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Analysis of Technical Efficiency of Milkfish Pond Farming in Sedari Village, Cibuaya District, Karawang Regency

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ABSTRACT

Milkfish is one of the leading aquaculture commodities which has high consumption value in Indonesia. The implementation of milkfish pond cultivation in Sedari Village, Cibuaya District is still not optimal because it is constrained by limited fertilizer provided by agricultural kiosks. The aim of this research is to identify the influence of production factors on production and to analyze the level of technical efficiency. The data analysis method used is the Stochastic Frontier production function. The research results show that the production factors that have a real and significant influence are pond area, seeds and labor. Meanwhile, the variables fertilizer, feed, pesticide, water pump and technology dummy did not have a significant effect on milkfish production in Sedari Village. Milkfish farming in Sedari Village is technically efficient because the average technical efficiency value is 0.84 with the highest efficiency level being 0.95 and the lowest efficiency level being 0.10.

INTRODUCTION

Fisheries are one of the sectors within the agricultural group that play a crucial role in the development of Indonesia's economy. The fisheries sector is a primary source of employment and income for the majority of Indonesians living in coastal areas. Indonesia possesses diverse fishery resources, including capture fisheries and aquaculture, both of which have significant potential for development. These resources are primarily focused on boosting the nation's economy (Juanti et al., 2014). This highlights that fish farming in Indonesia holds promising prospects, both for meeting domestic consumption needs and for export purposes.

Milkfish is a potential commodity widely distributed across Indonesia. West Java ranks third as a major production center for milkfish in Indonesia, following South Sulawesi and East Java (Ministry of Marine Affairs and Fisheries, 2019). Karawang Regency, located in West Java, is a key region for milkfish farming. It ranks second in production, with a yield of 19,783 tons, following Indramayu Regency, which produces 55,691 tons (Ministry of Marine Affairs and Fisheries, 2019).

Cibuaya District, within Karawang Regency, has a substantial area of fish ponds, covering 4,449 hectares (BPS Karawang Regency, 2022). Sedari Village, in particular, spans 3,787 hectares, of which 86.8% is pond area. As a result, the majority of the population in Sedari Village, comprising 462 people, are employed as milkfish farmers or laborers (Sedari Village Monograph Data, 2021). Fish farming in Sedari Village has been a long-established and generational business. According to observations at the research site, milkfish farming in Sedari Village is managed using both traditional and semi-intensive pond systems, differentiated by the stocking density of seeds and the type of feed provided (Ula & Kusnadi, 2017).

Farmers in Sedari Village face a significant challenge, namely the limited availability of fertilizers at local agricultural supply kiosks. This issue stems from the discontinuation of subsidized fertilizer allocation for aquaculture, as outlined in Minister of Agriculture Regulation No. 01 of 2020, which was eliminated in 2021. The limited supply of fertilizers has delayed farmers in starting their production cycles, specifically in land preparation. Furthermore, the limited involvement of fisheries extension officers and fish farming groups in Sedari Village has led to fish farmers relying solely on traditional, generational practices when it comes to using production inputs.

Given the circumstances, additional information is needed regarding the production factors affecting milkfish output and an analysis of the technical efficiency of the farming practices. Technical efficiency is influenced by the appropriate use of pond size, seeds, fertilizers, pesticides, and labor. The correct quantity or dosage of these inputs significantly impacts the level of technical efficiency. The aim of this study is to identify the influence of production factors on output and to analyze the level of technical efficiency in milkfish farming in Sedari Village, Cibuaya District, Karawang Regency.

METHOD

The research was conducted in Sedari Village, Cibuaya District, Karawang Regency, from August to November 2023. The population in this study consisted of 462 milkfish farmers in Sedari Village. A probability sampling method was used with a simple random sampling technique to determine the sample. Using the Slovin formula, the sample size was determined to be 42 respondents. This study utilized both primary and secondary data. Primary data were collected through direct interviews with the respondent using questionnaires, while secondary data were obtained from relevant institutions supporting this research. The analysis method used was Stochastic Frontier Analysis (SFA), employing the Cobb-Douglas production function. Mathematically, the production function is expressed as follows:

$$\text{Ln } Y = \text{Ln}a + b_1\text{Ln}X_1 + b_2\text{Ln}X_2 + b_3\text{Ln}X_3 + b_4\text{Ln}X_4 + b_5\text{Ln}X_5 + b_6\text{Ln}X_6 +$$

