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Potential and Utilization Rate of Anchovy *(Stolephorus* sp*)* Landed at UPTD Fishery Port Region I, Carocok Tarusan, West Sumatra Province

Potensi dan Tingkat Pemanfaatan Ikan Teri (Stolephorus sp) yang Didaratkan di UPTD Pelabuhan Perikanan Wilayah I Carocok Tarusan Provinsi Sumatera Barat

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Abstract

Open-access fishery resources encourage fishing competition that can cause stock decreases and overfishing; therefore, bioeconomic management based on sustainability potential and utilization rate assessments is needed to maintain sustainability. This research aims to determine anchovies' potential and utilization rate (*Stolephorus* sp) at the UPTD Fishery Port Region I, Carocok Tarusan, West Sumatra Province. The research was conducted in December 2024 using secondary data in the form of annual catch and fishing effort for 2016-2023, obtained from relevant institutions. The methods used were the *Catch Per Unit Effort* (CPUE) and surplus production models of Schaefer and Fox. Based on the results of the analysis, the Schaefer surplus production model was the most appropriate model for analyzing the potential of anchovies at the Carocok Tarusan Fishing Port. This model estimates MSY at 445,211.65 kg/year with an optimum effort of 6,547 trips/year. JTB is estimated at 356,169.32 kg/year. During the research period, the average utilization rate of anchovies reached 54%, showing that fish stocks were in a moderate state. This means anchovy resources have not been overexploited and can still be utilized optimally. The exploitation rate of 33% indicates that there are still opportunities to increase fishing efforts while continuing to apply the principles of sustainable management.

Keywords: Anchovy, CPUE, MSY, *Stolephorus* sp, Sustainable potential

Abstrak

Sumber daya perikanan yang bersifat akses terbuka mendorong persaingan penangkapan yang berpotensi menyebabkan penurunan stok dan *overfishing*, sehingga diperlukan pengelolaan berbasis bioekonomi dengan kajian potensi lestari dan tingkat pemanfaatan untuk menjaga keberlanjutan. Penelitian ini bertujuan untuk mengetahui potensi dan tingkat pemanfaatan ikan teri (*Stolephorus* sp.) di UPTD Pelabuhan Perikanan Wilayah I Carocok Tarusan, Provinsi Sumatera Barat. Penelitian dilaksanakan pada Desember 2024 menggunakan data sekunder berupa hasil tangkapan dan upaya penangkapan tahunan selama periode 2016-2023 yang diperoleh dari instansi terkait. Metode yang digunakan adalah pendekatan *Catch Per Unit Effort* (CPUE) serta model surplus produksi Schaefer dan Fox. Berdasarkan hasil analisis, model surplus produksi Schaefer adalah model yang paling tepat untuk menganalisis potensi ikan teri (*Stolephorus* sp.) di Pelabuhan Perikanan Carocok Tarusan. Model ini memberikan estimasi potensi tangkapan lestari (MSY) sebesar 445.211,65 kg/tahun dengan upaya optimum sebanyak 6.547 trip/tahun. Jumlah Tangkapan yang Diperbolehkan (JTB) ditetapkan sebesar 356.169,32 kg/tahun. Selama periode penelitian, tingkat pemanfaatan ikan teri rata-rata mencapai 54%, yang menunjukkan bahwa stok ikan berada dalam status *moderate*. Artinya, sumber daya ikan teri belum dieksploitasi berlebihan dan masih dapat dimanfaatkan lebih optimal. Tingkat pengupayaan sebesar 33% mengindikasikan bahwa penangkapan masih di bawah tingkat optimum, sehingga terdapat peluang untuk meningkatkan usaha penangkapan dengan tetap menerapkan prinsip pengelolaan yang berkelanjutan.

Kata kunci: CPUE, Ikan teri, MSY, Potensi Lestari, *Stolephorus* sp.

1. Introduction

Fisheries are open-access resources, meaning all parties can exploit them without restriction. This situation encourages competition among fishermen to obtain maximum catches. Although fishery resources can recover naturally, if excessive fishing pressure continues, it will cause a significant decline in fish stocks and potentially lead to overfishing (Rahayu, 2019).

