Time Efficiency for Replenishment of Sea Supplies Hand Line Fishing Vessel at Bungus Fishing Port, West Sumatra

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Abstract

Efficiency is the proper use of time, with no waste or loss. One of the important time efficiencies at the fishing port is the time of filling sea supplies, where the more efficient the time of filling sea supplies, the smaller the mooring costs that fishermen must incur, and the shorter the queue of ships filling sea supplies. Because many ships load and unload at the PPS Bungus dock, this results in a lack of mooring space and a queue of ships when refueling at sea. The time for filling sea supplies on hand line vessels at PPS Bungus is carried out the day before ship departure due to a lack of mooring space. This study aims to determine the time efficiency of filling sea supplies on handline vessels at PPS Bungus and to identify the factors that affect time efficiency. The method used is a survey of 20 handline vessels. Based on the study's results, the efficiency of filling time for marine supplies on hand line vessels ranges from 64.11% to 80.00%, with an average of 71.11%, indicating it is less efficient. The amount of wasted time is influenced by ship tonnage (x1), number of crew (x2), block ice (x3), amount of fuel (x4), clean water (x5), length of block ice track (x6), length of fuel track (x7), length of clean water (x8), length of food (x9) with multiple regression equation Y = 138.522 + 0.185 X1 + 1.012 X2 - 0.023 X3 + 0.482 X4 - 0.015 X5 - 0.889 X6 + 0.884 X7 -,163 X8 + 1.004 X9. The level of time efficiency in filling sea supplies for handline vessels is influenced by the time wasted, with a coefficient of determination (R2) of 78.4%.

1. Introduction

Bungus Ocean Fishing Port (PPS) is located in Bungus Barat village, Bungus Teluk Kabung sub-district, Padang city, West Sumatra province. Geographically, PPS Bungus is located at coordinates 010 00' 023 - 010 00' 15" LS and 1000 00' 233 - 1000 00' 34" East. The geographical location of PPS Bungus is highly strategic, as it lies in the middle of Sumatra Island and is close to the fishing grounds. This results in higher-quality fish because the catching day is shorter. In addition, PPS Bungus is the only Ocean Fishing Port on the West coast of Sumatra and currently remains the main port for the largest tuna export in Sumatra (PPS Bungus, 2011).

Supporting data for the efficiency of time for filling supplies at sea include variables such as ship tonnage (GT), number of personnel carrying supplies (people), activity actors (years), amount of fuel carried (L), amount of ice carried (blocks), amount of clean water carried (liters), length of fishermen's trajectory when filling supplies (m), catch, and number of supplies. One of the important time efficiencies of activity services at the fishing port is the time of filling the ship's sea supplies, where the more efficient the time of filling the ship's sea supplies, the smaller the mooring fees that fishermen must incur. In addition, the efficiency of the time required to fill the ship's sea supplies can reduce wasted time, because when filling the sea supplies, many fishing boats are doing so at

PPS Bungus, causing queues at the dock. The process of filling the sea supplies does not run smoothly (Hafidzah et al., 2022).

Efficiency is the proper use of time so that there is no waste or loss (Saragih, 2014). One of the important time efficiencies at the fishing port is the time required to fill marine supplies; the more efficient the filling, the lower the mooring fees fishermen incur and the shorter the queue of fishing vessels waiting to fill marine supplies at PPS Bungus. Because so many ships were loading and unloading at the PPS Bungus dock, there was a lack of mooring space, resulting in a queue of ships when refueling at sea. The time for filling sea supplies on handline vessels at PPS Bungus is scheduled the day before ship departure due to a lack of mooring space, which causes queues when filling sea supplies. The need for supplies on board is crucial in fishing activities, which aim to meet the needs of fishermen and crew members while sailing. These supplies include components such as fuel oil (BBM), oil, ice, clean water, salt, and food, which support the continuity of ship operations (Fitriyashari et al., 2014). This study aims to determine the time efficiency of filling sea supplies on hand line vessels at PPS Bungus, provide input to PPS Bungus on sea supplies activities, and identify the factors that affect the time efficiency of hand line vessel supplies.

