Efficiency of Tuna Unloading Time Hand Line Vessels at Bungus Fishing Port, West Sumatra Province

Rahmi Rahmadhani[1*], Jonny Zain[1*], Alit Hindri Yani[1]

[1]Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine, Universitas Riau, Pekanbaru 28293 Indonesia
* rahmi.rahmadhani0930@student.unri.ac.id

Article Info

Received
04 September 2025

Accepted
30 October 2025

Keywords:
Efficiency Level,
Tuna Unloading,
Hand Line,
PPS Bungus

Abstract

Tuna fish is one of Indonesia's leading commodities from the fisheries sector because it has high economic value. Fish unloading refers to the activities carried out by the crew after the ship arrives at the fish landing site. Efficiency, technically, refers to the ability of humans to carry out a task accurately without wasting energy, time, or money. Handline vessels are specifically designed to catch large pelagic fish, such as tuna, using handline gear. The purpose of this study was to determine the efficiency of tuna unloading time on hand-line vessels at Bungus Ocean Fishing Port and the factors that influence it. The research method used in this study is the survey method, namely direct observation of tuna unloading activities on handline vessels at the Bungus Ocean Fishing Port dock in West Sumatra Province. Based on research on tuna unloading activities on handline vessels at PPS Bungus, it can be concluded that unloading efficiency tends to vary, ranging from 44.19 to 85.19% with an average of 63.01%. This shows that the tuna unloading process on handline vessels at PPS Bungus tends to be less efficient. The amount of wasted time is influenced by ship tonnage (x1), number of fish (x2), unloading speed (x3), ship unloading power (x4), freeboard height (x5), with multiple regression equations Y = -35.662 + 293 X1 + 1,277 X2 - 6,467 X3 +793 X4 +328 X5. The level of tuna unloading efficiency on handline vessels is influenced by the time wasted, with a coefficient of determination (R2) of 72,5%.

1. Introduction

Bungus Ocean Fishing Port (PPS), located in Bungus Barat Village, Bungus Teluk Kabung District, Padang City, West Sumatra Province, has geographical coordinates at 01-02°15" LS and 100-23°34" East. Its very strategic geographical position in the middle of Sumatra Island, adjacent to the fishing grounds, improves the quality of the caught fish by shortening the fishing days. PPS Bungus is the only Ocean Fishing Port on the west coast of Sumatra and currently serves as the largest tuna export port in Sumatra (PPS Bungus, 2011).

According to Mulyadi (2007), efficiency technically refers to the ability of humans to carry out a task accurately without wasting energy, time, or money. In the view of Akmal et al. (2017), efficiency is an important factor in the fish unloading process, aiming to ensure that the catch reaches consumers in optimal quality conditions. In addition, time efficiency in the unloading process also aims to maintain the quality and freshness of the fish that arrives until it reaches consumers. It should be noted that the time efficiency of unloading fish at the fish landing base has a significant impact on the freshness of the fish. Inefficiencies in the management of fish unloading time, as mentioned by Alfin et al. (2013), reflect a lack of effective time management, so that wasted time on unloading activities will exceed effective time.

Fish unloading, as explained by Afandy (1998), refers to the activities carried out by the crew after the vessel arrives at the fish landing site outside the respective Fishing Port or Fish Landing Base. In this activity, the crew members remove the fish from the vessel's hold and then carry out the sorting process. Several factors influence the duration of fish unloading, including the type and size of the fish caught, the number of fish caught, the unloading method used, the number of workers, and the size of the vessel. In this context, the longer the unloading process, the lower the quality of the caught fish. Therefore, it is important to carry out the unloading process quickly and efficiently to maintain the quality of the fish. In addition, this action will help fishermen reduce production costs associated with mooring services at the dock, as well as avoid the accumulation of the fleet that would make fish landings.

Handline is a type of fishing gear used by traditional fishermen to catch fish at sea. Hand line is the simplest type of fishing gear. It consists of a fishing rod, fishing line, and ballast or bait. The fishing ground for hand line fishing is quite open and varied, allowing it to be operated from the surface to the bottom of the water, in coastal waters, and in the deep sea (Mulyadi et al., 2015). The purpose of this study was to determine the efficiency of tuna unloading time on hand-line vessels at Bungus Ocean Fishing Port (PPS) and the factors that influence it.

