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Request for Journal Publishing from Jerry Hutajulu

Tambahkan label

Jerry Hutajulu 5/12/2022

kepada zoobiomag2004

Dear Sir,
I would like to send you the manuscript titled **Study on Katsuwonus pelamis fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia,** and the related submission letter as attached.

I would be delighted to receive feedback and follow-up information from you.

Thank You,

Kindest regards.

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Submission letter

Article title: Study on Katsuwonus pelamis fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia

Hereby I would like to submit the manuscript entitled “**Study on Katsuwonus pelamis fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia**” to Aquaculture, Aquarium, Conservation & Legislation - International Journal of the Bioflux Society.

This manuscript was not submitted or published to any other journal. The authors declare that the manuscript is an original paper and contain no plagiarized text. All authors declare that they are not currently affiliated or sponsored by any organization with a direct economic interest in subject of the article. My co-authors have all contributed to this manuscript and approve this submission.

Corresponding author
Jerry Hutajulu,

7 December 2022

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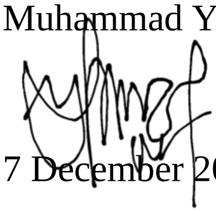
Muhammad Yusuf Annur



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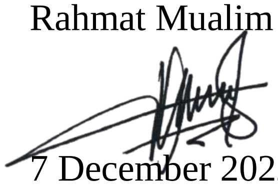

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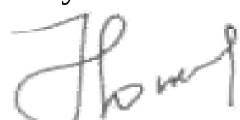

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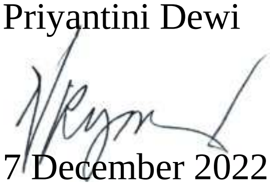

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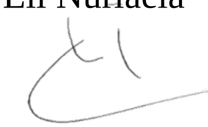

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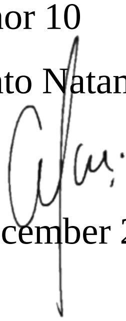

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kepada Eni

Dear Eni Kovacs,
Happy winter holiday,
I hope this email finds you well.

Have you received my final manuscript, as attached to my previous email?
If yes, I will be more than glad to receive your correction (if any) and do the required next steps.

kindest regards,
Jerry Hutajulu

Tampilkan kutipan teks

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Eni Kovacs 24/12/2022
Dear Jerry Hutajulu, We would like to inform you that after the preliminary evaluation your

Jerry Hutajulu 27/12/2022
kepada Eni

Dear Eni Kovacs,

Thanks for the update regarding the status of the manuscript.
As you suggest, I have made payment. Please find the Bank transfer receipt attached to this email.

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Dear Jerry Hutajulu,

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I will be your editor and I will stay at your disposition for all the aspects concerning your manuscript.

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Kind regards,
Editor AACL Bioflux
Eniko Kovacs

Jerry Hutajulu 7/12/2022
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Dear Eni Kovacs,

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Certificate/Letter of preliminary acceptance

This certificate shows that your paper:
Study on Katsuwonus pelamis fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia

Authors:
Jerry Hutajulu, Muhammad Y. Annur, Erick Nugraha, Rahmat Mualim, Yusrizal, Maman Hermawan, Tonny Kusumo, Priyantini Dewi, Eli Nurlaela, Granto N. Putra
was preliminary accepted for publication, with revision, in the scientific/academic journal:
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Thank you for publishing with us!

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Jerry Hutajulu 7/12/2022
kepada Eni

Dear Eni Kovacs,
Have a nice day.

Thank you for your prompt reply.
I will rectify the manuscript as soon as possible.

Best regards,
Jerry Hutajulu

Tampilkan kutipan teks

Jerry Hutajulu 7/12/2022
kepada Eni

Dear Eni Kovacs,

I've attached the revised manuscript and submission letter.
Please let me know if you have any questions or suggestions regarding the manuscript.

Best regards,
Jerry Hutajulu

Tampilkan kutipan teks

Study on *Katsuwonus pelamis* fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia

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Abstract. *Katsuwonus pelamis* is a prime fishery commodity widely spread in Indonesian waters. Referring to our data analysis, the production trend in Sadeng Fishery Port is significantly increasing over the 5-year timeline, from 2016 to 2020. In order to receive an authentic and detailed examination of the *K. pelamis* fishing business there, all related aspects, such as exploitation level, fishing gears, facilities, sales, and business financial condition have been successfully analyzed. As a conclusion, *K. pelamis* resource in the South Java Sea has been over-exploited, as indicated by a negative slope of CPUE and effort function. Fishing technologies used by local fishermen were still conventional and unproperly maintained, which lowers reliability, efficiency, and cruising range. Existing ice factory was also not in an operational state, since some of the major parts were broken. However, the *K. pelamis* on the markets were fresh, the sales were considered efficient, and the fishing business was financially profitable and feasible.

Key Words: exploitation level, fishing season, catch quality, sales, financial analysis.

Introduction. Indonesia is an archipelagic country with massive potential in the fishery business, due to the abundance of many fish species, among which the *Katsuwonus pelamis* (Amiluddin 2020; Kekenusa & Paendong 2016). *K. pelamis* is a high-migratory and cosmopolitan species commonly found in tropical and sub-tropical waters (Arai et al 2005; Satria & Kurnia 2017). In the Indonesian seas, they live in the Indian Ocean (West Sumatra Sea, South Java Sea, Bali Sea, South Lombok Island Sea, Sumbawa Island Sea) and Eastern Indonesia seas (Celebes Sea, Maluku Sea, Arafuru Sea, Banda Sea, Flores and Makassar Strait) (WWF 2015; Tuli 2018).

The Government of Special Region of Yogyakarta released a government regulation, No.16 of year 2011 that stipulates the transformation of Sadeng Fishery Port into an economic growth center for the coastal area of the eastern part of Gunung Kidul Regency, based on the fishery commodities business and tourism as the primary and secondary income, respectively. Following the regulation issuance, the local government and fishermen obtained benefits, since the total fish catch in that area has increased significantly, raising the overall income. Based on data from Sadeng Fishery Port, *K. pelamis* production experienced an increasing trend with a noticeable fluctuation from 2016 to 2020 (Figure 1). The lowest production, of 305.99 tons, occurred in 2016, while the highest occurred in 2020, with a total of around 1,395.53 tons.

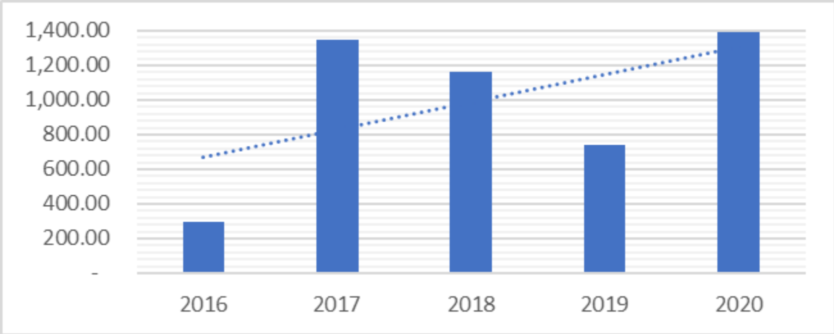

Figure 1. *Katsuwonus pelamis* production at Sadeng Fishery Port from 2016 to 2020.

Even though *K. pelamis* has a high reproduction rate, with all-year-round spawning (Kantun et al 2021) and widespread availability, it is still prone to the possibility of being over-exploited (Wujdi et al 2017). The increasing demand, overfishing, and lack of awareness from the government and society contribute significantly to the sustainability of the *K. pelamis* population. Therefore, examining the current *K. pelamis* exploitation level in Sadeng Fishery port and other aspects related to the *K. pelamis* fishing business is necessary.

Material and Method

Description of the study sites. This study was conducted from December 2020 until May 2021 at the Sadeng Fishery Port (Pelabuhan Perikanan Pantai or PPP), Girisubo District, Gunung Kidul, Special Region of Yogyakarta, Indonesia (Figure 2).

Figure 2. The location of Sadeng Fishery Port, Special Region of Yogyakarta, Indonesia (Google Earth 2022).

Data collection. Data are divided into two kinds, primary and secondary. Primary data were collected by using observation, direct interviews, and documentation, while secondary data were collected from existing sources (Siyoto & Sodik 2015). Any sampling in this research was done by using the Snowball method.

K. pelamis exploitation level. The exploitation level was examined by finding the relationship function of CPUE and Effort. The effort definition used in this research is the total number of fishing trips with 2 types of fishing gears: purse seines and hand lines. The Catch per Unit of Effort (CPUE) was calculated using the following formulas, incorporating the time series of total catch and effort (Nurhayati 2013).

$$CPUE_{st} = \frac{C_{st}}{E_{st}} \qquad FPI_{st} = \frac{CPUE_{st}}{CPUE_{st}} \qquad CPUE_i = \frac{C_i}{E_i} \qquad FPI_i = \frac{CPUE_i}{CPUE_{st}}$$

Where:

C_{st} - total catch by standard fishing gear;
C_i - total catch by used fishing gear;
E_{st} - total effort of standard fishing gear;
E_i - total effort of fishing gear *i*;
FPI_{st} - fishing power index of standard fishing gear;
FPI_i - fishing power index of fishing gear *i*;
$CPUE_{st}$ - total catch per effort of standard fishing gear;
$CPUE_i$ - total catch per effort of fishing gear *i*.

Since these two fishing gears have different catching abilities, effort standardization is needed to find the equivalency (Nurdin & Yusfiandayani 2016). The fishing gear that has the highest Catch Per Unit Effort (CPUE) is set as the standard Effort (Nurhayati 2013). From our data, the purse seine has the highest average CPUE value, of 4.29 tons trip^{-1}. Thus, purse seine is set as the standard with an FPI value = 1. The hand line FPI is calculated by dividing its CPUE value by the purse seine CPUE value, so that the FPI value of the hand line will be less than 1 (Al Aziz 2017). The standard handline Effort is calculated by multiplying the handline FPI with the actual Effort. Finally, the relationship between the fishing effort and CPUE can be obtained by using the regression method.

Maximum sustainable yield and sustainable catch effort. The maximum sustainable yield and sustainable catch effort were calculated using the Schaefer, and Fox exponential surplus production models. Both approaches are regression formulae incorporating the catch, standardized effort, and natural logarithm of the CPUE variables, in order to determine the points of intersection and slopes, as seen in Table 1 (Sparre & Venema 1998). In the Schaefer model, the net growth rate of fish stocks is described as a logistic function between the effort and CPUE (Atmaja et al 2017), while the Fox model utilizes a natural logarithmic relationship.

Table 1

Schaefer linear model and fox exponential model

Variable	*Schaefer linear model*	*Fox exponential model*
MSY	$-\frac{a^2}{4b}$	$-\left(\frac{1}{d}\right)\times exp^{(c-1)}$
E_{MSY}	$-\frac{a}{2b}$	$-\frac{1}{d}$

Where:
a - interception value of Schaefer model;
b - slope of Schaefer model;
c - interception value of Fox model;
d - slope of Fox model;
MSY - maximum sustainable yield;
E_{MSY} - sustainable catch effort.

Fishing season pattern. The temporal pattern was studied based on the moving average of the catch and effort time series data (Dajan 2004; Rahmawati et al 2013). The result of this calculation is the Fishing Season Index (FSI) for each month. Fishing season is indicated with FSI > 100%. Otherwise, the period is not a fishing season.

The catch quality. was determined by using organoleptic tests on fish samples from local markets as stated in the Indonesian National Standard (SNI) 2729:2013. Population quality, μ, is approximated as a range with a 95% confidence level (BSNI 2013).

$$P(\bar{x} - (1,96 * s / \sqrt{n})) \leq \mu \leq P(\bar{x} + (1,96 * s / \sqrt{n}))$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad s^2 = \frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)} \qquad s = \sqrt{\frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)}}$$

Where,
n - total number of panelists;
s^2 - variance of quality value;
1.96 - standard deviation coefficient at range 95%;
$\bar{x}$ - average quality value;
x - quality value from panelist i, where i = 1,2,3......n;
s - standard deviation of quality value.

***K. pelamis* sales**. *K. pelamis* is distributed through several supply chains, from producers to consumers. Two important quantitative variables to assess the sales aspect are fishermen's share (FS) and marketing efficiency (ME) (Iswahyudi 2019; Riandi et al 2017). FS is with the ratio of the fisherman's selling price divided by the last buying price of the chain times 100%. FS is inversely correlated with the total margin from each chain. While ME is calculated by dividing the total marketing cost by the selling price in each chain. The sales chain can be considered efficient if FS => 40% (Downey 1992) and ME < 33%, while if ME ranges 34 - 67%, it is considered less efficient. Otherwise, the sales are inefficient (Riandi et al 2017).

$$SM = CP - PP$$

$$FS = \left(\frac{PP}{CP}\right) \times 100\%$$

$$ME = \left(\frac{MP}{CP}\right) \times 100\%$$

Where:
SM - sales margin (USD kg^{-1});
CP - price on consumer level (USD kg^{-1});
PP - price on producer level (USD kg^{-1});
MP - total marketing cost (USD kg^{-1}).

The business financial feasibility was analyzed by calculating profit, RC ratio, and Return on Investment (ROI) (Hutajulu et al 2019). Invested cost, fixed cost, variable cost, and yearly revenue data were gathered from direct interviews with fishermen.

$$\pi = TR - TC$$

$$TC = VC + FC$$

$$\frac{R}{C} = \frac{TR}{TC}$$

$$ROI = \frac{\pi}{Initial\ Investment} \times 100\%$$

Where:
π - profit;
TC - total cost;
R - Revenue;
C - Cost;
VC - variable cost;

FC - fixed cost;
TR - total revenue.

Fishing technology, and port facilities that support *K. pelamis* fishing and product distribution are analyzed descriptively by using data from direct observation on site and records from Port Office.

Results. The *K. pelamis* exploitation level, maximum sustainable yield and sustainable catch effort, fishing season pattern, catch quality, sales, and business financial analysis are described as follows.

***K. pelamis* exploitation level.** The relationship function derived from the regression of fishing effort and CPUE is $y = -0.0655x + 5.7346$, as depicted in Figure 3. The slope or regression coefficient is -0.0655, which means that each additional fishing trip (effort) will cause a CPUE decrease of 0.0655 tons. It can be said that *K. pelamis* population has been over-exploited.

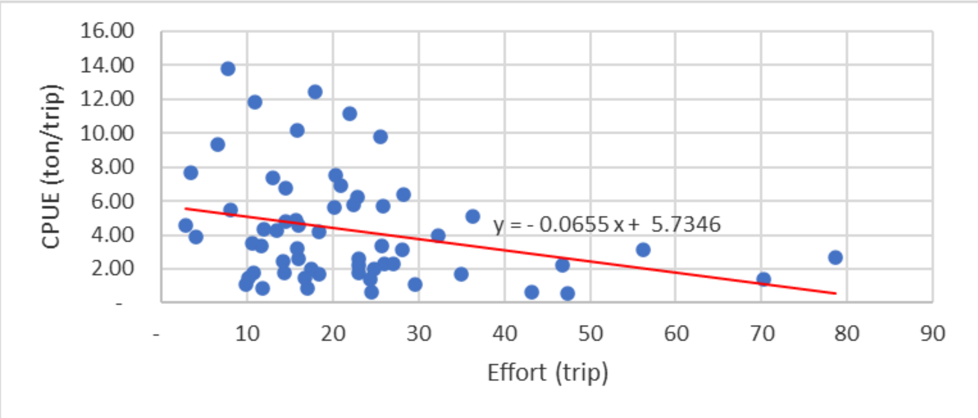

Figure 3. Relationship of effort and CPUE.

Maximum sustainable yield and sustainable catch effort. Schaefer and Fox approaches produce slightly different results (Table 2). Both approaches lines are provided in Figure 4. The comparisons of actual monthly catch during the 5-year timeline and MSY limit from Schaefer and Fox models are illustrated in Figure 5 and Figure 6.

Table 2

Interception and slope values with Schaefer and Fox models

Item	*Schaefer*	*Fox*
a or c	5.7346	1.5494
b or d	-0.0655	-0.0172
r	-0.2966	-0.3129
r^2	0.0880	0.0979
MSY	125.58 tons	100.91 tons
E_{MSY}	44 trips month^{-1}	58 trips month^{-1}

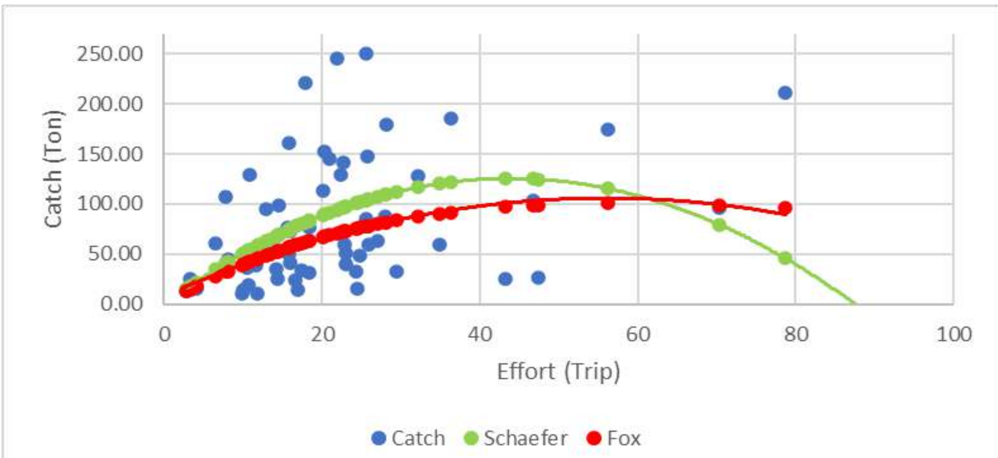

Figure 4. Schaefer and Fox functions.

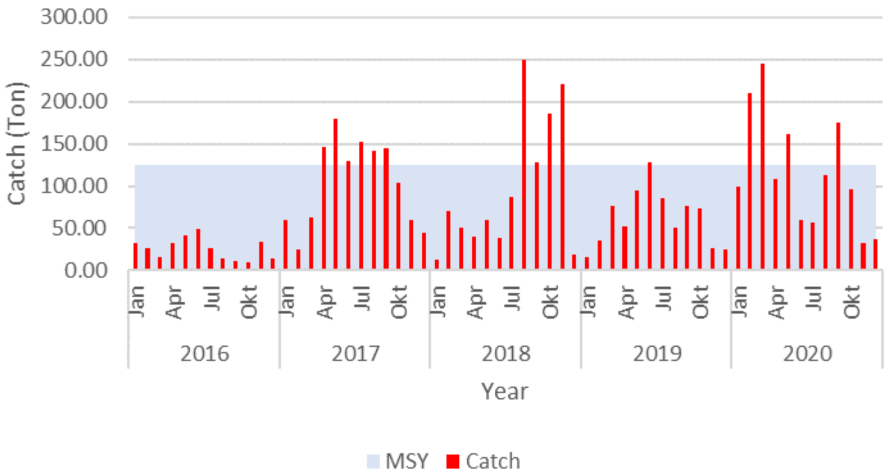

Figure 5. Comparation of monthly production and MSY from Schaefer method.