$b_7 LnX_7 + b_8 D + e^u$ ..... *(1)*

Explanation:

X_1 = Pond Area (hectarea)
X_2 = Milkfish seedlings (number of fish)
X_3 = Fertilizer (kg)
X_4 = Feed (kg)
X_5 = Pesticide (kg & liter)
X_6 = Labor (Person-days)
X_7 = Water Pump (Diesel fuel in liters)
D = Dummy Variable Technology
a = Constant (*intercept*)
e = Log Natural (2,178)
u = Error Term (*Disturbance term*)
$b_1,...,b_8$ = Regression coefficients or elasticity of each production factor

The technical efficiency of each farmer can be calculated using the following formula:

$$ET = \frac{Yi}{Yf} \times 100\% \text{ ..... } (2)$$

Explanation :

ET = Technical efficiency level
Yi = The amount of production (output) for farmer-i
Yf = The potential (frontier) production for farm-i

Decision criteria (Coelli *et al.,* 1998 in Machmuddin *et al*., 2018)

1. If the efficiency value is < 0,7 milkfish production is not technically efficient.
2. If the efficiency value is ≥ 0.7, milkfish production is technically efficient.

RESULT AND DISCUSSION

1. Analysis of Production Factors Affecting Milkfish Production

This study identified seven production inputs and one dummy variable: pond area, seedlings, fertilizer, feed, pesticides, labor, water pump, and technology dummy. These factors were analyzed using the stochastic frontier production function model with the Maximum Likelihood Estimation (MLE) approach to determine the optimal production level that can be achieved by combining the production factors (Coelli et al., 1998 in Machmuddin et al., 2018). The estimation results, generated through Frontier 4.1 software, are presented in Table 1.

Table 1. Estimation Results of the Stochastic Frontier Production Function

Variabel	Koefisien	Standar Error	t-hitung
Intercept	3,199	0,927	3,45
Ln Pond area (X_1)	0,564	0,155	***3,636**

Variabel	Koefisien	Standar Error	t-hitung
Ln Milkfish Seedlings (X_2)	0,275	0,112	**2,457
Ln Fertilizer (X_3)	0,012	0,069	0,181
Ln Feed (X_4)	0,009	0,015	0,607
Ln Pesticide (X_5)	0,017	0,075	0,236
Ln Labor (X_6)	0,163	0,074	**2,2088
Ln Water Pump (X_7)	0,052	0,031	1,675
Dummy Technology (D)	-4,827	3,146	-1,533
Sigma-Squared	1,5	0,642	2,336
Gamma	0,972	0,016	60,698
log likelihood function			-5,291
LR test of the one-sided error			18,257

Source: Primary Data, 2023 (Processed)

Explanation :

* = significant α = 1% (2,733)

** = significant α = 5% (2,034)

Based on the estimation results from Frontier 4.1 in Table 1, the influence of each production factor on milkfish farming in Sedari Village is as follows:

The Influence of Pond Area on Milkfish Production

The pond area variable has a t-value (3.636) greater than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating that pond area has a significant effect on milkfish production. The pond area has a positive coefficient of 0.564, meaning that for every 1% increase in pond area, milkfish production increases by 0.564%. The average pond size owned by the 42 respondent farmers in Sedari Village is 11 hectares. The larger the pond, the more milkfish can be cultivated, leading to increased production. Therefore, pond size positively affects the quality and optimal size and weight of the fish. This result aligns with a previous study by Wahyuni et al. (2019), which found that pond area significantly influenced milkfish production in Pati Regency.

The Influence of Seedlings on Milkfish Production

The seed (nener) variable has a t-value (2.457) greater than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating a significant effect on milkfish production. The seed variable has a positive coefficient of 0.275, meaning that a 1% increase in seed use will increase milkfish production by 0.275%. Similar findings were reported by Machmuddin et al. (2018) in Tarakan City, where milkfish production was influenced by the seed variable. Additionally, Lestariadi & Wati (2021) stated that seed density is a factor that affects production variation. However, the quality and quantity of seeds should be considered carefully to maximize the benefit of increasing seed usage (Sa'diyah et al., 2022).