2. Methodology

2.1. Time, Place, and Materials

This research will be conducted at PPS Bungus, West Sumatra Province.

2.2. Method

The research method used in this research is the survey method, namely by directly observing tuna unloading activities on handline vessels at the Bungus Ocean Fishing Port dock in West Sumatra Province, and by following these activities to obtain the necessary information at the time of unloading.

2.3. Procedures

In this study, the data consisted of both primary and secondary data. Primary data, or basic data, are used to determine the level of efficiency in tuna unloading time on hand-line vessels. The data consist of the time required for fish unloading activities, as follows: Mooring time, used for tuna landing activities, is calculated from the mooring ship to the dock until the tuna unloading activity is completed, namely, from the fish to the processing building (minutes). Wasted time is the time not used for fish landing during unloading (minutes). Effective time is the time spent solely on tuna unloading activities (minutes).

Secondary or supporting data are data used to explain the results of the tuna unloading time efficiency analysis. The data include ship tonnage, number of fish, unloading speed, ship unloading power, and freeboard height.

2.4. Data Analysis

The data obtained (primary and secondary) are collected and analyzed statistically and descriptively. To determine the level of efficiency of tuna unloading time on hand line vessels, using the formula according to Zain et al. (2011), as follows:

$$E = \frac{WE}{WT} \times 100\%$$

Where:

E	=	Efficiency level (%)
WE	=	Effective time used for tuna unloading activities (minutes)
WT	=	vessel mooring time Hand line fishing (minutes)

Based on the data analysis results, the level of efficiency is determined by classifying into 4 levels according to Alfin (2013) as follows.

Table 1. Efficiency level of fish unloading time

No.	Efficiency level	Efficiency value
1	Efficient	75 to 100%
2	Less efficient	50 to 74.99%
3	Inefficient	25 to 49.99%
4	Highly inefficient	< 25%

Efficiency is influenced by the time wasted during the unloading of the catch. According to Zain et al. (2022), to see the relationship between the efficiency of unloading time and wasted time in the form of a simple regression equation, as follows:

$$Y = a + bX$$

Description:

Y	=	Efficiency level %
X	=	Wasted time (minutes)
a	=	Constant
b	=	Regression coefficient

The relationship between the independent variables (ship tonnage, fish weight, number of fish, unloading speed, unloading power, and freeboard height) and the dependent variable (wasted time) can be examined using multiple regression analysis in SPSS. Before analyzing with multiple regression equations, a multicollinearity test is performed.

Furthermore, a multicollinearity analysis is conducted to assess whether the regression model used reveals correlations among the independent variables. If the independent variables are mutually independent, then multiple regression analysis proceeds.

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5$$

Description:

Y = Wasted time / effective time (minutes)
X1 = Ship tonnage (GT)
X2 = Number of fish (fish)
X3 = Unloading speed (tons/hour)
X4 = Unloading labour
X5 = Freeboard height (cm)
a = Constant
b = Regression coefficient

3. Result and Discussion

Hand Line Catch Unit

Handline vessels are specifically designed to catch large pelagic fish, such as tuna, using handline gear. Variants of handline vessels used to catch tuna range in size from small to large, tailored to the desired target species. In PPS Bungus, operating hand line vessels range in size from 10 to 30 GT and are generally made of fibre. Unloading personnel on handline vessels vary, usually consisting of 6 to 12 people who are in charge of the tuna unloading process.

Demolition Activity

Tuna unloading activities at PPS Bungus Port are carried out at the unloading dock and mooring dock. Before unloading begins, the port officer checks the data on the vessel's catch to ensure the information is available and valid. The ship's crew removes the fish from the hold, and port workers assist them in loading the fish into the transport car.