In response to this, one approach that can be taken to support the sustainability of fishery resources is by applying the concept of fisheries bioeconomics. Efforts that need to be made include assessing fish stocks to determine their sustainable potential or Maximum Sustainable Yield (MSY), the optimal level of fishing effort, and the extent to which anchovies are utilized. This step aims to ensure that fish resources remain sustainable and available without disturbing the balance of the population in nature. Assessing the sustainable potential and level of utilization in a water area is very important for controlling and monitoring fishing intensity, so that excessive exploitation does not occur. Determining MSY also serves to maintain fish stocks safe and stable, preventing a decline in future catches (Juniko et al., 2018).

The Technical Implementation Unit (UPTD) of the Carocok Tarusan Fishing Port Region I, located in Ampang Pulai Village, Koto XI Tarusan Subdistrict, is one of the largest fish landing centers in West Sumatra and a hub for fishing groups to carry out fishing activities and the loading and unloading of their catch. According to Rahman et al. (2022), anchovies are the dominant catch using the bagan boat at the Carocok Tarusan Regional Fisheries Port Unit I in West Sumatra Province, and are a leading commodity. Based on the annual report of the Carocok Tarusan Fishing Port, the production of anchovy catches from 2016 to 2023 fluctuated between 140,448 and 397,886 kg. This figure shows that anchovy production in this region has high fishery potential. As a continuously exploited resource, it is crucial to study the potential and level of utilization of anchovies to ensure that catches remain within sustainable limits, prevent overfishing, and support sustainable management.

2. Material and Method

2.1. Time and Place

This research was conducted in December 2024 at the Regional Fisheries Port Technical Implementation Unit (UPTD) I Carocok Tarusan, West Sumatra Province.

2.2. Methods

The research method was a survey conducted directly at the Technical Implementation Unit (UPTD) of Fishery Port Region I, Carocok Tarusan.

2.3. Data Analysis

2.3.1. CPUE

Catch per Unit Effort (CPUE) can be calculated by dividing the total fish catch by the fishing effort used in a specific period of time (time series). Thus, CPUE can be obtained through the following equation (Sparre & Venema, 1998).

$$\text{CPUE} = \frac{\text{Catch}}{\text{Effort}}$$

Explanation:

CPUE = Catch per Unit Effort (kg/trip) Effort = Effort total (trip)
Catch = Catch total (kg)

2.3.2. Production Surplus Model

Sustainable potential analysis can be conducted using two production surplus models, namely the Schaefer model and the Fox model (Sparre & Venema, 1998). The simple linear regression equation used is as follows:

$$Y = a+b(x)$$

Next, the values of the intercept (a) and slope (b) parameters can be determined using the following formula:

$$b = \frac{\sum x(i)*y(i)-\frac{1}{n}*\sum x(i)*\sum y(i)}{\sum x(i)^2-\frac{1}{n}(\sum x(i))^2} \qquad a = \bar{y}-\bar{x}*b$$

The Schaefer model, based on Sparre & Venema (1998), uses the following equation:

$$MSY = -0{,}25\frac{a^2}{b} \qquad F\text{-}Opt = -0{,}5\frac{a}{b} \qquad TAC = 80\%\ MSY$$

The equation in the Fox model was obtained through regression using natural anti-logarithms (LN), where effort was set as variable x and CPUE as variable y (Sparre & Venema, 1998).

$$MSY = -(\frac{1}{d})\exp(c-1) \qquad F\text{-}Opt = -\frac{1}{d} \qquad JTB = 80\%\ MSY$$

2.3.3. Utilization Rate and Effort Rate

Estimates of utilization and effort rates were made to determine the extent to which anchovy resources landed at the UPTD Fisheries Port Region I, Carocok, were being utilized and the fishing efforts being made. The utilization rate is calculated as a percentage by comparing the catch amount to the MSY value (Latuconsina, 2010), while the exploitation rate is calculated as a percentage based on the total effort compared to the F-Optimum value.