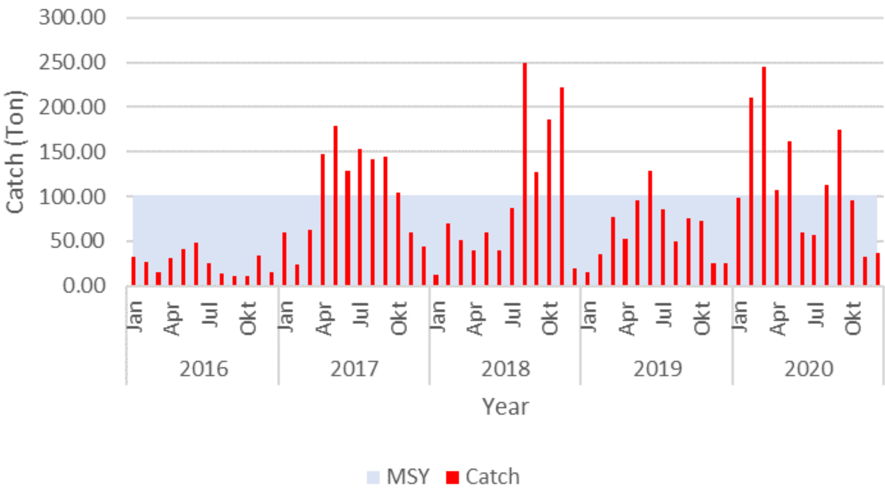

Figure 6. Comparation of monthly production and MSY from Fox method.

Fishing season pattern. The Fishing Season Index (FSI) is depicted in Figure 7. To be noted, the fishing season is associated with the number of catches and is not related to the number of stocks in the waters (Al Aziz 2017).

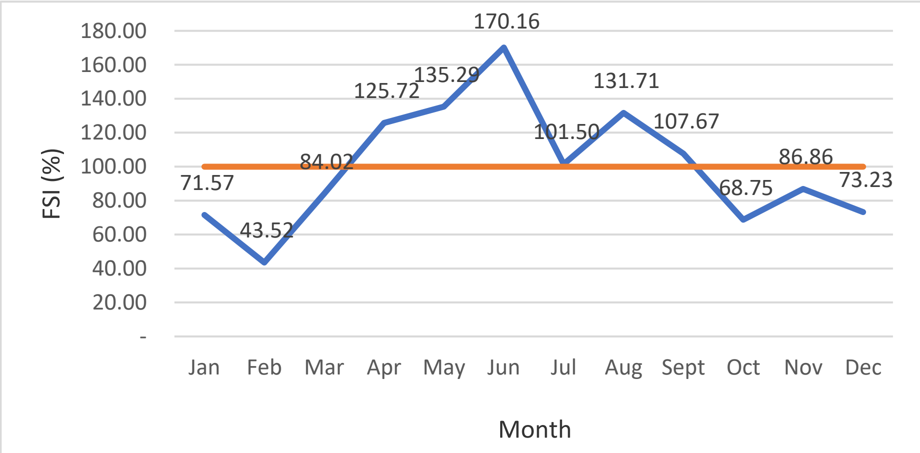

Figure 7. *Katsuwonus pelamis* fishing index at Sadeng fishery port.

The catch quality. The results of organoleptic tests on *K. pelamis* samples are presented in Table 3. The organoleptic value of *K. pelamis* is ranged from 7.51 to 7.92 which is relatively fresh (>7).

Table 3

Katsuwonus pelamis organoleptic test results

Description	*Value*
Average Organoleptic Value	7.72
Standard Deviation	0.59
μ Value (confidence coefficient 0.95)	7.51<μ<7.92

The sales of K. pelamis. As can be seen in Figure 8, there are five models of fish marketing schemes in Sadeng Fishery Port. Each scheme delivers different ***FS*** and ***ME*** which were described in tables 4 until 8.

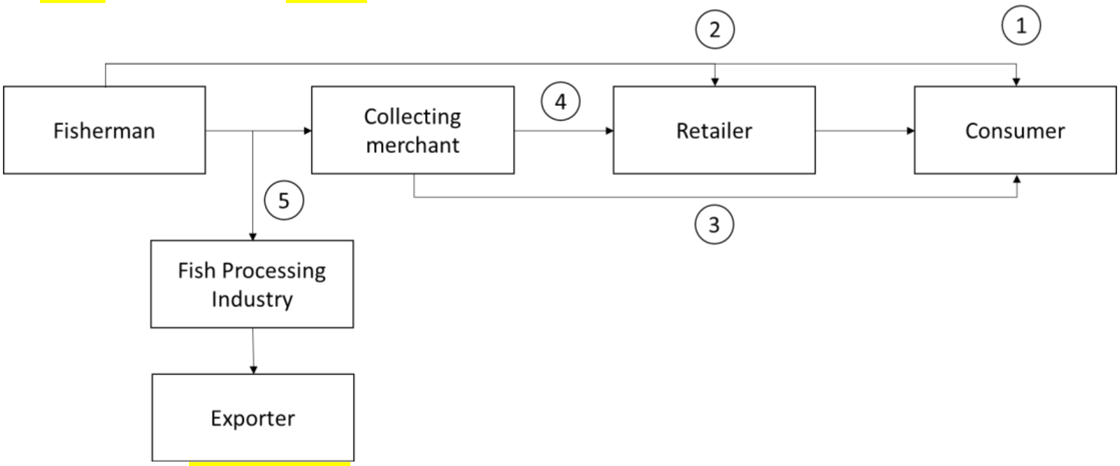

Figure 8. *Katsuwonus pelamis* marketing schemes at Sadeng Fishery Port.

Table 4

Scheme 1: Fishermen – Consumer

Category	*Criteria*	*(USD Kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	1.10		100%
	Operational expenditures	0.57		
	Profit	0.53		

Consumer	Buying price	1.10		
Total marketing price		0		
Marketing efficiency		0%		

This scheme has no marketing price since the end consumer directly buys the product from the fisherman. Although the fisherman's share is 100% and the marketing efficiency is 0% which is perfectly efficient in the sales term, most end consumers rarely buy products directly from the fishermen at the port.

Table 5

Scheme 2: Fishermen – Retailer – Consumer

Category	*Criteria*	*(USD Kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		85.8%
	Operational expenditures	0.57		
	Profit	0.4		
Retailer	Buying price	0.97		
	Selling price	1.13	0.16	
	Marketing cost	0.04		
	Profit	0.12		
Consumer	Buying price	1.13		
Total marketing price		0.04		
Marketing efficiency		3.54%		

In this case, the retailers are reaching fixed daily consumers not far from the port. Their market is the settlement within a 0 to 3 km radius of the port. The marketing costs induced can be considered low (around 0.04 USD kg^{-1}) since it is only calculating the transportation from the port. Moreover, most of these retailers are using their traditional stalls.

Table 6

Scheme 3: Fishermen – Collecting Merchant – Consumer

Category	*Criteria*	*(USD Kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		82.9%
	Operational expenditures	0.57		
	profit	0.4		
Collecting Merchant	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing costs	0.09		
	Profit	0.11		
Consumer	Buying price	1.17		
Total marketing costs		0.09		
Marketing efficiency		7.69%		

A collecting merchant is a kind of intermediate seller who usually sells various products with a higher volume than a retailer and operates in a traditional market up to 5 km from the port.

Table 7

Scheme 4: Fishermen – Collecting Merchant – Retailer – Consumer

Category	*Criteria*	*(USD Kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		63.8%
	Operational expenditures	0.57		
	profit	0.4		
Collecting Merchant	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing costs	0.09		
	Profit	0.11		
Retailer	Buying price	1.17		
	Selling price	1.52	0.35	
	Marketing costs	0.17		
	Profit	0.18		
Consumer	Buying price	1.52		
Total marketing costs		0.26		
Marketing efficiency		17.1%		

This scheme is the one that could reach the highest number of consumers since it penetrates the city center market, that is located quite far from the port. Even though the marketing cost is the highest, its marketing efficiency is as low as 17.1%.

Table 8

Scheme 5: Fishermen – Fish Processing Industry

Category	*Criteria*	*(USD Kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		100%
	Operational expenditures	0.57		
	profit	0.4		
Industry	Buying price	0.97		
Total marketing costs		0		
Marketing efficiency		0%		

The business financial feasibility. Table 9 shows the costs and revenue in one year for each fishing method.

Table 9

Cost and revenue

Description	*Fishing Methods*	
	Handline	*Purse seine*
Revenue (USD)	33,747.38	250,576.41

Investment cost (USD)	23,560.03	177,672.99
Fixed cost (USD)	3,679	20,296.36
Variable cost (USD)	23,669.96	156,725.89
Profit (USD)	6,399	73,554
RC ratio	1.23	1.42
ROI (%)	27%	41%

Fishing technology. The fishing operation at Sadeng Fishery Port is mainly done using handline and purse seine, as seen in Figures 9 and 10, respectively.

Figure 9. Original Photos of Fishing boat equipped with handline.

Figure 10. Original Photos of Fishing boat equipped with purse seine.

Port facilities. The existing facilities are classified into 3 categories, which are main, functional, and secondary. Main facilities are the basic or mandatory facilities as the minimum requirements of a port (Table 10). Functional facilities are the facilities that are directly used by port management or other stakeholders to enhance their operation process (Table 11), while other facilities that are not giving effects on the fishermen's and port management's income are categorized as secondary facilities. Most facilities were in proper condition, except for the ice factory (Figure 11).

Table 10

Main facilities

Description	*Volume*	*Condition*
Area	50,000 m^2	Good
Harbor pool >5 GT	22,900 m^2	Good
Harbor pool <5 GT	5,700 m^2	Good
Breakwater	135 m	Good
Dock	485 m	Good
Access road	720 m	Good
Bridge	15 m^2	Good
Open drainage	888.5 m	Good

Description	Volume	Condition
Boundary fence	450 m	Good

Table 11

Functional facilities

Description	Volume	Condition
Port offices	total 624 m^2	Good
Port fish auction	225 m^2	Good
Ice factory	3 units	Broken
Water tower	10 m^2	Good
Workshop	72 m^2	Good
Sleepway	1 unit	Good
Cold storage	169 m^2	Good
Net repair site	96 m^2	Good
Navigation lamp	4 units	Good
Light buoy	2 units	Good
Parking site	600 m^2	Good

Figure 11. Broken ice factory.

Discussions. Based on our calculation, *K. pelamis* fishing season occurs almost every month. The peak season's duration is of seven months, from March to September. The medium season's duration is of five months, from October to January. In comparison, the famine season occurs in February. Anggraeni et al (2015) and Talib (2017) also stated that the *K. pelamis* fishing season in southern Java occurs almost throughout the whole year. This condition can happen because *K. pelamis* is a migratory fish (Arai et al 2005) and spawns throughout the year (Hartaty & Arnenda 2019). Yoga et al (2014) stated that the upwelling phenomenon happens in the southern Java sea during the east season. This phenomenon is indicated by a low sea surface temperature and high levels of chlorophyll-a. Upwelling causes the southern Java sea to become fertile and increases the fish population (Anggraeni et al 2017).

Unfortunately, the *K. pelamis* exploitation during the fishing season, every year within this 5-year timeline, has exceeded the MSY limit, as can be interpreted from Figure 5, 6, and 7. The periods July to October 2018 and March 2020, as seen in Figure 6, are the most significant, where the catch reached over 200% of the MSY value. This result is in line with other sources from the research literature. According to KKP (2017), it is stated that the exploitation level of large pelagic fish in WPPNRI 573 (the Indian Ocean at the south side of Java, including Sadeng Fishery Port) has been over-exploited. Similarly, Setiyawan (2016) reported that the utilization status of *K. pelamis* in Prigi (Indian Ocean at the south side of Java) has reached the over-exploiting level, with a utilization rate of 114.9%.

According to Akoit & Nalle (2018), if the catch exceeded the MSY value, it can lead to the extinction because the utilization level has exceeded the species' biological growth function. Thus, the calculation of the sustainable fishing effort *(E_{MSY})* calculation is vital to estimate fishing effort at optimum conditions. The calculated sustainable fishing effort (E_{MSY}) value is of 44 trips month^{-1} with the Schaefer's model and of 58 trips month^{-1} with the Fox model.

Nevertheless, the *K. pelamis* fish sold on the markets were fresh, the sales were considered efficient, and the fishing business using handlines and purse seines at Sadeng Fishery Port could be declared financially profitable and feasible. As seen in Table 3, μ is in the range of 7.51 to 7.92 (BSNI 2013). Fisherman's share in all schemes was >40% (Downey 1992) and the marketing efficiency in the range of 0 to 33% (Riandi et al 2017). The profit induced by using a handline was USD 6,399 per year, while for a purse seine it was USD 73,554 per year. The R/C ratio of handline and purse seine were 1.23 and 1.42, respectively. These parameters indicate that the income obtained from the two fishing methods is greater than the costs incurred (Jumiyati et al 2021; Savitri et al 2017). Additionally, the ROI of both fishing gears was >25%, which shows that the *K. pelamis* fishing business earn high profits (Siahainenia 2021).

According to our observation, the existing fishing gears at Sadeng Fishery Port were still conventional. The fishermen relied on traditional boats, old diesel engines, and some malfunctioned gears. Moreover, most fishermen did not apply a routine maintenance to their gears, which lowers the reliability, fuel efficiency, and cruising distance. All the existing facilities functioned properly except for the ice factory (Figure 11). Consequently, fishermen and sellers must find the ice source outside the port, increasing the operational and marketing costs.

Conclusions. The study of *K. pelamis* fishing business at Sadeng Fishery Port suggested that the *K. pelamis* resource in the South Java Sea has been over-exploited. The fishing technology used by local fishermen was conventional and unproperly maintained. The *K. pelamis* fish arrived on the markets were fresh, with an organoleptic value 7.51 < μ < 7.92. The sales were considered efficient through all the distribution channels, with the fisherman's share of a minimum of 63.8%, and the maximum marketing efficiency was of 17.1%. The fishing business was financially profitable and feasible. Most existing facilities were in proper condition, except for the ice factory.

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Conflict of interest. The authors declare no conflict of interest.

References

Akoit M. Y., Nalle M., 2018 [Sustainable Management of Fishery Resources in North Central Timor Regency Based on a Bioeconomic Approach]. Journal of Indonesian Agribusiness 6(2): 85–106. [In Indonesian].

Al Aziz M. A., 2017 [Estimation of Komo tuna (*Euthynnus affinis*) Stock in Gresik Waters, East Java]. Brawijaya University. [In Indonesian]

Amiluddin, 2020 Financial feasibility analysis of skipjack tuna (*Katsuwonus pelamis*) catching in Bone bay, South Sulawesi, Indonesia. In IOP Conference Series: Earth and Environmental Science (Vol. 492, Issue 1).

Anggraeni R. I., Rahyono R., Widagdo S., 2017 [Correlation of Upwelling and Catch of Skipjack Tuna at East Season in Tamperan Waters, Pacitan]. Hang Tuah University. [In Indonesian].

Anggraeni R., Solichin A., Saputra S. W., 2015 [Several Biological Aspects of Skipjack Tuna (*Katsuwonus pelamis*) in Relation to Fisheries Management at PPP Sadeng, Gunungkidul Regency, Yogyakarta]. Management of Aquatic Resources Journal (MAQUARES) 4(3):230–239. [In Indonesian].

Arai T., Kotake A., Kayama S., Ogura M., Watanabe Y., 2005 Movements and life history patterns of the skipjack tuna *Katsuwonus pelamis* in the western Pacific, as revealed by otolith Sr:Ca ratios. Journal of the Marine Biological Association of the United Kingdom.

Atmaja S. B., Sadhotomo B., Nugroho D., 2017 Application of Non-Equilibrium Surplus Production Model on Scads (*Decapterus Macrosoma*) Fishery at Java Sea. Jurnal Penelitian Perikanan Indonesia 23(1):57–66.

BSNI (*Badan Standarisasi Nasional Indonesia*), 2013 *Ikan Segar* SNI 2729: 2013. Badan Standarisasi Nasional Indonesia Jakarta.

Dajan A., 2004 [Introduction to Statistics Method II]. Pustaka LP3ES, Jakarta. 358 p. [In Indonesian].

Downey, Erickson W. P., 1992 [Agrobusiness Management]. Erlangga, Jakarta. [In Indonesian].

Google Earth, 2022. Available at: https://earth.google.com/web/. Accessed: December 2022

Hartaty H., Arnenda G. L., 2019 [Examination of Cakalang's first mature gonad (Lm) (*Katsuwonus pelamis Linnaeus*), 1758) in Indian Ocean, South of Bali Province]. Jurnal Penelitian Perikanan Indonesia 25(2):135–145. [In Indonesian].

Hutajulu J., Kusumo T., Saputra A., Mualim R., Handri M., Sugriwa E. 2019 Financial analysis in the exploitation of blue swimming crab *Portunus pelagicus* in Banten Bay, West Java, Indonesia. Aquaculture, Aquarium, Conservation & Legislation 12(2):724–734.

Iswahyudi, Sustiyana, 2019 [Marketing Channel Patterns and Farmer's Share of water apple CV Camplong]. Jurnal Hexago 3(2):33–38. [In Indonesian].

Jumiyati S., Possumah N., Hadid A., Bachri S., Dua P., 2021 Eco-friendly utilization to increase income and efficiency of Banggai yam farming in the Banggai Islands, Central Sulawesi, Indonesia. IOP Conference Series: Earth and Environmental Science 797(1).

Kantun W., Cahyono I., Kabangnga A., Riana A. D., 2021 Stock assessment of skipjack tuna *Katsuwonus pelamis* in Makassar Strait, Indonesia. AACL Bioflux 14(2):988-995.

Kekenusa J. S., Paendong M. S., 2016 Analysis Determination of Fishing Season Skipjack Tuna (*Katsuwonus pelamis*) In the Belang Waters of Southeast Minahasa North Sulawesi. Jurnal Ilmiah Sains 16(2): 86-90.

Ministry of Marine Affairs and Fisheries, 2017 Ministry of Marine Affairs and Fisheries Decree No. 50 of year 2017.

Nurdin E., Yusfiandayani R., 2016 [Optimization of Fish Aggregating Devices, Fleet Units, and Fishing Season Pattern of Tuna at Prigi Waters, East Java]. Jurnal Penelitian Perikanan Indonesia 18(1):53–60. [In Indonesian].

Nurhayati A., 2013 [Analysis of the Sustainable Fisheries Potential at the Pangandaran area]. Jurnal Akuatika 4(2):195–209. [In Indonesian].

Rahmawati M., Fitri A. D. P., Wijayanto D., 2013 [Analysis of Catch per Unit Effort and Fishing Season Pattern of *Stolephorus spp*. at Pemalang Waters]. Journal of Fisheries Resources Utilization Management and Technology 2(3):213–222. [In Indonesian].

Riandi, Mustapa M. B., Iskandar S., 2017 [Efficiency Analysis of *Penaeus monodon* marketing in Sungai Lumpur Village, Cengal District, Ogan Komering Ilir Regency]. Jurnal Societa 6(2):81–87. [In Indonesian].

Satria A. I. W., Kurnia R., 2017 Population Structuce of (*Katsuwonus pelamis Linnaeus*, 1758) from Southern of Java Sea. Journal of Tropical Fisheries Management 1(1): 1-9.

Savitri I. K. E., Sormin R. B. D., Silaban B., 2017 Quality Indexes and Feasibility Analysis of Traditional Dried Anchovy from Buru Island. IOP Conference Series: Earth and Environmental Science 89(1).