The Influence of Fertilizer on Milkfish Production

The fertilizer variable has a t-value (0.181) less than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating that fertilizer does not significantly affect milkfish production. The fertilizer variable has a positive coefficient of 0.012, meaning that a 1% increase in fertilizer use would only increase production by 0.012%. The lack of proper fertilizer information causes suboptimal use. Traditional farmers in Sedari Village use an average ratio of 1:½ (100 kg urea and 50 kg SP36) per hectare. Semi-intensive farmers use varying dosages, some exceeding recommendations, while others fall short. This inconsistency may explain why fertilizer has no significant effect on production. The result is consistent with Machmuddin et al. (2018), who also found that fertilizer had no significant effect on milkfish production in Tarakan City.

The Influence of Feed on Milkfish Production

The feed variable has a t-value (0.607) less than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating that feed does not significantly affect milkfish production. Feed has a positive coefficient of 0.009, meaning that a 1% increase in feed usage would increase milkfish production by 0.009%. Semi-intensive farms use artificial feed to accelerate milkfish growth (Ula & Kusnadi, 2017). Extensive farms rely solely on natural food, while semi-intensive farms use pellet feed and expired bread. The average feed frequency in Sedari Village is once a day, which is not enough to have a significant impact on production, explaining why the feed variable is not significant.

The Influence of Pesticides on Milkfish Production

The pesticide variable has a t-value (0.236) less than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating that pesticides do not significantly affect milkfish production. Pesticides have a positive coefficient of 0.017, meaning that a 1% increase in pesticide use would increase production by 0.017%. Pesticides are used to control water pests and fish predators, but their application is based on experience rather than proper guidelines, which may result in lower effectiveness. This explains why pesticides do not significantly impact production in Sedari Village, similar to the findings of Sa'diyah et al. (2022) in Bima Regency.

The Influence of Labor on Milkfish Production

Labor has a t-value (2.208) greater than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating a significant effect on milkfish production. The labor variable has a positive coefficient of 0.163, meaning that a 1% increase in labor usage will increase milkfish production by 0.163%. Labor in Sedari Village includes land preparation, maintenance, and harvesting, with an average of more than five years of experience. Experienced laborers can address problems in the field, reducing the risk of crop failure and improving production. This result is

consistent with Machmuddin et al. (2018), who found that labor significantly affects milkfish production in Tarakan City.

The Influence of Water Pumps on Milkfish Production

The water pump variable, representing fuel used for pond water pumps, has a t-value (1.675) less than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating that water pumps do not significantly affect milkfish production. The water pump has a positive coefficient of 0.052, meaning that a 1% increase in water pump usage would increase milkfish production by 0.052%. However, water pump usage in Sedari Village depends on weather conditions and available funds, which may cause inconsistent usage and reduce its impact on production.

The Influence of Technology Dummy on Milkfish Production

The technology dummy variable has a t-value (-1.533) less than the t-table value (2.034) at the 5% significance level (α = 0.05), indicating that technology does not significantly affect milkfish production. The negative coefficient of -4.827 suggests that while technology has the potential to improve farming practices, improper application, such as infrequent feeding or insufficient stocking density, limits its effectiveness in increasing production.

2. Analysis of Technical Efficiency

The analysis of technical efficiency was conducted to address the second research question, which is to determine the level of technical efficiency in milkfish farming in Sedari Village. The distribution of technical efficiency levels achieved by the farmers is presented in Table 2.

Tabel 2. Distribution of Technical Efficiency Levels

No	Technical Efficiency Level	Respondent (Person)	Percentage (%)
1	TE ≤ 07	1	2
2	0,7< TE ≤ 0,8	5	12
3	0,8< TE ≤ 0,9	26	62
4	0,9< TE ≤ 1,0	10	24
Total		42	100
Average			0,8417
Maximum TE			0,9501
Minimum TE			0,1506

Source: Primary Data, 2023 (Processed)

A farm is considered efficient if it has reached an efficiency level of 0.7 or 70% (Coelli et al., 1998, in Machmuddin et al., 2018). Table 2 presents the results of technical efficiency levels in milkfish production in Sedari Village, showing the

minimum, maximum, and average technical efficiency levels. The technical efficiency levels achieved by milkfish farmers in the research area ranged from 0.15 to 0.95. Among the 42 respondents, 2% belonged to the group with an efficiency level of <0.7. Meanwhile, 12% were in the 0.76-0.78 efficiency range, 62% were in the 0.80-0.88 range (the largest proportion), and the remaining 24% were in the 0.90-0.95 range.