$$UR_c = \frac{c_i}{MSY}\ 100\% \qquad ER_f = \frac{f_i}{F\text{-}Opt}\ 100\%$$

3. Result and Discussion

3.1. Catch and Effort for Anchovy (Stolephorus sp.)

Based on Figure 1, the amount of anchovy catch at Carocok Port fluctuated from 2016 to 2023. In 2016, the catch was recorded at 283,192 kg, then declined consecutively in 2017 and 2018 to 237,630 kg and 154,767 kg. Starting in 2019, the catch increased to 167,559 kg and rose significantly in 2020 and 2021, reaching 299,716 kg and 397,886 kg, respectively, the highest peaks. However, in the last two years, namely 2022 and 2023, the catch declined sharply to 140,448 kg and 238,301 kg.

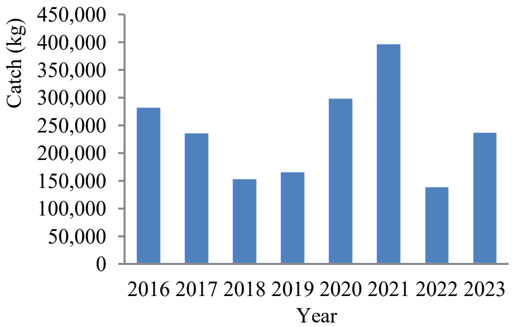

Figure 1. Catch of anchovy (*Stolephorus* sp.)

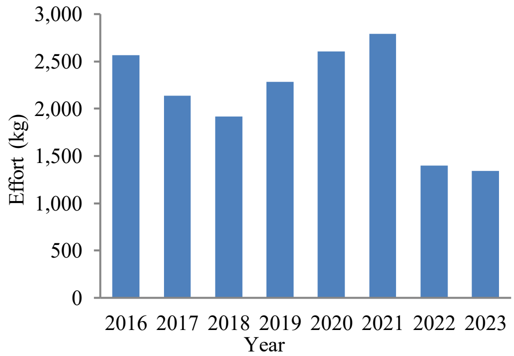

Figure 2. Fishing effort of anchovy (*Stolephorus* sp.)

Based on Figure 2, changes in catch results are in line with fluctuations in fishing effort during the same period. Anchovy fishing in Carocok Tarusan uses a bagan boat. The highest effort occurred in 2016 with 2,566 trips, then decreased in 2017 and 2018 to 2,135 and 1,920. From 2019 to 2021, effort rose again, peaking in 2021 with 2,789 trips, indicating an increase in fishing intensity. However, in 2022 and 2023, fishing effort fell sharply to 1,400 and 1,343 trips.

3.2. CPUE and LNCPUE

Based on Table 1, data from 2016 to 2023, the CPUE (Catch per Unit Effort) value of anchovies at Carocok Tarusan Fishing Port fluctuated, reflecting the dynamic relationship between catch and fishing effort. In 2016 and 2017, CPUE was quite high and stable, indicating efficient fishing despite a slight decrease in effort in 2017. In 2021, CPUE reached 142,663 kg/trip with the highest catch of 397,886 kg from 2,789 trips. However, in 2022, even though effort decreased dramatically to 1,400 trips, CPUE also decreased to 100,320 kg/trip because stock abundance was suspected to have also decreased. Interestingly, in 2023, there was a significantly increased in CPUE to 177.439 kg/trip, even though the effort was only 1,343 trips, indicating a possible recovery of the stock or the use of more effective fishing gear.

According to Listiyani et al. (2017), variations in CPUE (Catch Per Unit Effort) values are influenced by various vital factors, including the abundance of fish stocks in the waters, the efficiency and type of fishing gear used, environmental conditions such as season and water temperature, and the skills and fishing strategies employed by fishermen. These factors collectively determine the catch level obtained per fishing effort unit.