2. Methodology

2.1. Method

The research method used in this research is the survey method. A survey is a method of investigation carried out to obtain facts about existing symptoms, gather information based on facts, and collect main and supporting data for analysis or further research.

2.2. Data Analysis

Efficiency Level

The formula, according to Hafidzah et al. (2022), is used as follows:

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

Where:

E	=	Efficiency Level (%)
WE	=	Effective Replenishment Time (minutes)
WT	=	Replenishment Time of Hand Line Vessel Supplies (minutes)

The results of the analysis are then discussed, supported by data and the existing literature. The supporting data is presented in tables and graphs that show the relationship between each piece of supporting data and the level of efficiency in filling supplies at sea. To assess the efficiency of supply time, the formulas for effective time and wasted time are used. The main data are used to determine the level of efficiency in filling time for handline vessels. Supporting data is data used to explain the results of the analysis of the efficiency of filling time for hand line vessels, which consists of ship tonnage (GT), number of crew members (people), amount of fuel carried (liters), amount of ice carried (blocks), amount of clean water carried (liters), and length of fishing trails (m). The data were collected on 20 handline vessels. The survey conducted in this study aims to obtain information on the efficiency of filling time for handline boats at PPS Bungus.

Simple Linear Regression

According to Muhartini et al. (2021), the simple linear regression equation is an approach method for modeling the relationship between one dependent variable (Y) and one independent variable (X) with the following mathematical model:

$$Y = a + bX$$

Description:

Y	=	Non-independent variable (efficiency level of supply filling time) (%)
X	=	Wasted Time / Effective Time (minutes)
a	=	Constant
b	=	Regression coefficient

Multiple Regression

The shape of the relationship between wasted time and influencing factors will be seen through multiple regression equations as follows:

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + b7X7 + b8X8 + b9X9$$

Description:

Y	=	Wasted Time/Effective Time (depending on the r value of the simple regression equation) (minutes)
X1	=	Tonnage of the ship (GT)
X2	=	Number of crew members in one hand line vessel unit (people)
X3	=	Quantity of ice carried (blocks)
X4	=	Quantity of fuel carried (L)
X5	=	Quantity of clean water carried (L)
X6	=	Length of ice block track (m)

X7 = Length of fuel track (m)
X8 = Clean water path length (m)
X9 = Grocery track length (m)
a = Constant
b = Regression coefficient

To assess the relationship between wasted time and the factors that influence it, the correlation coefficient is used. Meanwhile, to determine how much these factors affect wasted time, the coefficient of determination is used.

3. Result and Discussion

Mooring and Supply Replenishment Time

Mooring time for the purpose of replenishing supplies at sea is the time that begins when the ship's mooring line is completely tied at the dock and ends when the ship's mooring line is released for departure, based on the results of 20 hand line vessel samples conducted at PPS Bungus, the mooring time of hand line vessels ranged from 155 to 540 minutes, with an average of about 312.3 minutes in one period of replenishing supplies. The KM. Muhiba recorded the longest mooring time of 540 minutes, while the KM. Hibo 03 had the shortest mooring time of 255 minutes.

The time of filling supplies is the time calculated from when fishermen order supplies that will be taken to sea until the supplies are neatly arranged on the boat (Zain, 2015). The results of the study of 20 handline vessels at the time of filling supplies ranged from 150 to 192 minutes, with an average of about 167.55 minutes during one period of filling supplies at sea. Ships such as Tiar Jaya 01 and KM. Rejeki Barokah 03 experienced the shortest resupply time, while the KM. Bina Sumber Jaya faces the longest resupply time.