Setiyawan A., 2016 The estimation of skipjack utilization rate in Prigi waters, East Java. Depik 5(1) 7–11.
Siahainenia S. M., 2021 Financial feasibility of hand line fisheries and determination of tuna production in Ambon Island. In IOP Conference Series: Earth and Environmental Science (Vol. 797, Issue 1).
Siyoto S., Sodik M. A., 2015 [Basic research methodology]. Literasi Media Publishing. [In Indonesian].
Sparre P., Venema, Siebren. C., 1998. Introduction to tropical fish stock assessment - Part 1: Manual. FAO.
Talib A., 2017 [Tuna and Skipjack Tuna (a Review: Management of Potential Resource in Indonesian Seas)]. Agrikan: Jurnal Agribisnis Perikanan 10(1):38–50. [In Indonesian].
Tuli M., 2018 [Skipjack Tuna Resource]. Ideas Publishing. Pp. 81. [In Indonesian].
Wujdi A., Setyadji B., Nugroho S. C., 2017 Stock Structure Identification of Skipjack Tuna (*Katsuwonus Pelamis Linnaeus*, 1758) In Indian Ocean (Indonesian Teritory of FMA 573) Using Otolith Shape Analysis. Jurnal Penelitian Perikanan Indonesia 23(2):77–82.
WWF., 2015 [Skipjack Tuna Fishing with Pole and Line (huhate): Guides for Fishing and Handling]. 1st ed. WWF-Indonesia. [In Indonesian].
Yoga B. R. B., Setyono H., Harsono G., 2014 [Dynamics of Upwelling and Downwelling Based on Variability of Sea Surface Temperature and Chlorophyll-a at Southern Java Waters]. Journal of Oceanography 3(1):57–66. [In Indonesian].
*** Government of the Special Region of Yogyakarta, 2011 [Regulation of the Special Region of Yogyakarta Number 16, concerning Zoning Plans for the Coastal Zone and Small Islands of the Province of the Special Region of Yogyakarta in 2011-2030]. [In Indonesian].
*** KKP, 2017 [Decree of the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia Number 50/KEPMEN-KP/2017]. Kementrian Kelautan dan Perikanan (KKP), 8 p. [In Indonesian].

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Study on *Katsuwonus pelamis* fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia

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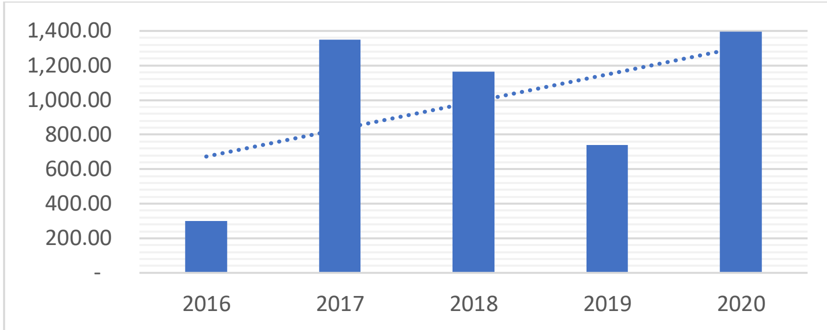
Abstract. *K. pelamis* (*Katsuwonus pelamis*) is a prime fishery commodity widely spread in Indonesian waters. Referring to our data analysis, the production trend in Sadeng Fishery Port is significantly increasing over the 5-year timeline from 2016 to 2020. In order to receive an authentic and detailed examination of the *K. pelamis* fishing business there, all related aspect, such as current exploitation level, fishing technology, facilities and infrastructure, sales, and financial condition have been successfully analyzed. As a result, *K. pelamis* resource in the South Java sea has been over-exploited, as indicated by a negative slope of CPUE and effort function. Fishing technologies used by local fishermen are still conventional and unproperly maintained, which causes low reliability, efficiency, and cruising range. Existing ice factory is also not in operational state, since some of the major parts are broken. However, the product quality is considered fresh, the existing sales are efficient, and the financial condition is profitable.
Key Words: Exploitation level, fishing season, catch quality, sales, financial analysis.

Introduction. Indonesia is an archipelagic country with massive potential in the fishery business. So many fish species have been mainly Indonesia's commodities; one of them is *K. pelamis* (*Katsuwonus pelamis*) (Amiluddin 2020; Kekenusa & Paendong 2016). *K. pelamis* is a high-migratory and cosmopolitan species commonly found in tropical and sub-tropical waters (Arai et al 2005; Satria & Kurnia 2017). In the Indonesian seas, they live in the Indian Ocean (West Sumatra sea, South Java sea, Bali sea, South Lombok Island sea, Sumbawa Island sea) and Eastern Indonesia seas (Celebes sea, Maluku sea, Arafuru sea, Banda sea, Flores and Makassar Strait) (WWF 2015; Tuli 2018).

Based on Ministry of Marine Affairs and Fisheries statistic data in 2019, the total catch of *K. pelamis* in Indonesia has reached 550,606 tons (Statistik KKP 2020). Specifically, at Sadeng Fishery Port, *K. pelamis* production experienced an increasing trend with noticeable fluctuation in the last five years (2016 – 2020), as seen in Graph 1. The lowest production, as much as 305.99 tons, occurred in 2016. In contrast, the highest was in 2020, with a total of around 1,395.53 tons.

The Government of Special Region of Yogyakarta released a government regulation No.16 Year 2011 that stipulates the transformation of Sadeng Fishery Port to be a growth center for the coastal area of the eastern part of Gunung Kidul Regency. The fishery commodities business and tourism as the primary and secondary income, respectively. Ever since the regulation was issued, the local government and fishermen have gained positive benefits since the total fish catch in that area has increased significantly, raising the overall income.



Graph 1. *K. pelamis* Production at Sadeng Fishery Port from 2016 - 2020

Even though *K. pelamis* has a high reproduction rate with all-year-round spawning (Kantun et al 2021) and widespread availability, it is still prone to the possibility of being overly exploited (Wujdi et al 2017). Increasing demand, overfishing, and lack of attention from the government and society contribute significantly to the sustainability of the *K. pelamis* population. Therefore, examining the current *K. pelamis* exploitation level in Sadeng Fishery port and other aspects related to the *K. pelamis* fishing business is necessary.

Material and Method

Description of the study timeline and site. This research was conducted from December 2020 until May 2021 at the Sadeng Fishery Port (*Pelabuhan Perikanan Pantai* or *PPP*), Girisubo District, Gunung Kidul, Special Region of Yogyakarta, Indonesia.

Data collection method. Data are divided into two kinds, primary and secondary. Primary data were collected by using observation, direct interviews, and documentation. While secondary data were collected from existing sources (Siyoto & Sodik 2015). Any sampling in this research was done by using Snowball Method.

Direct observation of the fishing boats was intended to gather the boat conditions, gear operation manual, and fishing methods. Invested cost, fixed cost, variable cost, and yearly revenue data were gathered from direct interviews with fishermen. Product or fish quality testing was carried out at the fish market by conducting organoleptic tests on fish samples according to the Indonesian national standards set out in SNI (Standar Nasional Indonesia) 2729:2013. While the sales and supply chain information were gained from direct interviews with fish sellers. Secondary data, such as time series catch and effort, and port facilities information were referred to existing records at Sadeng Fishery Port office.

Data analysis method.

Catch per Unit Effort (CPUE) is calculated using the following formulas incorporating time series total catch and effort. To be noted, effort should be standardized in advance (Nurhayati, 2013).

$$CPUE_{st} = \frac{C_{st}}{E_{st}} \qquad FPI_{st} = \frac{CPUE_{st}}{CPUE_{st}} \qquad CPUE_i = \frac{C_i}{E_i} \qquad FPI_i = \frac{CPUE_i}{CPUE_{st}}$$

With,

C_{st} :Total catch by standard fishing gear
C_i :Total catch by used fishing gear
E_{st} :Total effort of standard fishing gear
E_i :Total effort of fishing gear *i*
FPI_{st} :Fishing Power Index of standard fishing gear

FPI_i :Fishing Power Index of fishing gear *i*
$CPUE_{st}$:Total catch per effort of standard fishing gear
$CPUE_i$:Total catch per effort of fishing gear *i*

Maximum Sustainable Yield (MSY) is calculated using Schaefer and Fox Exponential model approaches incorporating catch, standardized effort, and natural logarithmic of CPUE variables with regression processes to gain lines intersection values and slopes, as seen in Table 1 (Sparre & Venema 1998).

Table 1

Schaefer Linear Model and Fox Exponential Model

Analysis	Schaefer Linear Model	Fox Exponential Model
MSY	$MSY = -\frac{a^2}{4b}$	$MSY = -\left(\frac{1}{d}\right) \times exp^{(c-1)}$
E_{MSY}	$E_{MSY} = -\frac{a}{2b}$	$E_{MSY} = -\frac{1}{d}$

Source : (Sparre & Venema, 1998)

With,
a : Interception value of Schaefer model
b : Slope of Schaefer model
c : Interception value of Fox model
d : Slope of Fox model
MSY : Maximum Sustainable Yield
E_{MSY} : Sustainable catch effort
$CPUE_{st}$: Catch per effort of standard fishing gear
$CPUE_i$: Catch per effort of fishing gear *i*

The technical aspect of fishing is analyzed by descriptively examining existing fishing boats, gears, and technologies local fishermen use at Sadeng Fishery Port.

Fishing season pattern is studied with the moving average method approach with time series catch and effort as the data (Dajan 2004; Rahmawati, et al 2013). The result of this calculation is the Fishing Season Index (FSI) for each month. It is considered a fishing season if FSI > 1 (> 100%). If FSI = 1 (=100%), it is in equilibrium. Otherwise, it is a non-fishing season.

The production quality of catch is quantitatively analyzed by referring to the method stated in Indonesia National Standard (SNI) 2729:2013. Population quality, μ, is approximated as a range with a 95% confidence level (BSNI 2013).

$$P(\bar{x} - (1,96 \times \frac{s}{\sqrt{n}})) \le \mu \le (\bar{x} + (1,96 \times \frac{s}{\sqrt{n}}))$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$s^2 = \frac{n \sum x_i^2 - (\sum x_i)^2}{n(n-1)}$$

$$s = \sqrt{\frac{n \sum x_i^2 - (\sum x_i)^2}{n(n-1)}}$$

With,

n : total number of panellists;
s^2 : Variance of quality value;
1,96 : standard deviation coefficient at range 95%;
$\overline{x}$: average quality value;
x : quality value from panellist-*i*, where *i* = 1,2,3......n;
s : standard deviation of quality value

The sales aspect of fishing products is studied by analyzing fish distribution from producers to consumers through several supply chains. Two important quantitative variables to assess the sales aspect are fishermen's share and marketing efficiency.

By definition, a fisherman's share is the consumer's or last chain's buying price divided by the selling price from a fisherman. Therefore, this variable is inversely correlated with the total margin from each chain.

$$SM = CP - PP$$

$$FS = \left(\frac{PP}{CP}\right) \times 100\%$$

SM = Sales Margin (USD/kg)
FS = Fisherman's share (%)
CP = Price on consumer level (USD/kg)
PP = Price on producer level (USD/kg)

The examination of marketing efficiency is by dividing the total marketing price by the consumer's or last chain's buying price, as formulated below,

$$ME = \left(\frac{MP}{CP}\right) \times 100\%$$

ME = Marketing Efficiency (%)
MP = Total marketing price (USD/kg)

Fisherman's or farmer's share is not the only variable used to decide whether the sales are efficient (Iswahyudi 2019). Marketing efficiency is also an important variable that should be considered. If ME calculation yields 0 – 33%, it is considered efficient. A range of 34 - 67% is considered less efficient. Otherwise, the sales are inefficient (Riandi et al 2017).

Financial feasibility analysis is quantitatively analyzed by calculating profit, RC ratio, and Return on Investment (ROI) (Hutajulu et al 2019).

Profit (π) was calculated using,

$$\pi = TR - TC$$

While total cost (TC) is defined as the sum of yearly variable cost (VC) and fixed cost (FC).

$$TC = VC + FC$$

RC Ratio is calculated by dividing total revenue (TR) with total cost (TC).

$$\frac{R}{C} = \frac{TR}{TC}$$

Return on Investment (ROI) is defined as the percentage of profit to the initial investment.

$$ROI = \frac{Profit}{Initial\ Investment} \times 100\%$$

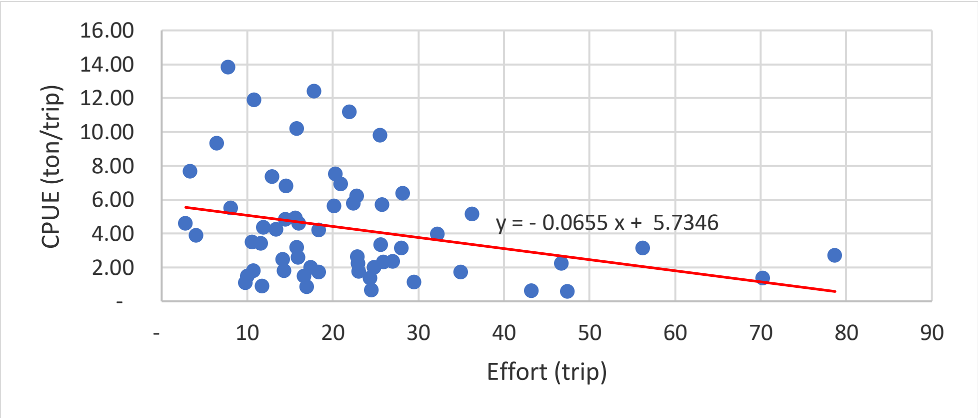
With,

π = Profit (USD/year)
TR = Total Revenue (USD/year)
TC = Total Cost (USD/year)
VC = Variable Cost (USD/year)
FC = Fixed Cost (USD/year)

Facilities and infrastructure that support *K. pelamis* fishing and product distribution are analyzed descriptively by using data from direct observation on site and records from Port Office.

Results and Discussion

The potential of *K. pelamis* resource is examined by finding its current exploitation level through the relationship function of CPUE and Effort. As the beginning, the Effort used in this research is the total number of the fishing trip from 2 (two) main fishing gears, those are purse seine and hand line. Since these two fishing gears have different catching abilities, effort standardization is needed to find the equivalency (Nurdin & Yusfiandayani 2016). The fishing gear that has the highest Catch Per Unit Effort (CPUE) is set as the standard Effort (Nurhayati 2013). As of our data, purse seine has the highest average CPUE value of 4.29 tons/trip. Thus, purse seine is set as the standard with an FPI value = 1. The hand line FPI is calculated by dividing its CPUE value by the purse seine CPUE value, so that the FPI value of the hand line will be less than 1 (Al Aziz 2017). The standard handline Effort is calculated by multiplying the handline FPI with the actual Effort.



Graph 2. Relationship between CPUE dan Fishing Effort

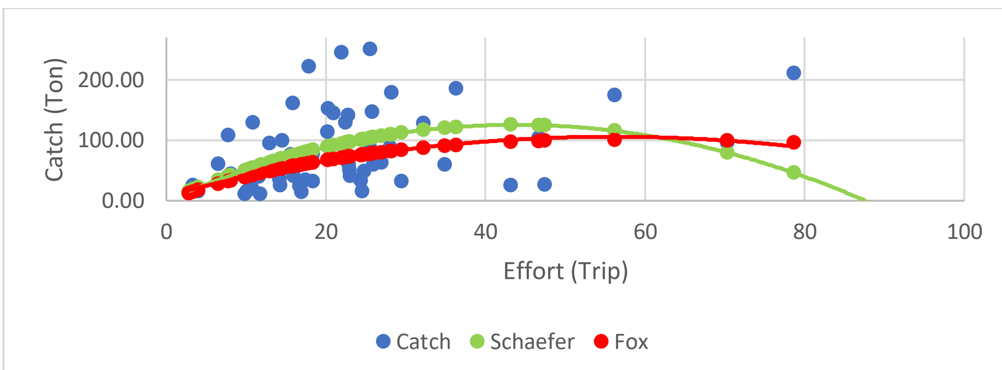
By using the regression method, the relationship function between fishing effort and CPUE is formed as $y = -0.0655x + 5.7346$ as figured in Graph 2. The slope or regression coefficient is -0.0655, which means that each additional fishing trip (effort) will cause a decrease in CPUE of 0.0655 tons. Thus, it can be said that the exploitation has reached over-exploited level.

For the second step, MSY estimation is carried out using the Surplus Production Model, the Schaefer, and Fox. Specifically for the Schaefer model, the net growth rate of fish stocks is described as a logistic function (Atmaja et al 2017). While the Schaefer model uses the logistic relationship between effort and CPUE, Fox utilizes the natural logarithmic relationship. Both models produce different interception and slope values , as presented in table 2 and illustrated in Graph 3. The calculation yields an MSY value of 125.58 tons from the Schaefer model and 100.91 tons from the Fox model. The comparisons of actual monthly catch during the 5-year timeline and MSY limit from Schaefer and Fox models are illustrated in Graph 4 and Graph 5.

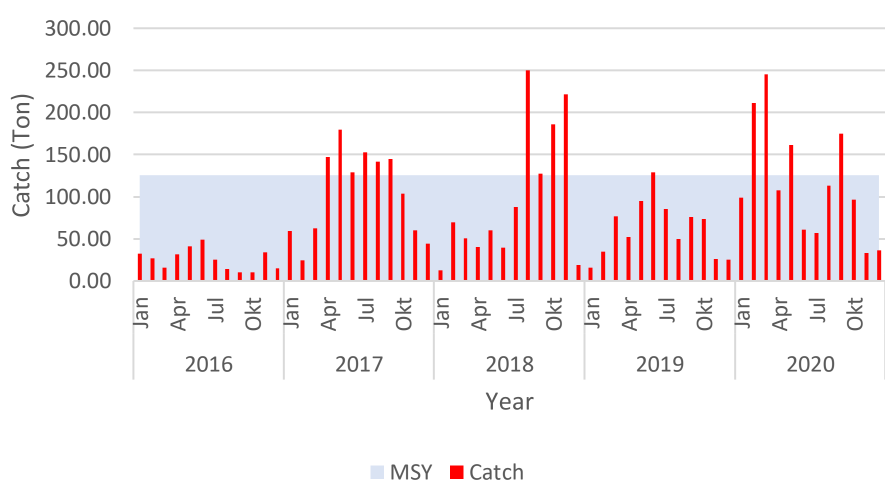
Table 2

Interception and Slope Values with Schaefer and Fox Models

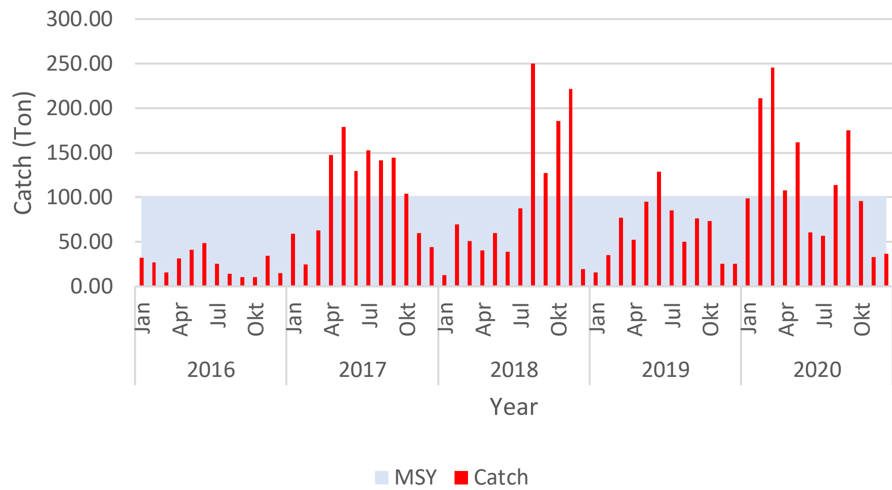
Item	Schaefer	Fox
a or c	5.7346	4.7086
c'		1.5494
b or d	-0.0655	-0.0172
r	-0.2966	-0.3129
r^2	0.0880	0.0979



Graph 3. Maximum Sustainable Yield from Schaefer and Fox models



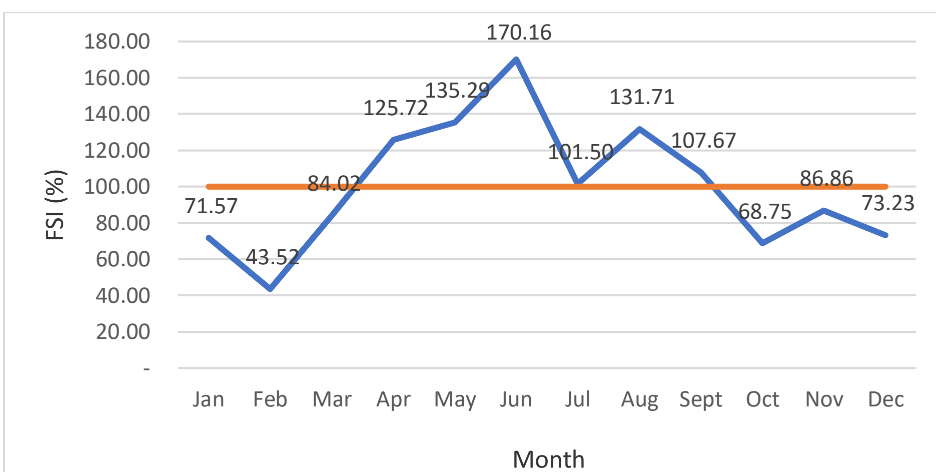
Graph 4. Comparation of monthly production and MSY from Schaefer method



Graph 5. Comparation of monthly production and MSY from Fox method

Fishing season. Based on the calculation following described method in the previous chapter, the Fishing Season Index (FSI) is depicted in Graph 6. To be noted, the fishing season is associated with the number of catches and is not related to the number of stocks in the waters (Al Aziz 2017).