Table 1. CPUE and LN-CPUE values of anchovy

No	Year	Catch (kg)	Effort (trip)	CPUE	Ln-CPUE
1	2016	283,192	2,566	110.363	4.704
2	2017	237,630	2,135	111.302	4.712
3	2018	154,767	1,920	80.608	4.390
4	2019	167,559	2,286	73.298	4.295
5	2020	299,716	2,607	114.966	4.745
6	2021	397,886	2,789	142.663	4.960
7	2022	140,448	1,400	100.320	4.608
8	2023	238,301	1,343	177.439	5.179
Total		1,919,499	17,046	910.959	37.592
Average		239,937	2,131	113.870	4.699

3.3. Maximum Sustainable Yield (MSY) and Optimum Effort (F-Opt)

In the Schaefer model, the regression equation CPUE(Y) = -0.0104X) Trip + 136 with R^2 A value of 0.0286 was obtained. Furthermore, in the Fox model, LN-CPUE(Y) = -0.00005 (X)Trip + 5.8152 y = -5e-05x + 4.81540 with R^2 of 0.0109. The equation in the surplus production model can only be applied when the slope (b) value is negative, indicating that an increase in fishing effort has the potential to reduce catch per unit of effort. If the slope value (b) is positive, the model cannot estimate stock size or determine optimal effort. In this condition, it can only be concluded that an increase in fishing effort still has the potential to increase catch (Sparre & Venema, 1998). With the intercept (a) and slope (b) values obtained from the regression equation, the MSY graph for the Schaefer model can be seen in Figure 3, while the MSY graph for the Fox model can be seen in Figure 4.