Wasted and Effective Supply Filling Time

Wasted time is the time used to carry out activities other than the activity of filling sea supplies. Based on the results of research on 20 samples of hand line vessels at PPS Bungus during the study, the time wasted during the process of filling sea supplies on hand line vessels varies between 30 and 61 minutes in one period of time filling sea supplies, with an average of about 48.3 minutes in one period of filling sea supplies. Ship KM. MNK Group 02 recorded the longest wasted time, while KM. Tiar Jaya 01 has the shortest wasted time.

Effective provisioning time, i.e., the time actually used for provisioning activities at sea, can be calculated by subtracting wasted time from provisioning time (Zain, 2015). The effective provisioning time ranges from 109 to 142 minutes, with an average of about 114.7 minutes during one period of filling supplies at sea. Where the fastest effective provisioning time occurs on the KM. Rajo 08 ship, and the longest effective provisioning time occurs on the KM. Karina 01 ship.

The efficiency of filling time at sea is the result of using the time to fill sea supplies quickly and precisely without increasing the wasted time used for other activities. According to Saragih et al. (2014), efficiency is the use of the right time so that there is no waste or loss, to find out how much the level of efficiency of filling time at sea for hand line vessels can be obtained from the comparison between the time of filling effective supplies and the length of time used by fishermen to fill supplies at sea. The comparison results are multiplied by 100%. Based on the study results, the efficiency ranged from 64.11 to 80%, with an average time efficiency of 71.11% during one period of filling supplies at sea.

Relationship between Efficiency Level and Wasted Time

Changes in the value of X (wasted time) in the form of a simple linear equation in 20 samples of hand line vessels at PPS Bungus are accompanied by changes in time efficiency, where the more wasted time increases, the more the level of time efficiency of filling supplies will increase, or with a linear regression equation Y = 90.031 - 0.407x. For more details, see Figure 1.

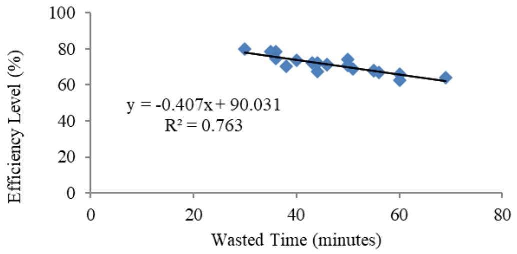

Figure 1. Relationship between efficiency level and wasted time

The regression coefficient (b) = -0.407 indicates a negative relationship between wasted time and efficiency, suggesting that the efficiency level of filling supplies at sea decreases. The coefficient of determination (R2) is 0.763, which means that 76.3% of the wasted time in filling supplies for hand line vessels and 23.7% are influenced by other factors not studied. While changes in the value of X (wasted time) in the form of a simple linear equation in 20 samples of hand line vessels at PPS Bungus are accompanied by changes in time efficiency, where the less wasted time, the more the efficiency level of filling time will decrease, or with a linear regression equation Y = 90.031 - 0.407x.

In this study, the effect of weather conditions on the time wasted during the filling of sea supplies was analyzed for 20 handline vessels at PPS Bungus. Weather conditions were divided into two categories, namely sunny and cloudy. The results showed that weather conditions do not have a significant influence on the level of efficiency in the activity of filling sea supplies, and weather conditions do not greatly affect the level of efficiency (Hafidzah et al., 2022). During the research, it was found that on sunny days, wasted time increased. This is because, in sunny weather, the crew tends to work more slowly. After all, the heat causes them to take longer to rest due to fatigue. On the other hand, when the weather is cloudy and not hot, crew members filling supplies at sea are less tired and need less time to rest. On average, the time wasted during sunny weather is 37.5 minutes, while during cloudy weather it is 30 minutes.

Relationship between Factors Affecting the Time to Replenish Sea Supplies and Wasted Time when Replenishing Supplies

To understand the relationship between the factors affecting the time taken to replenish supplies at sea and the time wasted, multiple regression analysis was used to examine the correlation (r) and determination (R2) values. Before running the multiple regression analysis, it is important to conduct a multicollinearity test to determine whether there is multicollinearity among the factors affecting wasted time in replenishing marine supplies on hand-line vessels.