Based on our calculation, *K. pelamis* fishing season happens almost every month. The peak season usually occurs for seven months, from March to September. The medium season happens for five months, from October to January. In comparison, the famine season occurs in February. Anggraeni et al (2015) and Talib (2017) also state that *K. pelamis* fishing season in southern Java occurs almost throughout the year. This condition can happen because *K. pelamis* is a migratory fish (Arai et al 2005) and spawns throughout the year (Hartaty & Arnenda 2019). Referring to research done by Yoga B et al (2014), the upwelling phenomenon happens in the southern java sea during the east season. This phenomenon is indicated by low sea surface temperature and high levels of chlorophyll-a. Upwelling causes the southern java sea to become fertile and increases the fish population (Anggraeni et al 2017).



Graph 6. *K. pelamis* Fishing Index in Sadeng Fishery Port

As can be interpreted from Graph 4, Graph 5, and Graph 6, it is clearly shown that the exploitation of *K. pelamis* during the fishing season in this 5-year timeline has exceeded the

MSY limit by over 250%. This condition has poorly impacted the sustainability of the *K. pelamis* population. The CPUE and effort correlation, as shown in Graph 2, has given quantitative evidence of the impact.

This founded over-exploitation condition is directly prove the truth of the statement in another source. According to Minister of Marine Affairs and Fisheries Regulations No. 50 Year 2017, it is stated that the exploitation level of large pelagic fish in WPP 573 (Indian Ocean at south side of Java, including Sadeng Fishery Port) has been over-exploited. Similarly, Setiyawan (2016) reported the utilization status of *K. pelamis* in Prigi has reached over-exploited level with a utilization rate of 114.9%.

According to Akoit & Nalle (2018), if the catch has exceeded the MSY value, it can lead to extinction because the utilization level has exceeded the species' biological growth function. Thus, sustainable fishing effort *(E_{MSY})* calculation is vital to estimate fishing effort at optimum conditions. The calculation result with the Schaefer model shows that the sustainable fishing effort (E_{MSY}) value is 44 trips/month. In comparison, calculation with the Fox model yields 58 trips/month.

Existing fishing technology and operation. The fishing operation at Sadeng Fishery Port is mainly done using handline and purse seine, as seen in Figures 1 and 2, respectively.

Figure 1. Handline and fishing boat

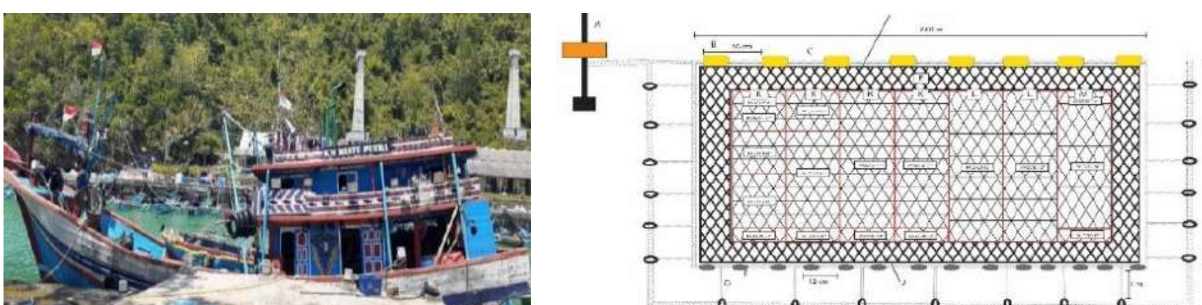


Figure 2. Purse seine and fishing boat

According to our observation, the existing fishing technologies at Sadeng Fishery Port are still conventional. The fishermen rely on traditional boats, old diesel engines, and some malfunctioned gears. Moreover, most fishermen are not applying routine maintenance to their gears, which causes low reliability, fuel efficiency, and cruising distance.

The quality aspect of production. The results of organoleptic tests on *K. pelamis* samples are presented in Table 3. The organoleptic value of *K. pelamis* is ranged from 7.51 to 7.92 which is relatively fresh (>7).

Tabel 3

K. pelamis Organoleptic Test Results

No.	Description	Value
1	Average Organoleptic Value	7.72
2	Standard Deviation	0.59
3	μ Value (confidence coefficient 0.95)	7.51 < μ < 7.92

Sales aspect. As can be seen in Figure 3, there are five models of fish marketing schemes in Sadeng Fishery Port. Each scheme delivers a different fisherman's share.

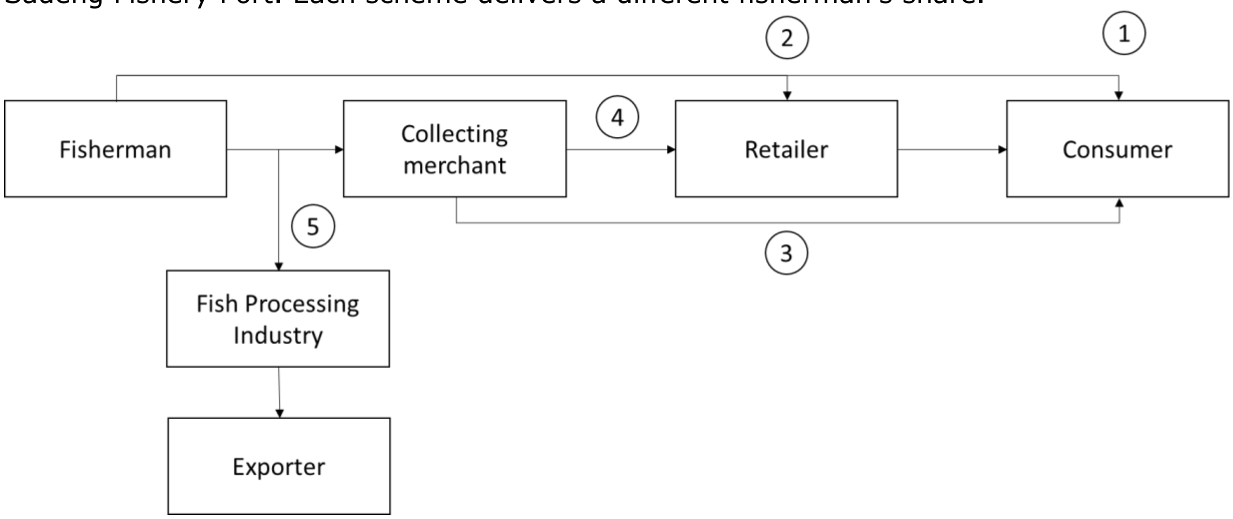


Figure 3. *K. pelamis* Marketing Schemes at Sadeng Fishery Port

Scheme 1: Fishermen – Consumer

Category(es)	Criteria(s)	(USD/kg)	Margin (USD)	Fisherman's share
Fishermen	Selling price	1.10		100%
	Operational	0.57		
	profit	0.53		
Consumer	Buying price	1.10		
	Total marketing price	0		
	Marketing efficiency	0%		

This scheme has no marketing price since the end consumer directly buys the product. Although the fisherman's share is 100% and the marketing efficiency is 0% which is perfectly efficient in the sales term, most end consumers rarely buy products directly from the fishermen at the port.

Scheme 2: Fishermen – Retailer – Consumer

Category(es)	Criteria(s)	(USD/kg)	Margin (USD)	Fisherman's share
Fishermen	Selling price	0.97		85.8%
	Operational	0.57		
	profit	0.4		
Retailer	Buying price	0.97		
	Selling price	1.13	0.16	
	Marketing price	0.04		
	Profit	0.12		
Consumer	Buying price	1.13		
	Total marketing price	0.04		
	Marketing efficiency	3.54%		

In this case, the retailers are reaching fixed daily consumers not far from the port. Their market is the settlement within a 0 to 3 km radius of the port. The marketing price induced can be considered low (around 0.04 USD/kg) since it is only calculating the transportation from the port. Moreover, most of these retailers are using their traditional stalls.

Scheme 3: Fishermen – Collecting Merchant – Consumer

Category(es)	Criteria(s)	(USD/kg)	Margin (USD)	Fisherman's share
Fishermen	Selling price	0.97		82.9%
	Operational	0.57		
	profit	0.4		
Col. Merch.	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing price	0.09		
	Profit	0.11		
Consumer	Buying price	1.17		
	Total marketing price	0.09		
	Marketing efficiency	7.69%		

A collecting merchant is a kind of intermediate seller who usually sells various products with a higher volume than a retailer and operates in a traditional market up to 5 km from the port.

Scheme 4: Fishermen – Collecting Merchant – Retailer – Consumer

Category(es)	Criteria(s)	(USD/kg)	Margin (USD)	Fisherman's share
Fishermen	Selling price	0.97		63.8%
	Operational	0.57		
	profit	0.4		
Col. Merch.	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing price	0.09		
	Profit	0.11		

Retailer	Buying price	1.17		
	Selling price	1.52	0.35	
	Marketing price	0.17		
	Profit	0.18		
Consumer	Buying price	1.52		
	Total marketing price	0.26		
	Marketing efficiency	17.1%		

This scheme is the one that could reach the highest number of consumers since it penetrates the city center market that is located quite far from the port. Even though the marketing price is the highest, its marketing efficiency is still very low, as much as 17.1%.

Scheme 5: Fishermen – Fish Processing Industry

Category(es)	Criteria(s)	(USD/kg)	Margin (USD)	Fisherman's share
Fishermen	Selling price	0.97		100%
	Operational	0.57		
	profit	0.4		
Industry	Buying price	0.97		
	Total marketing price	0		
	Marketing efficiency	0%		

Similar to the first scheme, this one has the perfect fisherman's share and marketing efficiency.

Overall, the sales aspect of *K. pelamis* in Yogyakarta is considered efficient, with fisherman's share in all schemes > 40% (Elpawati et al 2014) and marketing efficiency in the range of 0 to 33% (Riandi et al 2017).

Financial aspect. Table 4 shows the costs and revenue in one year for each fishing method.

Table 4

Cost and Revenue

No.	Description	Fishing Methods (USD)	
		Handline	Purse Seine
1	Revenue	33,747.38	250,576.41
2	Investment Cost	23,560.03	177,672.99
3	Fixed Cost	3,679	20,296.36
4	Variable Cost	23,669.96	156,725.89

The calculation of profit, R/C ratio, and Return of Investment are shown in table 5.

table 5

Financial Analysis

No.	Description	Fishing gears	
		Handline	Purse Seine
1	Profit (USD)	6,399	73,554
2	R/C Ratio	1,23	1.42
3	Return of Investmen (ROI)	27%	41%

The profit induced by using handline is USD 6,399 per year, while purse seine is USD 73,554 per year. The R/C ratio of handline and purse seine are 1.23 and 1.42, respectively. This condition shows that the income obtained from the two business units is greater than the costs incurred (Jumiyati et al 2021; Savitri et al 2017). ROI of both fishing gears > 25% shows that both fishing businesses earn high profits (Siahainenia 2021). The results of the financial analysis above conclude that the fishing business using handlines and purse seines at Sadeng Fishery Port can be declared profitable and feasible.

Facilities and Infrastructure available at Sadeng Fishery Port are listed below,

1) Road access
2) Harbor pool
3) Sailing channel
4) Harbor pier
5) Fish auction venue
6) Fisherman Solar Package Seller
7) Cold storage
8) Clean water wower
9) Ice factory
10) Service and Administration Office
11) Workshop and docking area
12) Net repair site

Based on direct observation, the existing infrastructure and facilities are sufficient to support the business activities at Sadeng Fishery Port. Most are in proper condition, except for the ice factory. This one facility has not been operated for a long time since the equipment was broken. Consequently, fishermen and sellers must find the ice source outside the port, increasing the operational and marketing cost.

Conclusions.

The study of *K. pelamis* fishing business at Sadeng Fishery Port yielded results as follows

- *K. pelamis* resource in the South Java sea has been over-exploited
- Existing fishing technologies used by local fishermen are still conventional and unproperly maintained
- The product quality is considered fresh with $7.51 < \mu < 7.92$
- The sales operation is classified as efficient with the minimum fisherman's share of 63.8% and maximum marketing efficiency of 17.1%
- The business is profitable
- Most existing infrastructure and facilities are in proper condition, except the ice factory, which need major remediations

Acknowledgement.
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References

Akoit, M. Y., Nalle, M., 2018 [Sustainable Management of Fishery Resources in North Central Timor Regency Based on a Bioeconomic Approach]. Journal of Indonesian Agribusiness 6(2): 85–106. [In Indonesian].

Al Aziz, M. A. 2017 [Estimation of Komo tuna (*Euthynnus affinis*) Stock in Gresik Waters, East Java]. Brawijaya University. [In Indonesian]

Amiluddin. 2020 Financial feasibility analysis of skipjack tuna (*Katsuwonus pelamis*) catching in Bone bay, South Sulawesi, Indonesia. In IOP Conference Series: Earth and Environmental Science (Vol. 492, Issue 1).

Anggraeni, R. I., Rahyono, R., Widagdo, S., 2017 [Correlation of Upwelling and Catch of Skipjack Tuna at East Season in Tamperan Waters, Pacitan]. Hang Tuah University. [In Indonesian].

Anggraeni, R., Solichin, A., Saputra, S. W., 2015 [Several Biological Aspects of Skipjack Tuna (*Katsuwonus pelamis*) in Relation to Fisheries Management at PPP Sadeng, Gunungkidul Regency, Yogyakarta]. Management of Aquatic Resources Journal (MAQUARES) 4(3):230–239. [In Indonesian].

Arai, T., Kotake, A., Kayama, S., Ogura, M., Watanabe, Y., 2005 Movements and life history patterns of the skipjack tuna *Katsuwonus pelamis* in the western Pacific, as revealed by otolith Sr:Ca ratios. Journal of the Marine Biological Association of the United Kingdom.

Atmaja, S. B., Sadhotomo, B., Nugroho, D., 2017 Application of Non-Equilibrium Surplus Production Model On Scads (Decapterus Macrosoma) Fishery In Java Sea. Jurnal Penelitian Perikanan Indonesia 23(1):57–66.

BSNI, (*Badan Standarisasi Nasional Indonesia*), 2013 *Ikan Segar* SNI 2729: 2013. Badan Standarisasi Nasional Indonesia Jakarta.

Dajan, A., 2004 [Introduction to Statistics Method II]. Pustaka LP3ES, Jakarta. 358 p. [In Indonesian].

Elpawati, Budiyanto, B., Zulmanery, 2014 [Efficiency Analysis of Milkfish Marketing channels in Tambak Sari Village, Tirtajaya District, Karawang Regency] 8(1):83–110. [In Indonesian].

Hartaty, H., Arnenda, G. L., 2019 [Examination of Cakalang's first mature gonad (Lm) (*Katsuwonus pelamis Linnaeus*, 1758) in Indian Ocean, South of Bali Province]. Jurnal Penelitian Perikanan Indonesia 25(2):135–145. [In Indonesian].

Hutajulu, J., Kusumo, T., Saputra, A., Mualim, R., Handri, M., Sugriwa, E. 2019 Financial analysis in the exploitation of blue swimming crab Portunus pelagicus in Banten Bay, West Java, Indonesia. Aquaculture, Aquarium, Conservation & Legislation 12(2):724–734.

Iswahyudi, Sustiyana, 2019 [Marketing Channel Patterns and Farmer's Share of water apple CV Camplong]. Jurnal Hexago 3(2):33–38. [In Indonesian].

Jumiyati, S., Possumah, N., Hadid, A., Bachri, S., Dua, P., 2021 Eco-friendly utilization to increase income and efficiency of Banggai yam farming in the Banggai Islands, Central Sulawesi, Indonesia. IOP Conference Series: Earth and Environmental Science 797(1).

Kantun W., Cahyono I., Kabangnga A., Riana A. D., 2021 Stock assessment of skipjack tuna *Katsuwonus pelamis* in Makassar Strait, Indonesia. AACL Bioflux 14(2):988-995.

Kekenusa J. S., Paendong M. S., 2016 Analysis Determination of Fishing Season Skipjack Tuna (*Katsuwonus pelamis*) In the Belang Waters of Southeast Minahasa North Sulawesi. Jurnal Ilmiah Sains 16(2): 86-90.

Nurdin, E., Yusfiandayani, R., 2016 [Optimization of Fish Aggregating Devices, Fleet Units, and Fishing Season Pattern of Tuna at Prigi Waters, East Java]. Jurnal Penelitian Perikanan Indonesia 18(1):53–60. [In Indonesian].

Nurhayati, A., 2013 [Analysis of the Sustainable Fisheries Potential at the Pangandaran area]. Jurnal Akuatika 4(2):195–209. [In Indonesian].

Rahmawati, M., Fitri, A. D. P., Wijayanto, D., 2013 [Analysis of Catch per Unit Effort and Fishing Season Pattern of *Stolephorus spp.* at Pemalang Waters]. Journal of Fisheries Resources Utilization Management and Technology 2(3):213–222. [In Indonesian].

Riandi, Mustapa, M. B., Iskandar, S., 2017 [Efficiency Analysis of *Penaeus monodon* marketing in Sungai Lumpur Village, Cengal District, Ogan Komering Ilir Regency]. Jurnal Societa 6(2):81–87. [In Indonesian].

Satria A. I. W., Kurnia R., 2017 Population Structuce of (*Katsuwonus pelamis,* Linnaeus, 1758) from Southern of Java Sea. Journal of Tropical Fisheries Management 1(1): 1-9.

Savitri, I. K. E., Sormin, R. B. D., Silaban, B., 2017 Quality Indexes and Feasibility Analysis of Traditional Dried Anchovy from Buru Island. IOP Conference Series: Earth and Environmental Science 89(1).