The minimum technical efficiency in milkfish production was 0.15, meaning the farmer only achieved 15% of the potential production. The maximum technical efficiency was 0.95, meaning the farmer achieved 95% of the potential production. The average technical efficiency of milkfish production was 0.84 or 84%, indicating that farmers still have the potential to increase production by 16% to reach maximum output. A farmer with the lowest technical efficiency, respondent No. 30, had an efficiency score of 0.15, indicating inefficiency. This inefficiency was caused by improper input combinations, particularly in terms of seed and labor usage. The seed density was below the recommended amount, and the lack of night supervision due to insufficient labor led to fish theft.

On the other hand, respondent No. 22 had the highest efficiency score of 0.95, meaning they had achieved technical efficiency. This was due to the appropriate use of inputs, particularly in optimizing the combination of inputs used. Additionally, this farmer's long experience of 40 years in milkfish farming contributed to their efficiency. Efficient farming practices, coupled with large land areas and sufficient, skilled labor, are crucial in achieving efficient milkfish farming.

CONCLUSION

Based on the research findings, the factors that significantly influenced milkfish production were pond size, seeds, and labor. Meanwhile, fertilizer, feed, pesticides, water pumps, and the technology dummy did not significantly impact production. Milkfish farming in Sedari Village was technically efficient, with an average technical efficiency score of 0.84, the highest efficiency being 0.95, and the lowest being 0.10. It is recommended that production factors be used according to the Standard Operating Procedure (SOP) for milkfish farming, and attention should be given to using inputs according to the type of pond employed. This can help increase production and improve technical efficiency in milkfish farming in Sedari Village, Cibuaya District, Karawang Regency.

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REFERENCES

Badan Pusat Statistik Kabupaten Karawang. (2022). Kecamatan Cibuaya Dalam Angka 2022. BPS Kabupaten Karawang, Karawang.

Desa Sedari. (2021). Data Monografi Desa Sedari. Desa Sedari, Kecamatan Cibuaya, Kabupaten Karawang.

Direktorat Jenderal Perikanan Budidaya, Kementerian Kelautan dan Perikanan. (2021). Laporan Kinerja Direktorat Jenderal Perikanan Budidaya tahun 2021. Ditjen Perikanan Budidaya KKP, Jakarta.

Islamiyah, D., Rachmawati, D., & Susilowati, T. (2017). Pengaruh Penambahan Madu Pada Pakan Buatan Dengan Dosis Yang Berbeda Terhadap Performa Laju Pertumbuhan Relatif, Efisiensi Pemanfaatan Pakan dan Kelulushidupan Ikan Bandeng. *Journal of Aquaculture Management and Technology,* 6(4), 67-76.

Juanti, F., Jumiati, A., & Santoso, E. (2014). Economic Landscape Subsektor Perikanan Pada Perekonomian Kabupaten Sidoarjo. *Jurnal Ekonomi Bisnis dan Akuntansi*, 1 (1): 42-52.

Sa'diyah, H., Marsum, N.Q. & Suparmin. (2022). Analisis Efisiensi Ekonomi dan Pendapatan Usaha Tambak Ikan Bandeng Di Kabupaten Bima. *Jurnal Agrimansion, 23(3),* 190-200.

Machmuddin, N., Sulistyo, A., & Purwati, Y. (2018). Analisis Efisiensi Produksi Budidaya Ikan Bandeng Di Kota Tarakan. *J-PEN Borneo: Jurnal Ilmu Pertanian,* 2(1), 1-7.

Ula,M., & Kusnadi,N. (2017). Analisis Usaha Budidaya Tambak Bandeng Pada Teknologi Tradisional Dan Semi Intensif Di Kabupaten Karawang. *Jurnal Forum Agribisnis,* 7(1), 49-61.

Wahyuni, T., Sasongko, & Muljaningsih, S. (2019). Analisis Efisiensi dan Faktor-Faktor Produksi Komoditas Sektor Basis Kabupaten Pati. *Jurnal Sosek KP,* 14(1), 59-72.