The results of the multicollinearity test on the collected data indicate that there is no significant relationship among the independent variables, so the symptoms of multicollinearity do not occur in this analysis. This is indicated by the VIF value, which is smaller than 10. The results of the multicollinearity test are shown in Table 1.

Table 1. Multicollinearity test results on (y) wasted time

Free Variable	Colinearity Statistic	
	Tolerance	VIF
Ship Tonnage	0,265	3,771
Number of crew members	0,634	1,578
Number of Ice Blocks	0,491	2,037
Fuel Quantity	0,322	3,105
Amount of Clean Water	0,313	3,191
Length of Ice Block Trajectory	0,410	2,441
Fuel Track Length	0,197	5,079
Water Passage Length	0,316	3,167
Grocery Trajectory Length	0,771	1,297

The tolerance value for the smallest independent variable is 0.197 (fuel track length), and the largest is 0.771 (food ingredient track length). If tolerance > 0.10 (greater) and > 10.00 (smaller), there is no multicollinearity in the regression model. The VIF value for the smallest independent variable (foodstuff trajectory length) is 1.297, and the largest VIF value (fuel trajectory length) is 5.097, indicating that multicollinearity is not present if VIF < 10.00.

The results of the data analysis were obtained using SPSS calculations.16 The results of the data analysis obtained using SPSS 16 calculations show that the level of time efficiency of filling marine supplies on hand line vessels at PPS Bungus has a strong correlation (r = 0.885). In contrast, the value of R2 obtained is 0.784 this states that 78.4% of the amount of time wasted when filling marine supplies on hand line vessels is influenced by independent variables consisting of ship tonnage (X1), number of crew (X2), the amount of block ice (X3), the amount of fuel (X4), the amount of water (X5), the length of the block ice track (X), the length of the fuel track (X_{67}), the length of the water track (X_8), the length of the food track

(X_9), this means that there are 21.6% other factors that are not studied such as smoking, chatting with fellow fishermen, waiting for the arrival of the fuel officer, waiting for the arrival of block ice, and resting.

From the results of the regression analysis of the data, the equation Y = 138,522 + 0,185 $_{X1}$ + 1,012 $_{X2}$ – 0,023 $_{X3}$ + 0,482 $_{X4}$ - 0,015 $_{X5}$ – 0,889 $_{X6}$ + 0,884 $_{X7}$ – 163 $_{X8}$ + 1,004 $_{X9.}$ The multiple linear regression equation above shows an intercept (a) value of 138.522, namely ship tonnage (X_1), number of crew members (X_2), amount of block ice (X_3), amount of fuel(X_4), amount of clean water (X_5), ice track length (X_6), fuel track length (X_7), water track length (X_8), food track length (X_9) which describes the diversity of wasted time.

The coefficient b_1 tonnage of the ship (X_1) of 0.185 states that if the other variables are constant and the tonnage of the ship increases by 1 GT, the wasted time will also increase by 0.185 minutes. With a positive coefficient, it can be concluded that there is a positive relationship between ship tonnage and wasted time, which means that the greater the tonnage of the ship, the more wasted time will increase.

In contrast to the opinion of Fajriati et al. (2021), who stated that the size of the ship on hand line vessels has a negative influence, this is thought to be because, when carrying out fishing operations, hand line vessels are mostly silent. The main engine is turned off so that the size of the ship does not have a big influence on the amount of fuel carried.

The coefficient b_2 for the number of crew members (X2) is 1.012, indicating that if the other variables are constant and the number of crew members increases by 1, the wasted time will increase by 1.012 minutes. With a positive coefficient, it can be concluded that there is a positive relationship between the number of crew members and wasted time, which means that the more the number of crew members increases, the more wasted time will increase.