Table 2. Observation data on the efficiency of tuna unloading time at PPS Bungus

Ship Name	Towing Time (Minutes)	Effective time (Minutes)	Unloading Speed (Ton/Hour)	Wasted Time (Minutes)	Efficiency of Unloading Time (%)
KM. Fitri 04	70	36	1,83	36	51.43
KM. Kevin Jaya 01	36	24	2,43	6	66.67
KM. Purse Seine 02	29	20	2,06	12	68.97
KM. Rejeki Barokah	48	23	3,15	25	47.72
KM. Bintang Laut 15	61	32	2,45	29	52.45
KM. Azzira	28	20	4,54	8	71.43
KM. Arkana	51	31	2,74	20	60.79
KM. Hibo 03	43	19	3,22	24	44.19
KM. LLB 32	28	23	3,68	5	82.14
KM. Rajo 21	27	23	2,23	4	85.19
Average	42.1	25.1	2.83	16.9	63.01

Fish unloading activities at PPS Bungus are served by unloading fish from 16.00 to 02.00 WIB. After the fish has been unloaded and loaded onto the dock, it is immediately weighed by the unloading personnel provided by the ship owner. Furthermore, the fish is immediately loaded into a transport car filled with ice beforehand to maintain its quality and freshness, as traditional fishermen used to catch fish at sea. Hand line is the simplest type of fishing gear. The parts of the construction of hand line fishing gear used by hand line boats at PPS Bungus consist of towline, snap, kili-kili, baseline, sinker, fishing line, launcher line, join line, and fishing rod.

Of the 10 handline vessels observed during the study, the mooring time ranged from 27 to 70 minutes, with an average of 42.1 minutes. Where the slowest mooring time occurred on the KM. Fitri 04 is 70 minutes, and the fastest mooring time occurs on the KM. Rajo 21, which is 27 minutes.

In this study, among the 10 ships observed, the effective unloading time ranged from 19 to 36 minutes, with an average effective unloading time of 25.1 minutes per ship. Hibo 03 recorded the fastest effective unloading time at 19 minutes, while the slowest was recorded on KM at 29 minutes. Fitri 04, which is 36 minutes.

The unloading of fish from 10 ships that became the object of research ranged from 4 to 36 minutes, with an average of 169 minutes. The least wasted time when unloading occurs on the KM. Rajo 21 with 4 minutes. In contrast, the most wasted time occurred on KM. Fitri 04, which is 36 minutes.

The level of loading time efficiency on handline vessels at PPS Bungus ranges from 42.72% to 85.19%, with an average of around 63.01%. Ship KM. Hibo 03 recorded the lowest level of loading time efficiency, while KM. Rajo 21 recorded the highest level of unloading time efficiency.

Relationship between Efficiency Level and Wasted Time

The relationship between wasted time and unloading efficiency at the time of unloading the catch is described by the following equation.

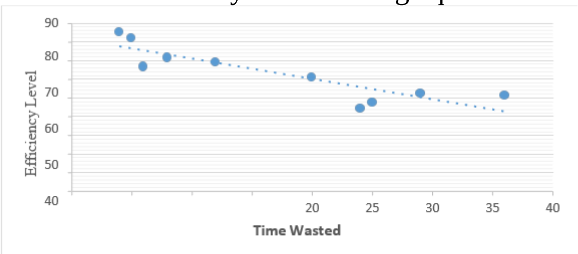

Figure 1. Relationship between efficiency level and wasted time

Figure 1 shows that the regression coefficient (b) = -1.089 indicates a negative relationship between wasted time and the level of efficiency, indicating that, for less wasted time, the lower the level of efficiency in tuna unloading. The coefficient of determination (R2) is 0.762, which means that 76.2% of the variance in tuna unloading time on handline vessels is explained by the waste time, and other factors account for 23.8%.

Multicollinearity Analysis

The coefficient b1 for ship tonnage (X1) of 293 means that every 1 Gross Tonnage (GT) increase in ship tonnage, with other factors held constant, will increase in wasted time. (Y) of 293 minutes. With this positive coefficient value, it can be concluded that there is a positive relationship between ship tonnage and the time required in the fish offloading process. In other words, the greater the tonnage of the vessel, the longer it takes to unload the fish.

The coefficient b2 for the number of fish (X2) of 1.277 means that every 1 increase in the number of fish landed, with other factors held constant, will increase in wasted time. (Y) of 1.277 minutes. Since this coefficient is positive, it can be concluded that there is a positive relationship between the number of fish landed and the wasted time in the unloading process. In other words, the more fish landed, the higher the wasted time in the unloading process will be.