Setiyawan, A., 2016 The estimation of skipjack utilization rate in Prigi waters, East Java. Depik 5(1) 7–11.

Siahainenia, S. M., 2021 Financial feasibility of hand line fisheries and determination of tuna production in Ambon Island. In IOP Conference Series: Earth and Environmental Science (Vol. 797, Issue 1).

Siyoto, S., Sodik, M. A., 2015 [Basic research methodology]. Literasi Media Publishing. [In Indonesian].

Sparre, P., Venema, Siebren. C., 1998. Introduction to tropical fish stock assessment - Part 1: Manual. FAO.

Sudjana, M. A., Ibrahim, R., 1996 [Statistic Methods]. Bandung, Penerbit Tarsito. [In Indonesian].

Talib, A., 2017 [Tuna and Skipjack Tuna (a Review: Management of Potential Resource in Indonesian Seas)]. Agrikan: Jurnal Agribisnis Perikanan 10(1):38–50. [In Indonesian].

Tuli M., 2018 [Skipjack Tuna Resource]. Ideas Publishing. Pp. 81. [In Indonesian].

Wujdi, A., Setyadji, B., & Nugroho, S. C., 2017 Stock Structure Identification of Skipjack Tuna (*Katsuwonus Pelamis Linnaeus*, 1758) In Indian Ocean (Indonesian Teritory of FMA 573) Using Otolith Shape Analysis. Jurnal Penelitian Perikanan Indonesia 23(2):77–82.

WWF., 2015 [Skipjack Tuna Fishing with Pole and Line (huhate): Guides for Fishing and Handling]. 1st ed. WWF-Indonesia. [In Indonesian].

Yoga B, R. B., Setyono, H., Harsono, G, 2014 [Dynamics of Upwelling and Downwelling Based on Variability of Sea Surface Temperature and Chlorophyll-a at Southern Java Waters]. Journal of Oceanography 3(1):57–66. [In Indonesian].

**Yogyakarta Special Region Government. (2011). Regulation of the Special Region of Yogyakarta Number 16 of 2011 concerning Zoning Plans for the Coastal Zone and Small Islands of the Province of the Special Region of Yogyakarta in 2011-2030.

**Statistik KKP. (2020). [Skipjack Tuna Production in Indonesia 2015-2019]. Pusat Data Statistik Dan Informasi Kementerian Kelautan Dan Perikanan. [In Indonesian].

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Study on *Katsuwonus pelamis* fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia

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Abstract. *K. pelamis* (*Katsuwonus pelamis*) is a prime fishery commodity widely spread in Indonesian waters. Referring to our data analysis, the production trend in Sadeng Fishery Port is significantly increasing over the 5-year timeline from 2016 to 2020. In order to receive an authentic and detailed examination of the *K. pelamis* fishing business there, all related aspect, such as exploitation level, fishing gears, facilities, sales, and business financial condition have been successfully analyzed. As a result, *K. pelamis* resource in the South Java Sea has been over-exploited, as indicated by a negative slope of CPUE and effort function. Fishing technologies used by local fishermen were still conventional and unproperly maintained, which causes low reliability, efficiency, and cruising range. Existing ice factory was also not in operational state since some of the major parts were broken. However, the *K. pelamis* quality in the markets were fresh, the sales were considered efficient, and the fishing business was financially profitable and feasible.

Key Words: Exploitation level, fishing season, catch quality, sales, financial analysis.

Introduction. Indonesia is an archipelagic country with massive potential in the fishery business. So many fish species have been mainly Indonesia's commodities; one of them is *K. pelamis* (*Katsuwonus pelamis*) (Amiluddin 2020; Kekenusa & Paendong 2016). *K. pelamis* is a high-migratory and cosmopolitan species commonly found in tropical and sub-tropical waters (Arai et al 2005; Satria & Kurnia 2017). In the Indonesian seas, they live in the Indian Ocean (West Sumatra sea, South Java sea, Bali sea, South Lombok Island sea, Sumbawa Island sea) and Eastern Indonesia seas (Celebes sea, Maluku sea, Arafuru sea, Banda sea, Flores and Makassar Strait) (WWF 2015; Tuli 2018).

Based on Ministry of Marine Affairs and Fisheries statistic data in 2019, the total catch of *K. pelamis* in Indonesia has reached 550,606 tons (Statistik KKP 2020). Specifically, at Sadeng Fishery Port, *K. pelamis* production experienced an increasing trend with noticeable fluctuation from 2016 to 2020 (Figure 1). The lowest production, as much as 305.99 tons, occurred in 2016. In contrast, the highest was in 2020, with a total of around 1,395.53 tons.

The Government of Special Region of Yogyakarta released a government regulation No.16 Year 2011 that stipulates the transformation of Sadeng Fishery Port to be a growth center for the coastal area of the eastern part of Gunung Kidul Regency. The fishery commodities business and tourism as the primary and secondary income, respectively. Ever since the regulation was issued, the local government and fishermen have gained positive benefits since the total fish catch in that area has increased significantly, raising the overall income.

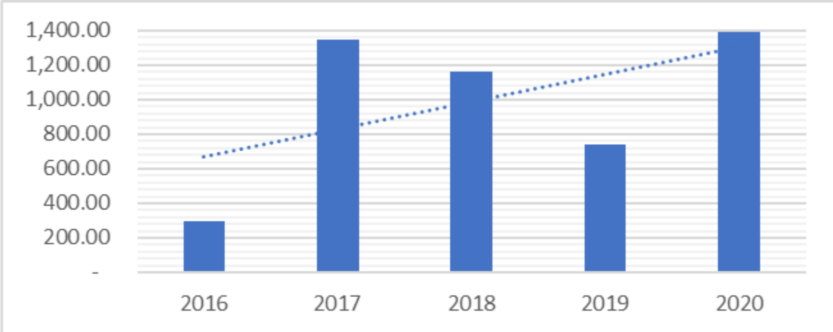

Figure 1. *K. pelamis* Production at Sadeng Fishery Port from 2016 – 2020

Even though *K. pelamis* has a high reproduction rate with all-year-round spawning (Kantun et al 2021) and widespread availability, it is still prone to the possibility of being overly exploited (Wujdi et al 2017). Increasing demand, overfishing, and lack of attention from the government and society contribute significantly to the sustainability of the *K. pelamis* population. Therefore, examining the current *K. pelamis* exploitation level in Sadeng Fishery port and other aspects related to the *K. pelamis* fishing business is necessary.

Material and Method

Description of the study sites. This study was conducted from December 2020 until May 2021 at the Sadeng Fishery Port (*Pelabuhan Perikanan Pantai* or *PPP*), Girisubo District, Gunung Kidul, Special Region of Yogyakarta, Indonesia (Figure 2).

Figure 2. The location of Sadeng Fishery Port, Special Region of Yogyakarta, Indonesia (Google Earth 2022).

Data collection. Data are divided into two kinds, primary and secondary. Primary data were collected by using observation, direct interviews, and documentation. While secondary data were collected from existing sources (Siyoto & Sodik 2015). Any sampling in this research was done by using Snowball method.

K. pelamis exploitation level was examined by finding the relationship function of CPUE and Effort. Effort used in this research is the total number of the fishing trip from 2 (two) main fishing gears, those are purse seine and hand line. Catch per Unit Effort (CPUE) was calculated using the following formulas incorporating time series total catch and effort (Nurhayati, 2013).

$$CPUE_{st} = \frac{C_{st}}{E_{st}} \qquad FPI_{st} = \frac{CPUE_{st}}{CPUE_{st}} \qquad CPUE_i = \frac{C_i}{E_i} \qquad FPI_i = \frac{CPUE_i}{CPUE_{st}}$$

With,

C_{st} = Total catch by standard fishing gear
C_i = Total catch by used fishing gear
E_{st} = Total effort of standard fishing gear
E_i = Total effort of fishing gear *i*
FPI_{st} = Fishing Power Index of standard fishing gear
FPI_i = Fishing Power Index of fishing gear *i*
$CPUE_{st}$ = Total catch per effort of standard fishing gear
$CPUE_i$ = Total catch per effort of fishing gear *i*

Since these two fishing gears have different catching abilities, effort standardization is needed to find the equivalency (Nurdin & Yusfiandayani 2016). The fishing gear that has the highest Catch Per Unit Effort (CPUE) is set as the standard Effort (Nurhayati 2013). As of our data, purse seine has the highest average CPUE value of 4.29 tons/trip. Thus, purse seine is set as the standard with an FPI value = 1. The hand line FPI is calculated by dividing its CPUE value by the purse seine CPUE value, so that the FPI value of the hand line will be less than 1 (Al Aziz 2017). The standard handline Effort is calculated by multiplying the handline FPI with the actual Effort. Finally, by using the regression method, the relationship function between fishing effort and CPUE can be formed.

Maximum sustainable yield and sustainable catch effort were calculated using the surplus production model, the Schaefer, and Fox exponential. Both approaches incorporate catch, standardized effort, and natural logarithmic of CPUE variables with regression processes to gain lines intersection values and slopes, as seen in Table 1 (Sparre & Venema 1998). In the Schaefer model, the net growth rate of fish stocks is described as a logistic function between effort and CPUE (Atmaja et al 2017). In comparison, Fox utilizes the natural logarithmic relationship.

Table 1

Schaefer Linear Model and Fox Exponential Model

Variable	*Schaefer Linear Model*	*Fox Exponential Model*
MSY	$-\frac{a^2}{4b}$	$-\left(\frac{1}{d}\right) \times exp^{(c-1)}$
E_{MSY}	$-\frac{a}{2b}$	$-\frac{1}{d}$

With,
a = Interception value of Schaefer model
b = Slope of Schaefer model
c = Interception value of Fox model
d = Slope of Fox model
MSY = Maximum Sustainable Yield
E_{MSY} = Sustainable catch effort

Fishing season pattern was studied with the moving average method approach with time series catch and effort as the data (Dajan 2004; Rahmawati et al 2013). The result of this calculation is the Fishing Season Index (FSI) for each month. It is considered a fishing season if FSI > 1 (> 100%). If FSI = 1 (=100%), it is in equilibrium. Otherwise, it is a non-fishing season.

The catch quality was determined by using organoleptic tests on fish samples from local markets as stated in Indonesia National Standard (SNI) 2729:2013. Population quality, μ, is approximated as a range with a 95% confidence level (BSNI 2013).

$$P(\bar{x} - (1,96 \times \frac{s}{\sqrt{n}})) \leq \mu \leq (\bar{x} + (1,96 \times \frac{s}{\sqrt{n}}))$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad s^2 = \frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)} \qquad s = \sqrt{\frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)}}$$

With,

n = Total number of panelists

s^2 = Variance of quality value

1,96 = Standard deviation coefficient at range 95%

$\bar{x}$ = Average quality value

x = Quality value from panellist-i, where i = 1,2,3......n

s = Standard deviation of quality value

The sales of K. pelamis are going through several supply chains from producers to consumers. Two important quantitative variables to assess the sales aspect are fishermen's share (FS) and marketing efficiency (ME) (Iswahyudi 2019; Riandi et al 2017). FS is formulated with selling price from fisherman divided by last chain's buying price times 100%. FS is inversely correlated with the total margin from each chain. While ME is calculated by dividing the total marketing price by the selling price in each chain. The sales chain can be considered efficient if FS ≥ 40% (Downey 1992), and ME 0 – 33%. If ME is ranged of 34 - 67% is considered less efficient. Otherwise, the sales are inefficient (Riandi et al 2017).

$$SM = CP - PP$$

$$FS = \left(\frac{PP}{CP}\right) \times 100\%$$

$$ME = \left(\frac{MP}{CP}\right) \times 100\%$$

With,

SM = Sales margin (USD/kg)

CP = Price on consumer level (USD/kg)

PP = Price on producer level (USD/kg)

MP = Total marketing price (USD/kg)

The business financial feasibility was analyzed by calculating profit, RC ratio, and Return on Investment (ROI) (Hutajulu et al 2019). Invested cost, fixed cost, variable cost, and yearly revenue data were gathered from direct interviews with fishermen.

$$\pi = TR - TC$$

$$TC = VC + FC$$

$$\frac{R}{C} = \frac{TR}{TC}$$

$$ROI = \frac{\pi}{Initial\ Investment} \times 100\%$$

With,

π = Profit

TC = Total cost

VC = Variable cost

FC = Fixed cost

TR = Total revenue

Fishing technology, and port facilities that support *K. pelamis* fishing and product distribution are analyzed descriptively by using data from direct observation on site and records from Port Office.

Results. The *K. pelamis* exploitation level, maximum sustainable yield and sustainable catch effort, fishing season pattern, catch quality, sales, and business financial analysis are described as follows.

***K. pelamis* exploitation level.** The relationship function derived from regression of fishing effort and CPUE is $y = -0.0655x + 5.7346$, as depicted in Figure 3. The slope or regression coefficient is -0.0655, which means that each additional fishing trip (effort) will cause a decrease in CPUE of 0.0655 tons. It can be said that *K. pelamis* population has been over-exploited.

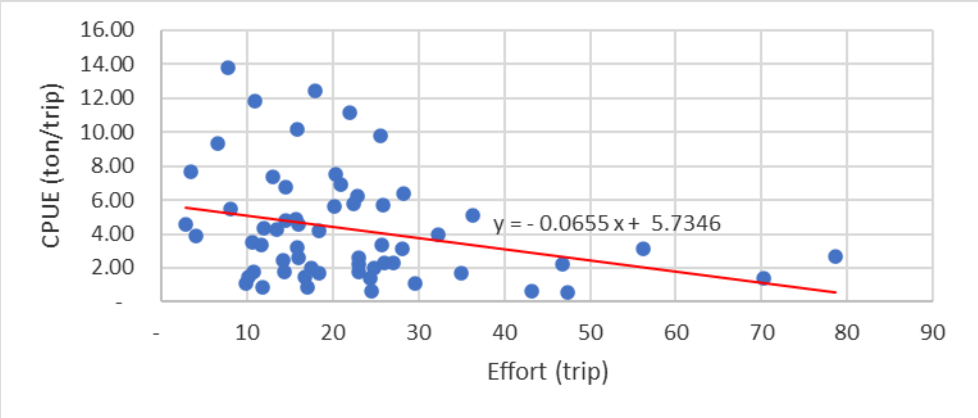

Figure 3. Relationship of Effort and CPUE

***Maximum sustainable yield and sustainable catch effort*.** Schaefer and Fox Exponential approaches produce slightly different results (Table 2). Both approaches lines are provided in Figure 4. The comparisons of actual monthly catch during the 5-year timeline and MSY limit from Schaefer and Fox models are illustrated in Figure 5 and Figure 6.

Table 2

Interception and Slope Values with Schaefer and Fox Models

Item	*Schaefer*	*Fox*
a or c	5.7346	4.7086
c'		1.5494
b or d	-0.0655	-0.0172
r	-0.2966	-0.3129
r^2	0.0880	0.0979
MSY	125.58 tons	100.91 tons
E_{MSY}	44 trips/month	58 trips/month

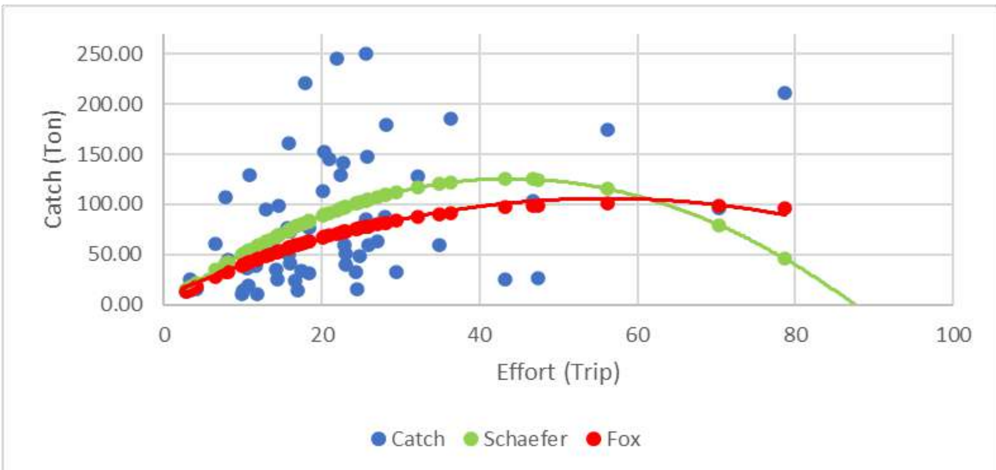

Figure 4. Schaefer and Fox functions

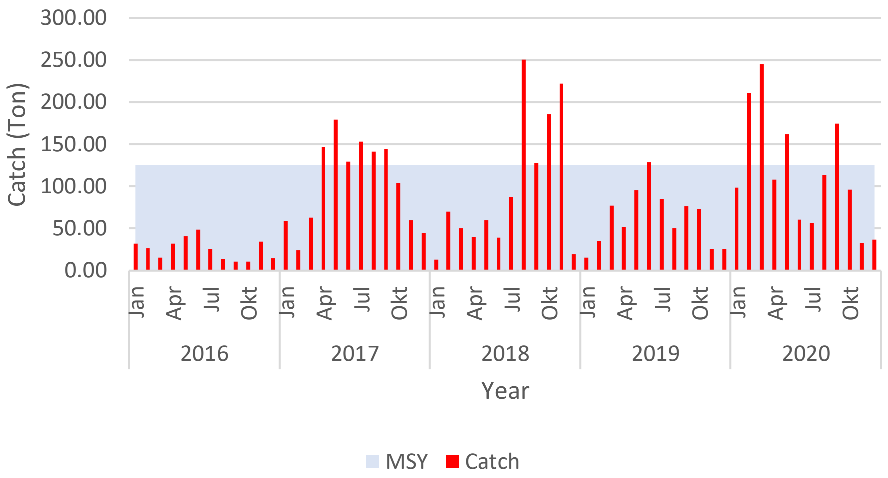

Figure 5. Comparation of monthly production and MSY from Schaefer method

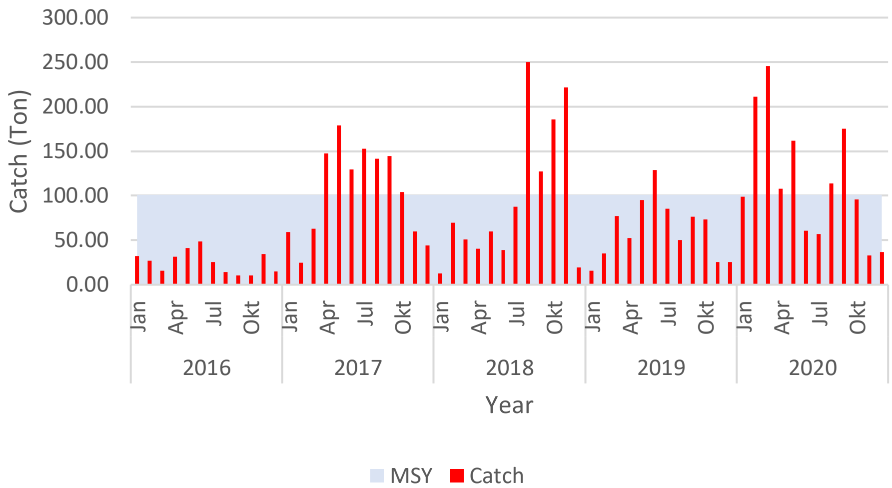

Figure 6. Comparation of monthly production and MSY from Fox method

Fishing season pattern. The Fishing Season Index (FSI) is depicted in Figure 7. To be noted, the fishing season is associated with the number of catches and is not related to the number of stocks in the waters (Al Aziz 2017).

