain constant. The feed variable has a positive and significant effect on tilapia fish fry production.

- Tilapia fish labor production elasticity ( $\beta_4$ ) of -0.012 indicates that every 1% increase in labor will decrease tilapia fish fry production by 0.012%, assuming other variables remain constant. However, the effect of labor is not statistically significant, so the increase in labor has not significantly contributed to increased production.
- The coefficient of the dummy variable for fertilizer use ( $\beta_5$ ) of -0.105 indicates that farmers who use fertilizer tend to have lower tilapia fish fry production than those who do not use fertilizer. However, the effect is not statistically significant, so this variable does not significantly contribute to the estimated Cobb-Douglas production function.

**Allocative Efficiency Analysis of Production Factors**

Allocative efficiency analysis is used to determine the efficiency of production factor use in tilapia fish hatchery businesses. This analysis is conducted on variables that significantly influence tilapia fish fry production, namely the number of broodstock and feed. The level of allocative efficiency is calculated using the ratio of the Marginal Product (NPM) of tilapia fish to the price of the factor of production ( $P_x$ ). The formula used is:

$$\frac{NPM_{Xi}}{P_{Xi}} = \frac{b_i \cdot Y \cdot P_y}{X_i \cdot P_{Xi}}$$

$$\frac{NPM_{Xi}}{P_{Xi}} = \frac{b_i \cdot Y \cdot P_y}{X_i \cdot P_{Xi}}$$

Description:

- $\beta_i$  = Variable regression coefficient  $X_i$
- $Y$  = average production
- $X_i$  = average input usage
- $P_y$  = output price
- $P_{Xi}$  = input price

Allocative efficiency criteria:

- $\frac{NPM_{Xi}}{P_{Xi}} = 1 \rightarrow$  efficient
- $\frac{NPM_{Xi}}{P_{Xi}} > 1 \rightarrow$  input usage is not yet efficient so it needs to be increased
- $\frac{NPM_{Xi}}{P_{Xi}} < 1 \rightarrow$  input usage is inefficient so it needs to be reduced

Table 9. Allocative Efficiency Analysis of Production Factors

Variable	$\beta_i$	$Y$	$X_i$	$P_y$	$P_{Xi}$	$\frac{NPM_{Xi}}{P_{Xi}}$	Criteria
Number of broodstock	0.633	53934 .43	1.344	207.6229 508	178,279	29.583	Not yet efficient (needs to be increased)
Feed	0.417	53934 .43	83.11	207.6229 508	1,246,721	0.045	Inefficient (needs to be reduced)

Interpretation:

Based on the results of the allocative efficiency analysis, the number of broodstock tilapia fish  $NPM_{Xi}/P_{Xi}$  was  $29.583 > 1$ , indicating that the number of broodstock is inefficient and needs to be increased to achieve optimal production conditions. Meanwhile, the feed variable,  $NPM_{Xi}/P_{Xi}$  tilapia fish, was  $0.045 < 1$ , indicating that feed use is inefficient and needs to be reduced because input usage has exceeded optimal conditions.

#### IV. CONCLUSION

The production factors of pond area, number of broodstock, feed, labor, and fertilizer together have a significant effect on the production of tilapia fish seeds in Tanjung District, Tabalong Regency. Partially, the factors that have a significant effect are the number of broodstock and feed, with positive elasticities of 0.633 and 0.417, respectively. The results of allocative efficiency show that the number of broodstock in tilapia fish  $NPM_{Xi}/P_{Xi}$  is  $29.583 > 1$ , so that the use of the number of broodstock is not efficient and still needs to be increased, while the feed in tilapia fish  $NPM_{Xi}/P_{Xi}$  is  $0.045 < 1$ , so that the use of feed is not efficient because it is excessive and needs to be reduced. Thus, optimal production can be achieved by increasing the number of broodstock appropriately and controlling feed use so that production costs are more efficient and the production results of tilapia fish seeds increase.

#### REFERENCES

- [1]. Azhari, R. (2015). Efficiency of areca nut production factors in Pidie Regency (case study in Padang Tiji District). *Unsyiah Journal*, 3(2).
- [2]. Tabalong Regency Central Statistics Agency. (2024). *Tabalong Regency in Figures 2024*. Tabalong Regency Statistics Agency.
- [3]. Florenthya, P. R. (2013). Factors Influencing Marine Fish and Tilapia Production in Pesisir Selatan Regency. *Journal of Development Economics*, 1(02).
- [4]. Jaya, I. M. (2020). *Quantitative and Qualitative Research Methods: Theory, Application, and Real-Life Research*. Yogyakarta: Anak Hebat Indonesia.
- [5]. Partowijoto. (2003). *Increasing Production as a Resilience Factor*. Dunia Insinyur Magazine, Jakarta.
- [6]. Primawanti, E. P., & Ali, H. (2023). The Influence of Information Technology, Web-Based Information Systems, and Knowledge Management on Employee Performance (Literature Review of Executive Support Systems for Business). *Journal of Information Systems Management Economics*, 3(3), 267–285.
- [7]. Putra, O. W., Chalid, H. N., & Aqualdo, N. (2014). Analysis of factors influencing tilapia fish cultivation production in Singingi District, Kuantan Singingi Regency. *JOM Fekon*, 1(1).
- [8]. Rewanda, T., Sasmi, M., & Jamalludin. (2021). Analysis of factors influencing tilapia fish production in Tebing Tinggi Village, Benai District, Kuantan Singingi Regency. *Green Swarnadwipa Journal*, 10(3).
- [9]. Sutiah, S. (2013). Optimizing tilapia fish hatchery production. *Journal of Economics and Business*, 5(6).
- [10]. Widiastuti, H. (2013). *Optimization of input usage and financial analysis in tilapia fish rearing business in floating nets in Karangjambe Village, Wanadadi District, Banjarnegara Regency, Central Java (Thesis)*. Bogor Agricultural University.