The coefficient b3 for unloading speed (X3) of -6.467 means that every 1 ton per hour increase in unloading speed, with all other factors held constant, will result in a decrease in wasted time (Y) of -6.467 minutes. Since this coefficient is negative, it indicates a negative relationship between unloading speed and wasted time.

wasted in the fish unloading process. In other words, the faster the unloading speed, the less time is wasted in the unloading process. The coefficient b4 for unloading human resources (X4) of 793 means that a 1-person increase in unloading manpower, with other factors held constant, will result in a decrease of 793 minutes in wasted time (Y). Since this coefficient is positive, it can be concluded that there is a positive relationship between the unloading force and the wasted time in the fish unloading process. In other words, the greater the unloading force, the more efficient it is.

The coefficient b5 for freeboard height (X5) of 328 indicates that a 1 cm increase in freeboard height, with other factors held constant, will result in a 328-minute increase in wasted time (Y). With this positive coefficient value, it can be concluded that there is a positive relationship between the freeboard height of the ship and the time required in the fish offloading process. This means that the higher the vessel's freeboard, the more efficient the time required to unload the fish. The relationship among the various factors that contribute to wasted time in the fish offloading process cannot be described separately. This is because all these factors occur within the same time span, and their interrelationships are inseparable.

This study found that the correlation coefficient R = 0.725 indicates a very strong relationship, meaning that the independent variable accounts for 72.5% of the variation in wasted time. In comparison, the other independent variables account for the remaining 27.5%. This is because when the ship arrives, the crew must wait for the transport car, which wastes time and affects the efficiency of unloading time on handline vessels at PPS Bungus.

A study on the efficiency of fish landing time relative to mooring time for gill net fishing vessels at the Perikanan Nusantara Port (PPN) Dumai, conducted by Novianti (2013), found that several factors influenced the time wasted in the process. These factors include the time fishermen spend resting, making boat repairs, waiting for the catch to be unloaded, and waiting in the queue of carts to transport the catch to the Fish Auction Place (TPI).

The regression coefficient of ship tonnage (X1) of 293 in this study shows that ship tonnage has a positive influence on the level of efficiency in the fish unloading process. In other words, when ship tonnage increases, the level of efficiency in fish unloading also increases. This indicates that the greater the ship's cargo capacity, the more efficient the fish offloading process.

In contrast to the findings conducted by Sibarani (2019) at Sibolga Nusantara Fishing Port. The study shows that the efficiency of fish landing time in the context of purse seine fishing vessels negatively influences the level of landing time efficiency. In this case, the larger the GT of the purse seine vessel fleet, the more fish the vessels can hold, ultimately resulting in decreased landing time efficiency and longer fish landing times. This difference shows that the effect of vessel tonnage on time efficiency can vary depending on the type and operational context of the fishing vessel used.

The regression coefficient for the number of fish (x2) of 293 means that there is a positive relationship between the number of fish landed and time efficiency in the unloading process. In this context, the more tuna fish landed, the more efficiently time was used. This is because tuna landed at the Bungus Ocean Fishing Port (PPS Bungus) are generally large, so the landing process is done individually, one by one. Since these large fish require special handling, vessels carrying large numbers of them will take longer to unload. Therefore, the large number of fish landed will result in increased wasted time during unloading activities at PPS Bungus.

The regression coefficient for unloading speed (x3) of -6.467 indicates a negative relationship between unloading speed and time efficiency in the unloading process. In other words, the faster the unloading speed, the less efficient the time used in unloading fish. This result differs from Nardi's (2013) view, which argued that the higher the unloading speed, the higher the efficiency.

However, it is important to note that research results may vary depending on the context and parameters used in the study. While Novianti (2013) found a positive relationship between unloading speed and fish landing time efficiency, with a strong correlation (R=0.755), the study described here shows a negative relationship between unloading speed and unloading time efficiency. This suggests that in different contexts, additional factors or different research methods may produce different results.

The regression coefficient for stevedores (x4) of 793 indicates a positive relationship between the number of stevedores and time efficiency in the unloading process. This means that the more unloading labour available, the more efficiently time is used unloading fish. This result is similar to the findings in Nardi's (2013) research, which states that the more unloading personnel there are on the ship, the less time is needed in the landing process, and vice versa.