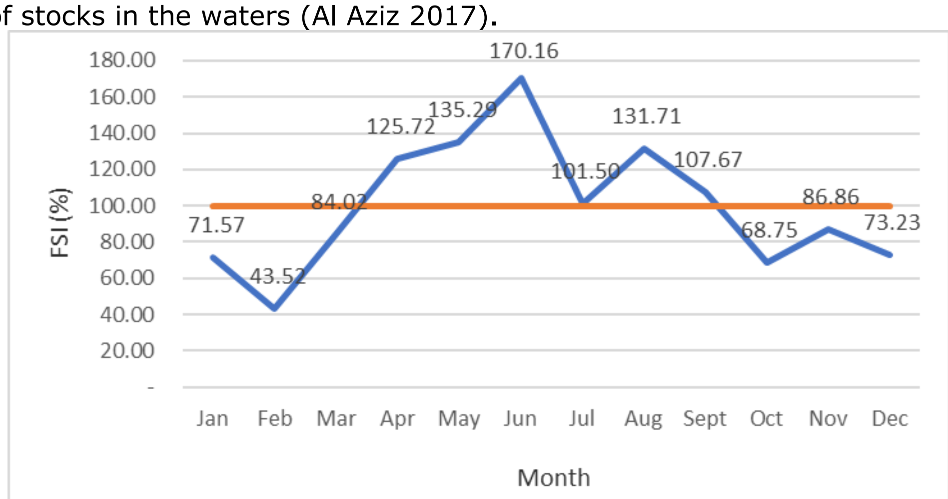

Figure 7. K. pelamis Fishing Index at Sadeng Fishery Port

The catch quality. The results of organoleptic tests on *K. pelamis* samples are presented in Table 3. The organoleptic value of *K. pelamis* is ranged from 7.51 to 7.92 which is relatively fresh (>7).

Table 3

K. pelamis Organoleptic Test Results

Description	*Value*
Average Organoleptic Value	7.72
Standard Deviation	0.59
μ Value (confidence coefficient 0.95)	7.51 < μ < 7.92

The sales of K. pelamis. As can be seen in Figure 8, there are five models of fish marketing schemes in Sadeng Fishery Port. Each scheme delivers different $\boldsymbol{FS}$ and $\boldsymbol{ME}$ which described in Table 4 until 8.

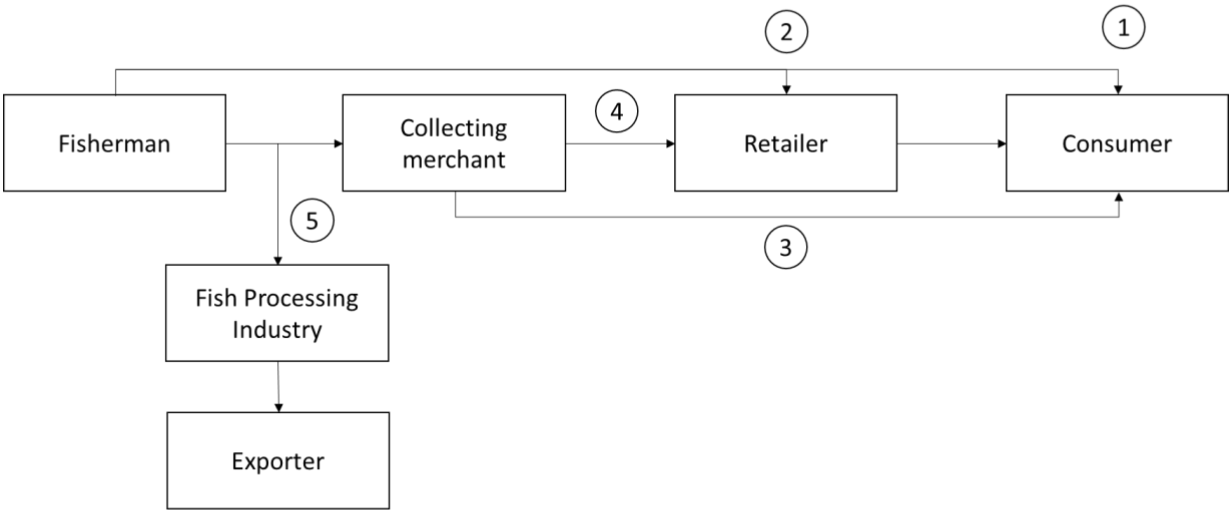

Figure 8. *K. pelamis* marketing schemes at Sadeng Fishery Port

Table 4

Scheme 1: Fishermen – Consumer

Category	*Criteria*	*(USD/kg)*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	1.10		100%
	Operational	0.57		
	profit	0.53		
Consumer	Buying price	1.10		
	Total marketing price	0		
	Marketing efficiency	0%		

This scheme has no marketing price since the end consumer directly buys the product from fisherman. Although the fisherman's share is 100% and the marketing efficiency is 0% which is perfectly efficient in the sales term, most end consumers rarely buy products directly from the fishermen at the port.

Table 5

Scheme 2: Fishermen – Retailer – Consumer

Category	*Criteria*	*(USD/kg)*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		85.8%
	Operational	0.57		
	profit	0.4		
Retailer	Buying price	0.97		

	Selling price	1.13	0.16	
	Marketing price	0.04		
	Profit	0.12		
Consumer	Buying price	1.13		
	Total marketing price	0.04		
	Marketing efficiency	3.54%		

In this case, the retailers are reaching fixed daily consumers not far from the port. Their market is the settlement within a 0 to 3 km radius of the port. The marketing price induced can be considered low (around 0.04 USD/kg) since it is only calculating the transportation from the port. Moreover, most of these retailers are using their traditional stalls.

Table 6

Scheme 3: Fishermen – Collecting Merchant – Consumer

Category	*Criteria*	*(USD/kg)*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		82.9%
	Operational	0.57		
	profit	0.4		
Col. Merch.	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing price	0.09		
	Profit	0.11		
Consumer	Buying price	1.17		
	Total marketing price	0.09		
	Marketing efficiency	7.69%		

A collecting merchant is a kind of intermediate seller who usually sells various products with a higher volume than a retailer and operates in a traditional market up to 5 km from the port.

Table 7

Scheme 4: Fishermen – Collecting Merchant – Retailer – Consumer

Category	*Criteria*	*(USD/kg)*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		63.8%
	Operational	0.57		
	profit	0.4		
Col. Merch.	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing price	0.09		
	Profit	0.11		
Retailer	Buying price	1.17		
	Selling price	1.52	0.35	
	Marketing price	0.17		
	Profit	0.18		
Consumer	Buying price	1.52		
	Total marketing price	0.26		
	Marketing efficiency	17.1%		

This scheme is the one that could reach the highest number of consumers since it penetrates the city center market that is located quite far from the port. Even though the marketing price is the highest, its marketing efficiency is still very low, as much as 17.1%.

Table 8

Scheme 5: Fishermen – Fish Processing Industry

Category	*Criteria*	*(USD/kg)*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		100%
	Operational	0.57		
	profit	0.4		
Industry	Buying price	0.97		
	Total marketing price	0		
	Marketing efficiency	0%		

The business financial feasibility. Table 9 shows the costs and revenue in one year for each fishing method.

Table 9

Cost and Revenue

Description	*Fishing Methods*	
	Handline	*Purse seine*
Revenue (USD)	33,747.38	250,576.41
Investment Cost (USD)	23,560.03	177,672.99
Fixed Cost (USD)	3,679	20,296.36
Variable Cost (USD)	23,669.96	156,725.89
Profit (USD)	6,399	73,554
RC ratio	1,23	1.42
ROI (%)	27%	41%

Fishing technology. The fishing operation at Sadeng Fishery Port is mainly done using handline and purse seine, as seen in Figures 9 and 10, respectively.

Figure 9. Fishing boat equipped with handline

Figure 10. Fishing boat equipped with purse seine

Port facilities. The existing facilities are classified into 3 categories, which are main, functional, and secondary. Main facilities are the basic or mandatory facilities as the minimum requirements of a port (Table 10). Functional facilities are the facilities that are directly used by port management or other stakeholders to enhance their operation process (Table 11). While other facilities that are not giving effects on the fishermen's and port management's income are categorized as secondary facilities. Most facilities were in proper condition, except for the ice factory (Figure 11).

Table 10

Main Facilities

Description	*Volume*	*Condition*
Area	50,000 m^2	Good
Harbor pool >5 GT	22,900 m^2	Good
Harbor pool <5 GT	5,700 m^2	Good
Breakwater	135 m	Good
Dock	485 m	Good
Access road	720 m	Good
Bridge	15 m^2	Good
Open drainage	888.5 m	Good
Boundary fence	450 m	Good

Table 11

Functional Facilities

Description	*Volume*	*Condition*
Port offices	total 624 m^2	Good
Port fish auction	225 m^2	Good
Ice factory	3 units	Broken
Water tower	10 m^2	Good
Workshop	72 m^2	Good
Sleepway	1 unit	Good
Cold storage	169 m^2	Good
Net repair site	96 m^2	Good
Navigation lamp	4 units	Good
Light buoy	2 units	Good
Parking site	600 m^2	Good

Figure 11. Broken ice factory

Discussions. Based on our calculation, *K. pelamis* fishing season happens almost every month. The peak season usually occurs for seven months, from March to September. The medium season happens for five months, from October to January. In comparison, famine season occurs in February. Anggraeni et al (2015) and Talib (2017) also state that *K. pelamis* fishing season in southern Java occurs almost throughout the year. This condition can happen because *K. pelamis* is a migratory fish (Arai et al 2005) and spawns throughout the year (Hartaty & Arnenda 2019). Referring to research done by Yoga B et al (2014), the upwelling phenomenon happens in the southern java sea during the east season. This phenomenon is indicated by low sea surface temperature and high levels of chlorophyll-a. Upwelling causes the southern java sea to become fertile and increases the fish population (Anggraeni et al 2017).

Unfortunately, *K. pelamis* exploitation during the fishing season in each year within this 5-year timeline has exceeded the MSY limit, as can be interpreted from Figure 5, 6, and 7. In July – October 2018 and March 2020 as seen in Figure 6 is the most significant where the catch reached over 200% of the MSY value. This result is directly proving the statements written in other sources. According to Minister of Marine Affairs and Fisheries Regulations No. 50 Year 2017, it is stated that the exploitation level of large pelagic fish in WPP 573 (Indian Ocean at south side of Java, including Sadeng Fishery Port) has been over-exploited. Similarly, Setiyawan (2016) reported the utilization status of *K. pelamis* in Prigi (Indian Ocean at south side of Java) has reached over-exploited level with a utilization rate of 114.9%.

According to Akoit & Nalle (2018), if the catch has exceeded the MSY value, it can lead to extinction because the utilization level has exceeded the species' biological growth function. Thus, sustainable fishing effort (E_{MSY}) calculation is vital to estimate fishing effort at optimum conditions. The calculation result with the Schaefer model shows that the sustainable fishing effort (E_{MSY}) value is 44 trips/month. In comparison, calculation with the Fox model yields 58 trips/month.

Nevertheless, *K. pelamis* sold in the markets were fresh, the sales were considered efficient, and the fishing business using handlines and purse seines at Sadeng Fishery Port could be declared financially profitable and feasible. As seen in Table 3, μ is in the range of 7.51 to 7.92 (BSNI 2013). Fisherman's share in all schemes >40% (Downey 1992) and marketing efficiency in the range of 0 to 33% (Riandi et al 2017). The profit induced by using handline was USD 6,399 per year, while purse seine was USD 73,554 per year. The R/C ratio of handline and purse seine were 1.23 and 1.42, respectively. These parameters indicate that the income obtained from the two fishing methods is greater than the costs incurred (Jumiyati et al 2021; Savitri et al 2017). Additionally, ROI of both fishing gears >25%, which shows that the *K. pelamis* fishing business earn high profits (Siahainenia 2021).

According to our observation, the existing fishing gears at Sadeng Fishery Port were still conventional and there was one facility that need to be remediated. The fishermen relied on traditional boats, old diesel engines, and some malfunctioned gears. Moreover, most fishermen did not apply routine maintenance to their gears, which causes low reliability, fuel efficiency, and cruising distance. All existing facilities functioned properly except for the ice factory (Figure 11). Consequently, fishermen and sellers must find the ice source outside the port, increasing the operational and marketing cost.

Conclusions. The study of *K. pelamis* fishing business at Sadeng Fishery Port yielded results as follows,

- *K. pelamis* resource in the South Java Sea has been over-exploited.
- Fishing technology used by local fishermen were still conventional and unproperly maintained.
- *K. pelamis* quality in the markets were fresh with $7.51 < \mu < 7.92$.
- The sales were considered efficient with the minimum fisherman's share of 63.8% and maximum marketing efficiency of 17.1% from all marketing channels.
- The fishing business was financially profitable and feasible.
- Most existing facilities were in proper condition, except for the ice factory.

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References

Akoit M. Y., Nalle M., 2018 [Sustainable Management of Fishery Resources in North Central Timor Regency Based on a Bioeconomic Approach]. Journal of Indonesian Agribusiness 6(2): 85–106. [In Indonesian].

Al Aziz M. A., 2017 [Estimation of Komo tuna (***Euthynnus affinis***) Stock in Gresik Waters, East Java]. Brawijaya University. [In Indonesian]

Amiluddin, 2020 Financial feasibility analysis of skipjack tuna (***Katsuwonus pelamis***) catching in Bone bay, South Sulawesi, Indonesia. In IOP Conference Series: Earth and Environmental Science (Vol. 492, Issue 1).

Anggraeni R. I., Rahyono R., Widagdo S., 2017 [Correlation of Upwelling and Catch of Skipjack Tuna at East Season in Tamperan Waters, Pacitan]. Hang Tuah University. [In Indonesian].

Anggraeni R., Solichin A., Saputra S. W., 2015 [Several Biological Aspects of Skipjack Tuna (***Katsuwonus pelamis***) in Relation to Fisheries Management at PPP Sadeng, Gunungkidul Regency, Yogyakarta]. Management of Aquatic Resources Journal (MAQUARES) 4(3):230–239. [In Indonesian].

Arai T., Kotake A., Kayama S., Ogura M., Watanabe Y., 2005 Movements and life history patterns of the skipjack tuna ***Katsuwonus pelamis*** in the western Pacific, as revealed by otolith Sr:Ca ratios. Journal of the Marine Biological Association of the United Kingdom.

Atmaja S. B., Sadhotomo B., Nugroho D., 2017 Application of Non-Equilibrium Surplus Production Model on Scads (***Decapterus Macrosoma***) Fishery at Java Sea. Jurnal Penelitian Perikanan Indonesia 23(1):57–66.

BSNI (*Badan Standarisasi Nasional Indonesia*), 2013 *Ikan Segar* SNI 2729: 2013. Badan Standarisasi Nasional Indonesia Jakarta.

Dajan A., 2004 [Introduction to Statistics Method II]. Pustaka LP3ES, Jakarta. 358 p. [In Indonesian].

Downey, Erickson W. P., 1992 [Agrobusiness Management]. Erlangga, Jakarta. [In Indonesian].

Elpawati, Budiyanto B., Zulmanery, 2014 [Efficiency Analysis of Milkfish Marketing channels in Tambak Sari Village, Tirtajaya District, Karawang Regency] 8(1):83–110. [In Indonesian].

Google Earth, 2022. Available at: https://earth.google.com/web/. Accessed: December 2022

Hartaty H., Arnenda G. L., 2019 [Examination of Cakalang's first mature gonad (Lm) (***Katsuwonus pelamis Linnaeus***), 1758) in Indian Ocean, South of Bali Province]. Jurnal Penelitian Perikanan Indonesia 25(2):135–145. [In Indonesian].
Hutajulu J., Kusumo T., Saputra A., Mualim R., Handri M., Sugriwa E. 2019 Financial analysis in the exploitation of blue swimming crab ***Portunus pelagicus*** in Banten Bay, West Java, Indonesia. Aquaculture, Aquarium, Conservation & Legislation 12(2):724–734.
Iswahyudi, Sustiyana, 2019 [Marketing Channel Patterns and Farmer's Share of water apple CV Camplong]. Jurnal Hexago 3(2):33–38. [In Indonesian].
Jumiyati S., Possumah N., Hadid A., Bachri S., Dua P., 2021 Eco-friendly utilization to increase income and efficiency of Banggai yam farming in the Banggai Islands, Central Sulawesi, Indonesia. IOP Conference Series: Earth and Environmental Science 797(1).
Kantun W., Cahyono I., Kabangnga A., Riana A. D., 2021 Stock assessment of skipjack tuna ***Katsuwonus pelamis*** in Makassar Strait, Indonesia. AACL Bioflux 14(2):988-995.
Kekenusa J. S., Paendong M. S., 2016 Analysis Determination of Fishing Season Skipjack Tuna (***Katsuwonus pelamis***) In the Belang Waters of Southeast Minahasa North Sulawesi. Jurnal Ilmiah Sains 16(2): 86-90.
Nurdin E., Yusfiandayani R., 2016 [Optimization of Fish Aggregating Devices, Fleet Units, and Fishing Season Pattern of Tuna at Prigi Waters, East Java]. Jurnal Penelitian Perikanan Indonesia 18(1):53–60. [In Indonesian].
Nurhayati A., 2013 [Analysis of the Sustainable Fisheries Potential at the Pangandaran area]. Jurnal Akuatika 4(2):195–209. [In Indonesian].
Rahmawati M., Fitri A. D. P., Wijayanto D., 2013 [Analysis of Catch per Unit Effort and Fishing Season Pattern of ***Stolephorus spp.*** at Pemalang Waters]. Journal of Fisheries Resources Utilization Management and Technology 2(3):213–222. [In Indonesian].
Riandi, Mustapa M. B., Iskandar S., 2017 [Efficiency Analysis of *Penaeus monodon* marketing in Sungai Lumpur Village, Cengal District, Ogan Komering Ilir Regency]. Jurnal Societa 6(2):81–87. [In Indonesian].
Satria A. I. W., Kurnia R., 2017 Population Structuce of (***Katsuwonus pelamis Linnaeus***, 1758) from Southern of Java Sea. Journal of Tropical Fisheries Management 1(1): 1-9.
Savitri I. K. E., Sormin R. B. D., Silaban B., 2017 Quality Indexes and Feasibility Analysis of Traditional Dried Anchovy from Buru Island. IOP Conference Series: Earth and Environmental Science 89(1).
Setiyawan A., 2016 The estimation of skipjack utilization rate in Prigi waters, East Java. Depik 5(1) 7–11.
Siahainenia S. M., 2021 Financial feasibility of hand line fisheries and determination of tuna production in Ambon Island. In IOP Conference Series: Earth and Environmental Science (Vol. 797, Issue 1).
Siyoto S., Sodik M. A., 2015 [Basic research methodology]. Literasi Media Publishing. [In Indonesian].
Sparre P., Venema, Siebren. C., 1998. Introduction to tropical fish stock assessment - Part 1: Manual. FAO.
Sudjana M. A., Ibrahim R., 1996 [Statistic Methods]. Bandung, Penerbit Tarsito. [In Indonesian].
Talib A., 2017 [Tuna and Skipjack Tuna (a Review: Management of Potential Resource in Indonesian Seas)]. Agrikan: Jurnal Agribisnis Perikanan 10(1):38–50. [In Indonesian].
Tuli M., 2018 [Skipjack Tuna Resource]. Ideas Publishing. Pp. 81. [In Indonesian].
Wujdi A., Setyadji B., Nugroho S. C., 2017 Stock Structure Identification of Skipjack Tuna (***Katsuwonus Pelamis Linnaeus***, 1758) In Indian Ocean (Indonesian Teritory of FMA 573) Using Otolith Shape Analysis. Jurnal Penelitian Perikanan Indonesia 23(2):77–82.