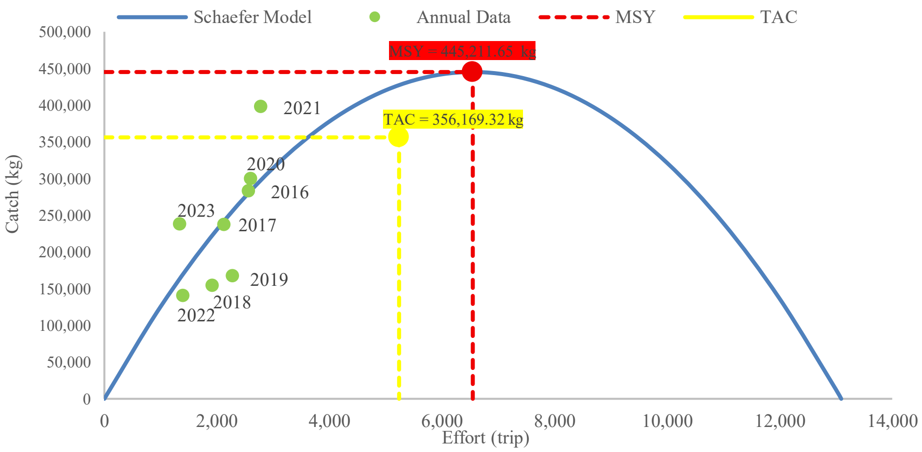

Figure 3. Schaefer model MSY

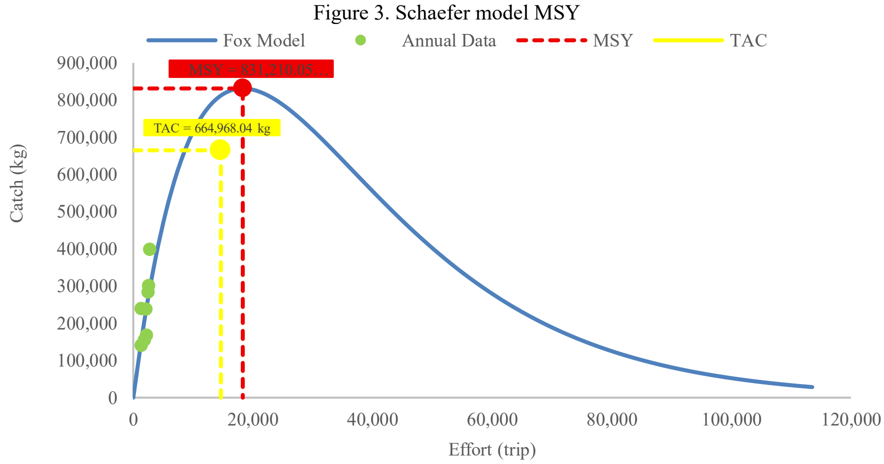

Figure 4. Grafik MSY model fox

Based on the Schaefer Model analysis, the Maximum Sustainable Yield (MSY) value was obtained at 445,211.65 kg at a fishing effort level of 6,547 trips. Meanwhile, the Total Allowable Catch (TAC) was set at 356,169.32 kg with around 5,238 trips. All annual data from 2016 to 2023 show that effort and catch are still below the MSY and TAC limits, indicating the potential for increasing sustainable fishing efforts. The highest catch was recorded in 2021, close to the MSY, while 2022 and 2023 showed a decline in catch despite no significant reduction in effort.

Understanding Total Allowable Catch (TAC) not only regulates the amount of catch but also plays an indirect role in controlling the exploitation of fishery resources. In addition, TAC can be easily combined with a catch quota allocation system based on the type of fishing fleet. In this way, the potential for competition among fishing vessels to quickly reach the maximum catch can be minimized, thereby avoiding catches that exceed the TAC limit (Wijayanto et al., 2014).

MSY is a guideline in fisheries resource management that allows fishing activities to be carried out without causing a population decline. The goal is to keep fish stocks at a safe level. In other words, MSY aims to maintain stock balance so that fisheries production does not decline in the future (Pasaribu et al., 2024).

3.4. Comparison of Scaefer and Fox

A comparison of the values obtained from the Schaefer and Fox models can be seen in Table 2.

Table 2. Comparison of the Schaefer and Fox models

Value	Schaefer	Fox
Intercept	135.99996	4.81540
Slope	-0.01039	-0.00005
R^2	0.0286	0.0109
R	0.169019048	0.104301905
MSY	445,211.65 kg	831,210.05 kg
F Optimum	6,547 trip	18,311 trip
TAC	356,169.32 kg	664,968.04 kg

Based on Table 2, the Schaefer model is considered the most appropriate for representing anchovies' stock and management conditions (*Stolephorus* sp.). The most suitable model was selected considering two main factors: a high coefficient of determination (R^2) value and a low total allowable catch (TAC). According to Fauziyah et al. (2019), a high R^2 value indicates that the model can explain data variations better, resulting in more accurate predictions regarding fish stocks. On the other hand, a low JTB supports the principle of prudence in resource management by setting catch limits to reduce the risk of overexploitation.

3.5. Utilization Rate and Effort Rate

Based on Table 3, the level of utilization of anchovy resources from 2016 to 2023 shows that most years fall into the moderate category. This category applies when the annual catch has not reached 80% of the estimated potential of the fish resources. Of the eight years recorded, seven years were in the moderate category, namely 2016 (64%), 2017 (53%), 2018 (35%), 2019 (38%), 2020 (67%), 2022 (32%), and 2023 (54%). The year 2021, with a utilization rate of 89%, falls into the fully-exploited category, which is in the range of 80–100% of the estimated potential.

Table 3. Utilization rate and effort rate

No.	Year	Utilization Rate	Effort Rate
1	2016	64%	39%
2	2017	53%	37%
3	2018	35%	29%
4	2019	38%	35%
5	2020	67%	40%
6	2021	89%	43%
7	2022	32%	21%
8	2023	54%	21%
Total		431%	265%
Average		54%	33%

The average utilization rate during this period was 54%, indicating that fish resource utilization is generally below its optimal capacity. Meanwhile, the average exploitation rate was recorded at 33%, showing that efforts to support fishing activities, such as using fleets, fishing gear, and labor, are also not optimal. Overall, these conditions indicate that there is still room to improve the sustainable utilization of fish resources, while considering potential limitations to prevent overexploitation. This is in line with Pasaribu (2024), who states that fish resources that are semi-exploited or developing indicate that the fish population is experiencing fishing pressure that is still below the maximum level. In other words, fish from these populations can still be caught without posing a serious threat to their sustainability