In addition, these results differ from those of Simarmata (2013), which showed that the number of unloading personnel has a strong correlation with the efficiency of fish landing time (R=0.56). This finding suggests that the number of stevedores can have a significant impact on the efficiency of fish landing time, but the results of the study described show the opposite relationship. This suggests that the influence of the number of stevedores on the fish offloading process may vary depending on context and other factors.

The regression coefficient for freeboard height (x6) of 328 indicates a positive relationship between the vessel's freeboard height and time efficiency in the dismantling process. In other words, the higher the vessel's freeboard, the more efficiently the dismantling time is used. A sufficient freeboard height on a vessel can make it easier for demolition workers to lift fish onto the dock. However, the results of this study differ from those of Nardi (2013), which showed that the higher the ship's freeboard, the lower the efficiency. This explanation indicates that many factors influence efficiency, and the vessel's freeboard height may have different effects depending on the context and other factors involved in the unloading process. In other words, the results of the study may differ depending on the variables studied and the specific context.

Based on the research analysis conducted at the Bungus Ocean Fishing Port (PPS Bungus), the fish unloading process at this port is classified as less efficient, with an average efficiency of 63.01%. Therefore, the port needs to undertake evaluation efforts to overcome this problem. One step PPS Bungus can take is to more closely monitor the unloading process on handline vessels to reduce wasted time during fish unloading. This could include improvements in the organization of the unloading process, increasing the efficiency of stevedoring work, or implementing best practices in fish unloading management. By doing so, the port can improve the efficiency of fish unloading activities, which, in turn, will support improved service quality and output from the fishing industry at PPS Bungus.

4. Conclusion

Based on the results of research on tuna unloading activities on handline vessels at PPS Bungus, it can be concluded that the efficiency of fish unloading time ranges from 44.19% to 85.19% and averages 63.01%. This shows that the tuna unloading process on handline vessels at PPS Bungus is less efficient. The level of unloading efficiency depends on the amount of time wasted. The amount of wasted time is influenced by ship tonnage, number of fish, unloading speed, ship unloading power, and freeboard height.

References

Akmal, N., & Rizwan, E.M. (2017). Analysis of Fish Loading and Unloading of Purse Seine of Fishing Vessel in Lampulo Ocean Fishing Port. *Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah*, *2*(4): 472-483.

Hariski, M., Asshiddiqi, M., & Adriani, A. (2022). Efesiensi Waktu Pendaratan Hasil Tangkapan dengan Menggunakan Alat Tangkap Sondong di Pangkalan Pendaratan Ikan Kota Dumai Provinsi Riau. *Jurnal Ilmu dan Teknologi Perikanan Tangkap*, *7*(2): 151.

Hutauruk, R.M., & Rengi, P. (2017). Penanganan Pendaratan Hasil Tangkapan di Pelabuhan Perikanan Samudera Bungus Provinsi Sumatera Barat. *Jurnal Perikanan dan Kelautan*, *22*(2): 57-64.

Larasati, H., Bambang, A. N., & Boesono, H. (2013). Analisis Faktor-faktor yang Mempengaruhi Terbentuknya Harga Ikan Kembung Lelaki (*Rastrelliger kanagurta*) Hasil Tangkapan Purse Seine di TPI Bulu Kabupaten Tuban Jawa Timur. *Journal of Fisheries Resources Utilization Management and Technology*, *2*(3): 121-130.

Nardi, N., Zain, J., & Syaifuddin, S. (2013). *Study on Time Efficiency of Tuna (Thunnus sp) Catches Landing Toward Mooring Time of the Long Liner at Fishing Port of Bungus, West Sumatera Province*. Universitas Riau.

PPS Bungus. (2011). *Profil Umum Pelabuhan Perikanan Samudera Bungus Kota Padang Provinsi Sumatera Barat*. PPS Bungus

Zain, J. (2015). Komparasi Efisiensi Waktu Bongkardan Waktu Pengisian Perbekalan Melautkapal Perikanan Sondong di PPI Dumai Provinsi Riau. *Jurnal IPTEKS Pemanfaatan Sumberdaya Perikanan*, *2*(3).

Zain, J., Rengi, P., & Devi, M. (2022). Time Efficiency of Loading of Fishing Supplies Liftnet Boat in Bungus Fishing Port, West Sumatera. *Asian Journal of Aquatic Sciences*, *5*(1):131-137