WWF., 2015 [Skipjack Tuna Fishing with Pole and Line (huhate): Guides for Fishing and Handling]. 1st ed. WWF-Indonesia. [In Indonesian].
Yoga B. R. B., Setyono H., Harsono G., 2014 [Dynamics of Upwelling and Downwelling Based on Variability of Sea Surface Temperature and Chlorophyll-a at Southern Java Waters]. Journal of Oceanography 3(1):57–66. [In Indonesian].
Yogyakarta Special Region Government, 2011 Regulation of the Special Region of Yogyakarta Number 16 of 2011 concerning Zoning Plans for the Coastal Zone and Small Islands of the Province of the Special Region of Yogyakarta in 2011-2030.
Statistik KKP, 2020 [Skipjack Tuna Production in Indonesia 2015-2019]. Pusat Data Statistik Dan Informasi Kementerian Kelautan Dan Perikanan. [In Indonesian].

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Study on *Katsuwonus pelamis* fishing business at Sadeng Fishery Port, Yogyakarta, Indonesia

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Abstract. *Katsuwonus pelamis* is a prime fishery commodity widely spread in Indonesian waters. Referring to our data analysis, the production trend in Sadeng Fishery Port is significantly increasing over the 5-year timeline, from 2016 to 2020. In order to receive an authentic and detailed examination of the *K. pelamis* fishing business there, all related aspects, such as exploitation level, fishing gears, facilities, sales, and business financial condition have been successfully analyzed. As a conclusion, *K. pelamis* resource in the South Java Sea has been over-exploited, as indicated by a negative slope of CPUE and effort function. Fishing technologies used by local fishermen were still conventional and unproperly maintained, which lowers reliability, efficiency, and cruising range. Existing ice factory was also not in an operational state, since some of the major parts were broken. However, the *K. pelamis* on the markets were fresh, the sales were considered efficient, and the fishing business was financially profitable and feasible.
Key Words: exploitation level, fishing season, catch quality, sales, financial analysis.

Introduction. Indonesia is an archipelagic country with massive potential in the fishery business, due to the abundance of many fish species, among which the *Katsuwonus pelamis* (Amiluddin 2020; Kekenusa & Paendong 2016). *K. pelamis* is a high-migratory and cosmopolitan species commonly found in tropical and sub-tropical waters (Arai et al 2005; Satria & Kurnia 2017). In the Indonesian seas, they live in the Indian Ocean (West Sumatra Sea, South Java Sea, Bali Sea, South Lombok Island Sea, Sumbawa Island Sea) and Eastern Indonesia seas (Celebes Sea, Maluku Sea, Arafuru Sea, Banda Sea, Flores and Makassar Strait) (WWF 2015; Tuli 2018).

The Government of Special Region of Yogyakarta released a government regulation, No. 16 of year 2011 that stipulates the transformation of Sadeng Fishery Port into an economic growth center for the coastal area of the eastern part of Gunung Kidul Regency, based on the fishery commodities business and tourism as the primary and secondary income, respectively. Following the regulation issuance, the local government and fishermen obtained benefits, since the total fish catch in that area has increased significantly, raising the overall income. Based on data from Sadeng Fishery Port, *K. pelamis* production experienced an increasing trend with a noticeable fluctuation from 2016 to 2020 (Figure 1). The lowest production, of 305.99 tons, occurred in 2016, while the highest occurred in 2020, with a total of around 1,395.53 tons.

Even though *K. pelamis* has a high reproduction rate, with all-year-round spawning (Kantun et al 2021) and widespread availability, it is still prone to the possibility of being over-exploited (Wujdi et al 2017). The increasing demand, overfishing, and lack of awareness from the government and society contribute significantly to the sustainability of the *K. pelamis* population. Therefore, examining the current *K. pelamis* exploitation level in Sadeng Fishery port and other aspects related to the *K. pelamis* fishing business is necessary.

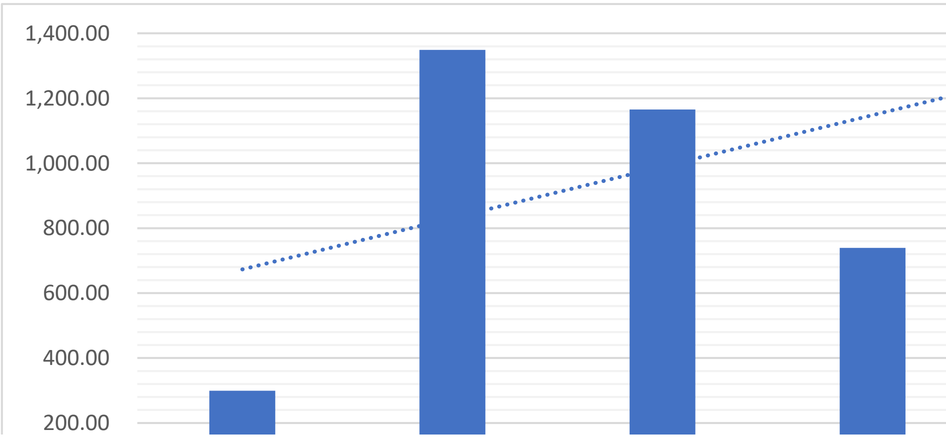

Figure 1. *Katsuwonus pelamis* production at Sadeng Fishery Port from 2016 to 2020.

Material and Method

Description of the study sites. This study was conducted from December 2020 until May 2021 at the Sadeng Fishery Port (Pelabuhan Perikanan Pantai or PPP), Girisubo District, Gunung Kidul, Special Region of Yogyakarta, Indonesia (Figure 2).

Figure 2. The location of Sadeng Fishery Port, Special Region of Yogyakarta, Indonesia

Data collection. Data are divided into two kinds, primary and secondary. Primary data were collected by using observation, direct interviews, and documentation, while secondary data were collected from existing sources (Siyoto & Sodik 2015). Any sampling in this research was done by using the Snowball method.

K. pelamis exploitation level. The exploitation level was examined by finding the relationship function of CPUE and Effort. The effort definition used in this research is the total number of fishing trips with 2 types of fishing gears: purse seines and hand lines. The Catch per Unit of Effort (CPUE) was calculated using the following formulas, incorporating the time series of total catch and effort (Nurhayati 2013).

$$CPUE_{st} = \frac{C_{st}}{E_{st}} \qquad FPI_{st} = \frac{CPUE_{st}}{CPUE_{st}} \qquad CPUE_i = \frac{C_i}{E_i} \qquad FPI_i = \frac{CPUE_i}{CPUE_{st}}$$

Where:
C_{st} - total catch by standard fishing gear;
C_i - total catch by used fishing gear;
E_{st} - total effort of standard fishing gear;
E_i - total effort of fishing gear *i*;

FPI_{st} - fishing power index of standard fishing gear;
FPI_i - fishing power index of fishing gear *i*;
$CPUE_{st}$ - total catch per effort of standard fishing gear;
$CPUE_i$ - total catch per effort of fishing gear *i.*

Since these two fishing gears have different catching abilities, effort standardization is needed to find the equivalency (Nurdin & Yusfiandayani 2016). The fishing gear that has the highest Catch Per Unit Effort (CPUE) is set as the standard Effort (Nurhayati 2013). From our data, the purse seine has the highest average CPUE value, of 4.29 tons trip^{-1}. Thus, purse seine is set as the standard with an FPI value = 1. The hand line FPI is calculated by dividing its CPUE value by the purse seine CPUE value, so that the FPI value of the hand line will be less than 1 (Al Aziz 2017). The standard handline Effort is calculated by multiplying the handline FPI with the actual Effort. Finally, the relationship between the fishing effort and CPUE can be obtained by using the regression method.

Maximum sustainable yield and sustainable catch effort. The maximum sustainable yield and sustainable catch effort were calculated using the Schaefer, and Fox exponential surplus production models. Both approaches are regression formulae incorporating the catch, standardized effort, and natural logarithm of the CPUE variables, in order to determine the points of intersection and slopes, as seen in Table 1 (Sparre & Venema 1998). In the Schaefer model, the net growth rate of fish stocks is described as a logistic function between the effort and CPUE (Atmaja et al 2017), while the Fox model utilizes a natural logarithmic relationship.

Table 1

Schaefer linear model and fox exponential model

Variable	*Schaefer linear model*	*Fox exponential model*
MSY	$-\frac{a^2}{4b}$	$-\left(\frac{1}{d}\right) \times exp^{(c-1)}$
E_{MSY}	$-\frac{a}{2b}$	$-\frac{1}{d}$

Where:
a - interception value of Schaefer model;
b - slope of Schaefer model;
c - interception value of Fox model;
d - slope of Fox model;
MSY - maximum sustainable yield;
E_{MSY} - sustainable catch effort.

Fishing season pattern. The temporal pattern was studied based on the moving average of the catch and effort time series data (Dajan 2004; Rahmawati et al 2013). The result of this calculation is the Fishing Season Index (FSI) for each month. Fishing season is indicated with FSI > 100%. Otherwise, the period is not a fishing season.

The catch quality. was determined by using organoleptic tests on fish samples from local markets as stated in the Indonesian National Standard (SNI) 2729:2013. Population quality, μ, is approximated as a range with a 95% confidence level (BSNI 2013).

$$P(\bar{x} - (1{,}96 * s / \sqrt{n})) \leq \mu \leq P(\bar{x} + (1{,}96 * s / \sqrt{n}))$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad s^2 = \frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)} \qquad s = \sqrt{\frac{n\sum x_i^2 - (\sum x_i)^2}{n(n-1)}}$$

Where:

n - total number of panelists;
s^2 - variance of quality value;
1.96 - standard deviation coefficient at range 95%;
$\bar{x}$ - average quality value;
x - quality value from panelist i, where i = 1,2,3......n;
s - standard deviation of quality value.

***K. pelamis* sales**. *K. pelamis* is distributed through several supply chains, from producers to consumers. Two important quantitative variables to assess the sales aspect are fishermen's share (FS) and marketing efficiency (ME) (Iswahyudi 2019; Riandi et al 2017). FS is with the ratio of the fisherman's selling price divided by the last buying price of the chain times 100%. FS is inversely correlated with the total margin from each chain. While ME is calculated by dividing the total marketing cost by the selling price in each chain. The sales chain can be considered efficient if FS => 40% (Downey 1992) and ME < 33%, while if ME ranges 34 - 67%, it is considered less efficient. Otherwise, the sales are inefficient (Riandi et al 2017).

$$SM = CP - PP$$

$$FS = \left(\frac{PP}{CP}\right) \times 100\%$$

$$ME = \left(\frac{MP}{CP}\right) \times 100\%$$

Where:
SM - sales margin (USD kg^{-1});
CP - price on consumer level (USD kg^{-1});
PP - price on producer level (USD kg^{-1});
MP - total marketing cost (USD kg^{-1}).

The business financial feasibility was analyzed by calculating profit, RC ratio, and Return on Investment (ROI) (Hutajulu et al 2019). Invested cost, fixed cost, variable cost, and yearly revenue data were gathered from direct interviews with fishermen.

$$\pi = TR - TC$$

$$TC = VC + FC$$

$$\frac{R}{C} = \frac{TR}{TC}$$

$$ROI = \frac{\pi}{Initial\ Investment} \times 100\%$$

Where:
π - profit;
TC - total cost;
R - revenue;
C - cost;
VC - variable cost;
FC - fixed cost;
TR - total revenue.

Fishing technology, and port facilities that support *K. pelamis* fishing and product distribution are analyzed descriptively by using data from direct observation on site and records from Port Office.

Results. The *K. pelamis* exploitation level, maximum sustainable yield and sustainable catch effort, fishing season pattern, catch quality, sales, and business financial analysis are described as follows.

***K. pelamis* exploitation level**. The relationship function derived from the regression of fishing effort and CPUE is $y = -0.0655x + 5.7346$, as depicted in Figure 3. The slope or regression coefficient is -0.0655, which means that each additional fishing trip (effort) will cause a CPUE decrease of 0.0655 tons. It can be said that *K. pelamis* population has been over-exploited.

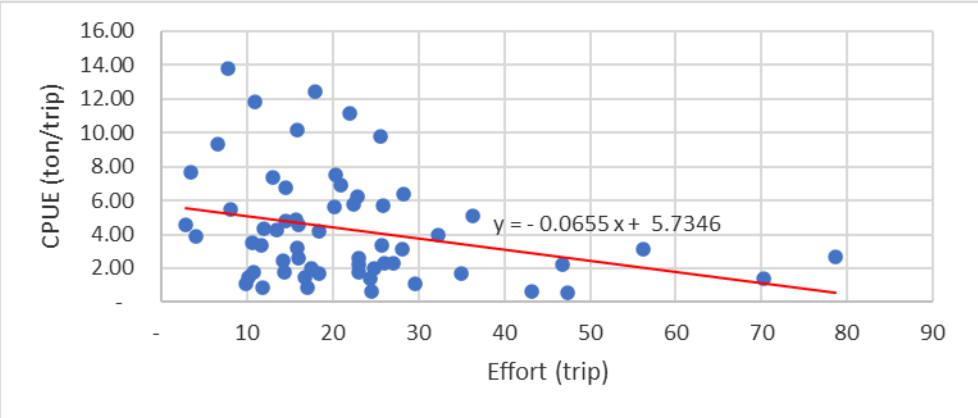

Figure 3. Relationship of effort and CPUE.

Maximum sustainable yield and sustainable catch effort. Schaefer and Fox approaches produce slightly different results (Table 2). Both approaches lines are provided in Figure 4. The comparisons of actual monthly catch during the 5-year timeline and MSY limit from Schaefer and Fox models are illustrated in Figure 5 and Figure 6.

Table 2

Interception and slope values with Schaefer and Fox models

Item	*Schaefer*	*Fox*
a or c	5.7346	1.5494
b or d	-0.0655	-0.0172
r	-0.2966	-0.3129
r^2	0.0880	0.0979
MSY	125.58 tons	100.91 tons
E_{MSY}	44 trips month^{-1}	58 trips month^{-1}

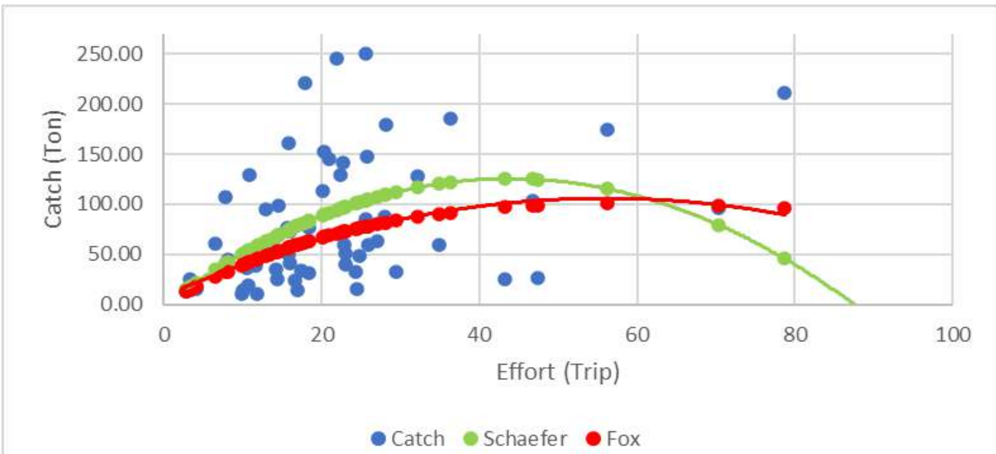

Figure 4. Schaefer and Fox functions.

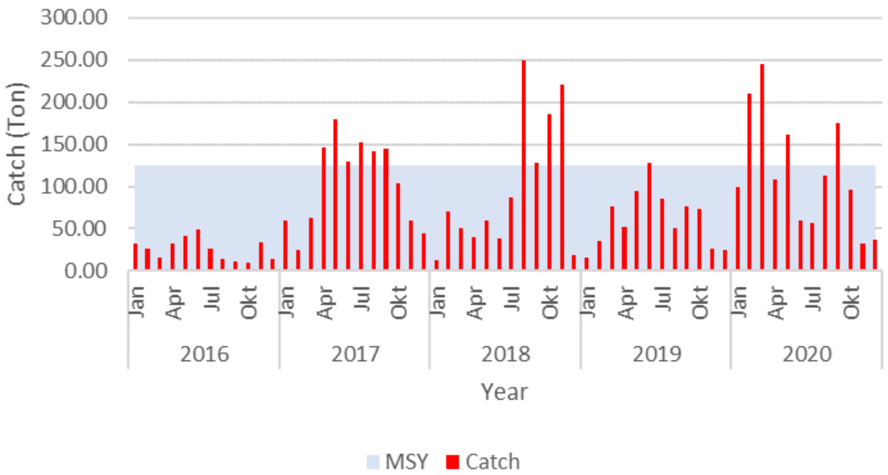

Figure 5. Comparation of monthly production and MSY from Schaefer method.

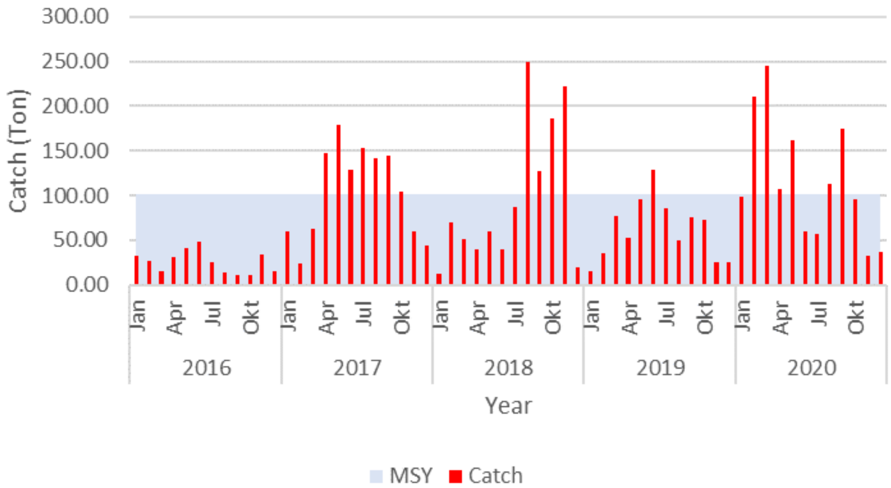

Figure 6. Comparation of monthly production and MSY from Fox method.

Fishing season pattern. The Fishing Season Index (FSI) is depicted in Figure 7. To be noted, the fishing season is associated with the number of catches and is not related to the number of stocks in the waters (Al Aziz 2017).

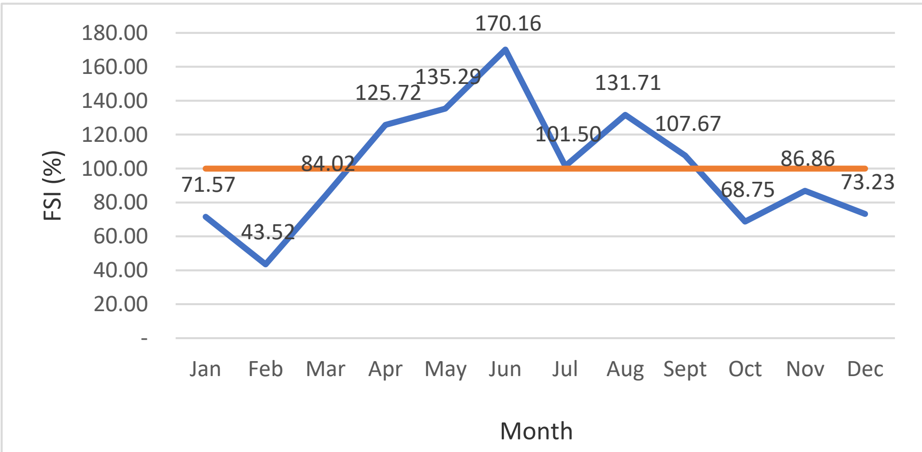

Figure 7. *Katsuwonus pelamis* fishing index at Sadeng fishery port.