4. Conclusions

Based on the results of the study, it can be concluded that Schaefer's production surplus model is the most appropriate model for analyzing the potential of anchovies (*Stolephorus* sp.) at the Carocok Tarusan Regional Fisheries Port Technical Implementation Unit (UPTD). This model estimates the maximum sustainable yield

(MSY) of 445,211.65 kg per year with an optimum effort of 6,547 trips. To maintain stock sustainability, the Total Allowable Catch (TAC) is set at 356,169.32 kg per year. During the research period, the average utilization rate of anchovies reached 54%, indicating that the fish stock is in a moderate status. This means anchovy resources have not been overexploited and still have room for more optimal utilization. On the other hand, the exploitation rate of 33% indicates that current catches are still below the optimum level, so there is an opportunity to increase fishing efforts while still applying the principles of sustainable management.

5. References

Fauziyah, F., Ardani, A., Agustriani, F., Ermatita, & Putra, A. (2019). Model-Model Surplus Produksi untuk *Fish Stock Assessment*: Dilengkapi dengan Pedoman Praktis. *Moeka Publishing*. 175 pp.

Juniko, N., Mudzakir, A.K., & Wijayanto, D. (2018). Analisis Bioekonomi Sumberdaya Ikan Teri (*Stolephorus* sp.) di Pesisir Kabupaten Pekalongan Jawa Tengah. *Journal of Fisheries Resources Utilization Management and Technology*, *7*(4): 29-38.

Latuconsina, H. (2010). Pendugaan Potensi dan Tingkat Pemanfaatan Ikan Layang (*Decapterus* spp) di Perairan Laut Flores Sulawesi Selatan. *Agrikan: Jurnal Agribisnis Perikanan*, *3*(2): 47-54.

Listiyani, A., Wijayanto, D., & Jayanto, B.D. (2017). Analisis CPUE (*Catch per Unit Effort*) dan Tingkat Pemanfaatan Sumberdaya Perikanan Lemuru (*Sardinella lemuru*) di Perairan Selat Bali. Jurnal Perikanan Tangkap: *Indonesian Journal of Capture Fisheries,* 1(1): 1-9.

Pasaribu, D.D., Retno, R., Rumondang, A., & Handoco, E. (2024). Pendugaan Stok Ikan Kembung (*Rastrelliger* sp.) Yang Didaratkan di Pelabuhan Perikanan Nusantara Sibolga Provinsi Sumatera Utara. *Jurnal Minfo Polgan*, 13(2): 1658-1667.

Pasaribu, M.W., Zain, J., & Nofrizal, N. (2024). Pendugaan Potensi Lestari Ikan Cakalang (*Katsuwonus pelamis*) yang Didaratkan di Pelabuhan Perikanan Nusantara Sibolga, Provinsi Sumatera Utara. *Ilmu Perairan (Aquatic Science)*, *12*(2): 244-249.

Rahayu, T., Wijayanto, D., & Triarso, I. (2019). Analisis Bioekonomi Perikanan Teri Glagah (*Stolephorus* indicus) dengan Alat Tangkap Jaring Lingkar Teri di Perairan Kabupaten Brebes. *Journal of Fisheries Resources Utilization Management and Technology*, *8*(3): 1-11.

Rahman, A., Nasution, P., & Rengi, P. (2022). Analisis Teknis dan Finansial Usaha Perikanan Bagan Perahu KM. Wafik 02 di Pelabuhan Perikanan Pantai Carocok Tarusan Sumatera Barat. *Ilmu Perairan (Aquatic Science)*, *10*(2): 129-139.

Sparre, S., & Venema, V. (1998). *Introduksi Pengkajian Stok Ikan Tropis*. Pusat Penelitian dan Pengembangan Perikanan, Badan Penelitian dan Pengembangan Pertanian. Jakarta. 438 pp.

Wijayanto, D., & Yulianto, T. (2014). Analisis Potensi Tangkap Sumberdaya Rajungan (*Blue Swimming Crab*) di Perairan Demak. *Journal of Fisheries Resources Utilization Management and Technology*, *3*(3): 248-256