The catch quality. The results of organoleptic tests on *K. pelamis* samples are presented in Table 3. The organoleptic value of *K. pelamis* is ranged from 7.51 to 7.92 which is relatively fresh (>7).

Table 3

Katsuwonus pelamis organoleptic test results

Description	*Value*
Average Organoleptic Value	7.72
Standard Deviation	0.59
µ Value (confidence coefficient 0.95)	7.51<µ<7.92

The sales of K. pelamis. As can be seen in Figure 8, there are five models of fish marketing schemes in Sadeng Fishery Port. Each scheme delivers different $\boldsymbol{FS}$ and $\boldsymbol{ME}$ which were described in Tables 4 to 8.

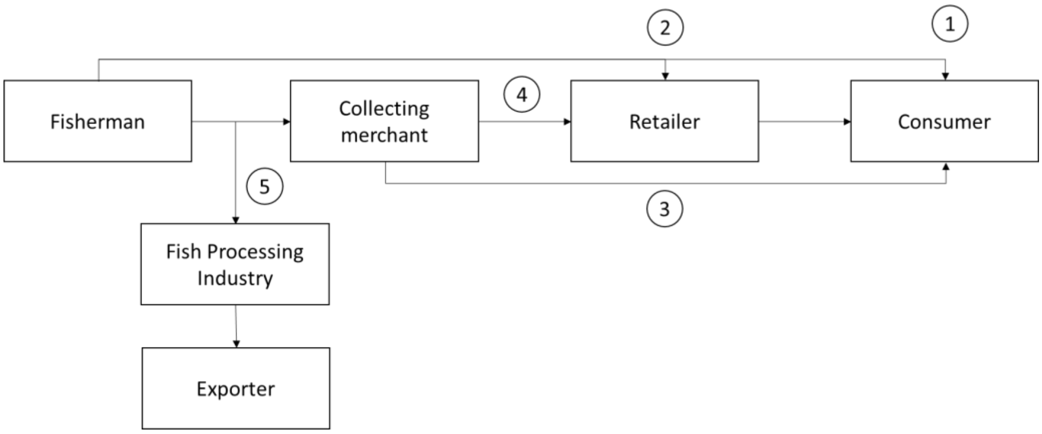

Figure 8. *Katsuwonus pelamis* marketing schemes at Sadeng Fishery Port.

Table 4

Scheme 1: Fishermen – Consumer

Category	*Criteria*	*(USD kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	1.10		100%
	Operational expenditures	0.57		
	Profit	0.53		
Consumer	Buying price	1.10		
Total marketing price		0		
Marketing efficiency		0%		

This scheme has no marketing price since the end consumer directly buys the product from the fisherman. Although the fisherman's share is 100% and the marketing efficiency is 0% which is perfectly efficient in the sales term, most end consumers rarely buy products directly from the fishermen at the port.

Table 5

Scheme 2: Fishermen – Retailer – Consumer

Category	*Criteria*	*(USD Kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		85.8%
	Operational expenditures	0.57		
	Profit	0.4		
Retailer	Buying price	0.97		
	Selling price	1.13	0.16	
	Marketing cost	0.04		
	Profit	0.12		

Category	Criteria	(USD Kg^{-1})	Margin (USD)	Fisherman's share
Consumer	Buying price	1.13		
Total marketing price		0.04		
Marketing efficiency		3.54%		

In this case, the retailers are reaching fixed daily consumers not far from the port. Their market is the settlement within a 0 to 3 km of the port. The marketing costs induced can be considered low (around 0.04 USD kg^{-1}) since it is only calculating the transportation from the port. Moreover, most of these retailers are using their traditional stalls.

Table 6

Scheme 3: Fishermen – Collecting Merchant – Consumer

Category	Criteria	(USD kg^{-1})	Margin (USD)	Fisherman's share
Fishermen	Selling price	0.97		82.9%
	Operational expenditures	0.57		
	profit	0.4		
Collecting Merchant	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing costs	0.09		
	Profit	0.11		
Consumer	Buying price	1.17		
Total marketing costs		0.09		
Marketing efficiency		7.69%		

A collecting merchant is a kind of intermediate seller who usually sells various products with a higher volume than a retailer and operates in a traditional market up to 5 km from the port.

Table 7

Scheme 4: Fishermen – Collecting Merchant – Retailer – Consumer

Category	Criteria	(USD kg^{-1})	Margin (USD)	Fisherman's share
Fishermen	Selling price	0.97		63.8%
	Operational expenditures	0.57		
	profit	0.4		
Collecting Merchant	Buying price	0.97		
	Selling price	1.17	0.20	
	Marketing costs	0.09		
	Profit	0.11		
Retailer	Buying price	1.17		
	Selling price	1.52	0.35	
	Marketing costs	0.17		
	Profit	0.18		
Consumer	Buying price	1.52		
Total marketing costs		0.26		
Marketing efficiency		17.1%		

This scheme is the one that could reach the highest number of consumers since it penetrates the city center market, that is located quite far from the port. Even though the marketing cost is the highest, its marketing efficiency is as low as 17.1%.

Table 8

Scheme 5: Fishermen – Fish Processing Industry

Category	*Criteria*	*(USD kg^{-1})*	*Margin (USD)*	*Fisherman's share*
Fishermen	Selling price	0.97		100%
	Operational expenditures	0.57		
	profit	0.4		
Industry	Buying price	0.97		
Total marketing costs		0		
Marketing efficiency		0%		

The business financial feasibility. Table 9 shows the costs and revenue in one year for each fishing method.

Table 9

Cost and revenue

Description	*Fishing Methods*	
	Handline	*Purse seine*
Revenue (USD)	33,747.38	250,576.41
Investment cost (USD)	23,560.03	177,672.99
Fixed cost (USD)	3,679	20,296.36
Variable cost (USD)	23,669.96	156,725.89
Profit (USD)	6,399	73,554
RC ratio	1.23	1.42
ROI (%)	27%	41%

Fishing technology. The fishing operation at Sadeng Fishery Port is mainly done using handline and purse seine, as seen in Figures 9 and 10, respectively.

Figure 9. Fishing boat equipped with handline (Original photos).

Figure 10. of Fishing boat equipped with purse seine (Original photos).

Port facilities. The existing facilities are classified into 3 categories, which are main, functional, and secondary. Main facilities are the basic or mandatory facilities as the minimum requirements of a port (Table 10). Functional facilities are the facilities that are directly used by port management or other stakeholders to enhance their operation process (Table 11), while other facilities that are not giving effects on the fishermen's and port management's income are categorized as secondary facilities. Most facilities were in proper condition, except for the ice factory (Figure 11).

Table 10

Main facilities

Description	*Volume*	*Condition*
Area	50,000 m^2	Good
Harbor pool >5 GT	22,900 m^2	Good
Harbor pool <5 GT	5,700 m^2	Good
Breakwater	135 m	Good
Dock	485 m	Good
Access road	720 m	Good
Bridge	15 m^2	Good
Open drainage	888.5 m	Good
Boundary fence	450 m	Good

Table 11

Functional facilities

Description	*Volume*	*Condition*
Port offices	total 624 m^2	Good
Port fish auction	225 m^2	Good
Ice factory	3 units	Broken
Water tower	10 m^2	Good
Workshop	72 m^2	Good
Sleepway	1 unit	Good
Cold storage	169 m^2	Good
Net repair site	96 m^2	Good
Navigation lamp	4 units	Good
Light buoy	2 units	Good
Parking site	600 m^2	Good

Figure 11. Broken ice factory (Original photo).

Discussions. Based on our calculation, *K. pelamis* fishing season occurs almost every month. The peak season's duration is of seven months, from March to September. The medium season's duration is of five months, from October to January. In comparison, the famine season occurs in February. Anggraeni et al (2015) and Talib (2017) also stated that the *K. pelamis* fishing season in southern Java occurs almost throughout the whole year. This condition can happen because *K. pelamis* is a migratory fish (Arai et al 2005) and spawns throughout the year (Hartaty & Arnenda 2019). Yoga et al (2014) stated that the upwelling phenomenon happens in the southern Java sea during the east season. This phenomenon is indicated by a low sea surface temperature and high levels of chlorophyll-a. Upwelling causes the southern Java sea to become fertile and increases the fish population (Anggraeni et al 2017).

Unfortunately, the *K. pelamis* exploitation during the fishing season, every year within this 5-year timeline, has exceeded the MSY limit, as can be interpreted from Figure 5, 6, and 7. The periods July to October 2018 and March 2020, as seen in Figure 6, are the most significant, where the catch reached over 200% of the MSY value. This result is in line with other sources from the research literature. According to KKP (2017), it is stated that the exploitation level of large pelagic fish in WPPNRI 573 (the Indian Ocean at the south side of Java, including Sadeng Fishery Port) has been over-exploited. Similarly, Setiyawan (2016) reported that the utilization status of *K. pelamis* in Prigi (Indian Ocean at the south side of Java) has reached the over-exploiting level, with a utilization rate of 114.9%.

According to Akoit & Nalle (2018), if the catch exceeded the MSY value, it can lead to the extinction because the utilization level has exceeded the species' biological growth function. Thus, the calculation of the sustainable fishing effort (E_{MSY}) calculation is vital to estimate fishing effort at optimum conditions. The calculated sustainable fishing effort (E_{MSY}) value is of 44 trips month^{-1} with the Schaefer's model and of 58 trips month^{-1} with the Fox model. Nevertheless, the *K. pelamis* fish sold on the markets were fresh, the sales were considered efficient, and the fishing business using handlines and purse seines at Sadeng Fishery Port could be declared financially profitable and feasible. As seen in Table 3, μ is in the range of 7.51 to 7.92 (BSNI 2013). Fisherman's share in all schemes was >40% (Downey 1992) and the marketing efficiency in the range of 0 to 33% (Riandi et al 2017). The profit induced by using a handline was USD 6,399 per year, while for a purse seine it was USD 73,554 per year. The R/C ratio of handline and purse seine were 1.23 and 1.42, respectively. These parameters indicate that the income obtained from the two fishing methods is greater than the costs incurred (Jumiyati et al 2021; Savitri et al 2017). Additionally, the ROI of both fishing gears was >25%, which shows that the *K. pelamis* fishing business earn high profits (Siahainenia 2021).

According to our observation, the existing fishing gears at Sadeng Fishery Port were still conventional. The fishermen relied on traditional boats, old diesel engines, and some malfunctioned gears. Moreover, most fishermen did not apply a routine maintenance to their gears, which lowers the reliability, fuel efficiency, and cruising distance. All the existing facilities functioned properly except for the ice factory (Figure 11). Consequently, fishermen and sellers must find the ice source outside the port, increasing the operational and marketing costs.

Conclusions. The study of *K. pelamis* fishing business at Sadeng Fishery Port suggested that the *K. pelamis* resource in the South Java Sea has been over-exploited. The fishing technology used by local fishermen was conventional and unproperly maintained. The *K. pelamis* fish arrived on the markets were fresh, with an organoleptic value $7.51 < \mu < 7.92$. The sales were considered efficient through all the distribution channels, with the fisherman's share of a minimum of 63.8%, and the maximum marketing efficiency was of 17.1%. The fishing business was financially profitable and feasible. Most existing facilities were in proper condition, except for the ice factory.

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Conflict of interest. The authors declare no conflict of interest.

References

Akoit M. Y., Nalle M., 2018 [Sustainable management of fishery resources in North Central Timor Regency based on a bioeconomic approach]. Journal of Indonesian Agribusiness 6(2):85–106. [In Indonesian].

Al Aziz M. A., 2017 [Estimation of Komo tuna (*Euthynnus affinis*) Stock in Gresik Waters, East Java]. BSc Thesis Brawijaya University, 64 p. [In Indonesian]

Amiluddin, 2020 Financial feasibility analysis of skipjack tuna (*Katsuwonus pelamis*) catching in Bone Bay, South Sulawesi, Indonesia. IOP Conference Series: Earth and Environmental Science 492:012164.

Anggraeni R. I., Rahyono R., Widagdo S., 2017 [Correlation of upwelling and catch of skipjack tuna at east season in Tamperan Waters, Pacitan]. Conference Paper. Seminar Nasional Kelautan XII. Hang Tuah University, 7 p. [In Indonesian].

Anggraeni R., Solichin A., Saputra S. W., 2015 [Several biological aspects of skipjack tuna (*Katsuwonus pelamis*) in relation to fisheries management at PPP Sadeng, Gunungkidul Regency, Yogyakarta]. Management of Aquatic Resources Journal (MAQUARES) 4(3):230–239. [In Indonesian].

Arai T., Kotake A., Kayama S., Ogura M., Watanabe Y., 2005 Movements and life history patterns of the skipjack tuna *Katsuwonus pelamis* in the western Pacific, as revealed by otolith Sr:Ca ratios. Journal of the Marine Biological Association of the United Kingdom, 85(5): 1211–1216.

Atmaja S. B., Sadhotomo B., Nugroho D., 2017 Application of non-equilibrium surplus production model on scads (*Decapterus Macrosoma*) fishery at Java Sea. Jurnal Penelitian Perikanan Indonesia 23(1):57–66.

Dajan A., 2004 [Introduction to statistics method II]. Pustaka LP3ES, Jakarta, 358 p. [In Indonesian].

Downey, Erickson W. P., 1987 Agribusiness Management. McGraw-Hill, Singapore, 477 p.

Hartaty H., Arnenda G. L., 2019 [Examination of Cakalang's first mature gonad (Lm) (*Katsuwonus pelamis Linnaeus*), 1758) in Indian Ocean, South of Bali Province]. Jurnal Penelitian Perikanan Indonesia 25(2):135–145. [In Indonesian].

Hutajulu J., Kusumo T., Saputra A., Mualim R., Handri M., Sugriwa E., 2019 Financial analysis in the exploitation of blue swimming crab *Portunus pelagicus* in Banten Bay, West Java, Indonesia. Aquaculture, Aquarium, Conservation & Legislation 12(2):724–734.

Iswahyudi, Sustiyana, 2019 [Marketing channel patterns and farmer's share of water apple CV Camplong]. Jurnal Hexago 3(2):33–38. [In Indonesian].

Jumiyati S., Possumah N., Hadid A., Bachri S., Dua P., 2021 Eco-friendly utilization to increase income and efficiency of Banggai yam farming in the Banggai Islands, Central Sulawesi, Indonesia. IOP Conference Series: Earth and Environmental Science 797:012012.
Kantun W., Cahyono I., Kabangnga A., Riana A. D., 2021 Stock assessment of skipjack tuna *Katsuwonus pelamis* in Makassar Strait, Indonesia. AACL Bioflux 14(2):988-995.
Kekenusa J. S., Paendong M. S., 2016 Analysis determination of fishing season skipjack tuna (*Katsuwonus pelamis*) In the Belang Waters of Southeast Minahasa North Sulawesi. Jurnal Ilmiah Sains 16(2):86-90.
Nurdin E., Yusfiandayani R., 2016 [Optimization of fish aggregating devices, fleet units, and fishing season pattern of tuna at Prigi Waters, East Java]. Jurnal Penelitian Perikanan Indonesia 18(1):53–60. [In Indonesian].
Nurhayati A., 2013 [Analysis of the sustainable fisheries potential at the Pangandaran area]. Jurnal Akuatika 4(2):195–209. [In Indonesian].
Rahmawati M., Fitri A. D. P., Wijayanto D., 2013 [Analysis of catch per unit effort and fishing season pattern of *Stolephorus spp.* at Pemalang Waters]. Journal of Fisheries Resources Utilization Management and Technology 2(3):213–222. [In Indonesian].
Riandi, Mustapa M. B., Iskandar S., 2017 [Efficiency analysis of *Penaeus monodon* marketing in Sungai Lumpur Village, Cengal District, Ogan Komering Ilir Regency]. Jurnal Societa 6(2):81–87. [In Indonesian].
Satria A. I. W., Kurnia R., 2017 Population structure of (*Katsuwonus pelamis Linnaeus*, 1758) from Southern of Java Sea. Journal of Tropical Fisheries Management 1(1): 1-9.
Savitri I. K. E., Sormin R. B. D., Silaban B., 2017 Quality indexes and feasibility analysis of traditional dried anchovy from Buru Island. IOP Conference Series: Earth and Environmental Science 89:012005.
Setiyawan A., 2016 The estimation of skipjack utilization rate in Prigi waters, East Java. Depik 5(1):7–11.
Siahainenia S. M., 2021 Financial feasibility of hand line fisheries and determination of tuna production in Ambon Island. IOP Conference Series: Earth and Environmental Science 797:012011.
Siyoto S., Sodik M. A., 2015 [Basic research methodology]. Literasi Media Publishing, 132 p. [In Indonesian].
Sparre P., Venema, Siebren C., 1998 Introduction to tropical fish stock assessment - Part 1: Manual. FAO, 407 p.
Talib A., 2017 [Tuna and skipjack tuna (a Review: Management of potential resource in Indonesian Seas)]. Agrikan: Jurnal Agribisnis Perikanan 10(1):38–50. [In Indonesian].
Tuli M., 2018 [Skipjack tuna resource]. Ideas Publishing, 81 p. [In Indonesian].
Wujdi A., Setyadji B., Nugroho S. C., 2017 Stock structure identification of skipjack tuna (*Katsuwonus Pelamis Linnaeus*, 1758) in Indian Ocean (Indonesian Teritory of FMA 573) using otolith shape analysis. Jurnal Penelitian Perikanan Indonesia 23(2):77–82.
Yoga B. R. B., Setyono H., Harsono G., 2014 [Dynamics of upwelling and downwelling based on variability of sea surface temperature and chlorophyll-a at southern Java Waters]. Journal of Oceanography 3(1):57–66. [In Indonesian].
*** BSNI, Badan Standarisasi Nasional Indonesia, 2013 Ikan Segar SNI 2729:2013.
*** Government of Special Region of Yogyakarta, 2011 [Regulation of the Special Region of Yogyakarta Number 16, concerning Zoning Plans for the Coastal Zone and Small Islands of the Province of the Special Region of Yogyakarta in 2011-2030]. [In Indonesian].
*** KKP, 2017 [Decree of the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia Number 50/KEPMEN-KP/2017]. Kementrian Kelautan dan Perikanan (KKP), 8 p. [In Indonesian].
*** Ministry of Marine Affairs and Fisheries, 2017 Ministry of Marine Affairs and Fisheries Decree No. 50 of year 2017.

*** WWF, 2015 [Skipjack tuna fishing with pole and line (huhate): Guides for fishing and handling]. WWF-Indonesia. [In Indonesian].

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Thank you.

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Jerry Hutajulu 27 Jan
kepada Eni

Dear Dr. Eni Kovacs,
We hope this email finds you well.

We, the authors, express our deepest gratitude to you and all of the Bioflux editorial team members. Because of your support and advice during the process, this article could be finally published. We got a great experience working with all of you. I hope we can work together again in the future.

Yours sincerely,
Jerry Hutajulu and the authors

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