In contrast to the opinion of Hafidzah et al. (2022), the coefficient b4 for the number of actors filling supplies (X4) is -9.5800, indicating a negative relationship with effective time when filling supplies. This means that every additional crew member will reduce wasted time by 9.5800 minutes, if the amounts of clean water, fuel, and ice blocks remain constant. Likewise, with the number of crew members, the more who go to sea, the more clean water is needed at sea, such as for cooking and bathing. This is in accordance with Sihono's (2008) opinion, which states that the longer the ship operates, the greater the number of fishing needs.

The coefficient b_3 for the number of ice blocks (X4) is -0.023; this indicates that, holding the other variables fixed, each additional ice block will increase the wasted time by -0.023 minutes. With a negative coefficient, it can be concluded that there is a negative relationship between the number of ice blocks and wasted time, which means that the more the number of ice blocks decreases, the more the wasted time will decrease.

In contrast to Hafidzah's (2022) opinion, the coefficient b3 for the number of ice blocks (X3) is 0.1652, indicating a positive relationship with effective time when filling supplies. This means that each filling of 1 block of ice will increase the effective time by 0.1652 minutes, if the amount of clean water, fuel, and crew is fixed.

The coefficient b_4 for the amount of fuel (X5) is 0.482; this indicates that, holding the other variables constant, a 1-L increase in fuel results in a 0.482-minute increase in wasted time. With a positive coefficient, it can be concluded that there is a positive relationship between fuel consumption and wasted time, meaning that the greater the fuel consumption, the more wasted time there will be. In contrast to the opinion of Fajriati et al. (2021), the fishing trip is negative; the longer the fishing trip lasts, the longer the engine will be operated, which results in an increase in the required fuel consumption.

The coefficient b_5 of the amount of clean water (X_6) is -0.015; this states that if the other variables are fixed and the amount of clean water increases by 1 L, the wasted time will also increase by -0.015 minutes. With a negative coefficient, it can be concluded that there is a negative relationship between the amount of clean water and wasted time, meaning that as the amount of clean water decreases, wasted time decreases.

In contrast to the opinion of Triardi et al. (2014), who state that the relationship between the amount of water carried by fishermen and the level of efficiency of filling time for sea supplies has a positive relationship, this means that if the amount of water carried increases by one unit (1 L), the level of efficiency of sea supplies will increase.

The coefficient b_6 for the length of the ice block track (X7) is 0.889, indicating that if the other variables are held constant and the length of the ice block track increases by 1 m, the wasted time will increase by 0.889 minutes. With a negative coefficient, it can be concluded that there is a negative relationship between the length of the ice block track and wasted time, which means that the longer the length of the ice block track, the more wasted time will increase.

The coefficient b_7 for the fuel path length (X8) is 0.884; this indicates that, holding the other variables constant, a 1-m increase in the fuel path length results in a 0.884-minute increase in wasted time. With a positive coefficient, it can be concluded that there is a positive relationship between the length of the fuel trajectory and the wasted time, which means that the greater the length of the fuel trajectory, the more wasted time will increase.

The coefficient b_8 for the length of the clean water path (X9) is -2.163, indicating that, holding the other variables constant, a 1 m increase in the length of the clean water path results in a -2.163 minute increase in wasted time. With a negative coefficient, it can be concluded that there is a negative relationship between the length of the clean water trajectory and wasted time: the longer the clean water trajectory, the greater the decrease in wasted time.

The coefficient b_9 of the length of the food trajectory (X_9) is 1.004. This states that if the other variables are fixed and the length of the food trajectory increases by 1 meter, the wasted time will also increase by 1.004 minutes. With a positive coefficient, it can be concluded that there is a positive relationship between the length of the food trajectory and wasted time, meaning that the longer the food trajectory, the greater the wasted time. The amount of block ice, the amount of clean water, the track length of block ice, and the track length of clean water negatively influence wasted time. This means that the less block ice there is, the less clean water there is, and the shorter the path length of block ice and clean water, the less time will be wasted.

On the contrary, ship tonnage, number of crew members, amount of fuel, fuel track length, and food track length have a positive influence on wasted time. This means that the greater the ship's tonnage, the more crew members, the more fuel, and the longer the length of the fuel and food trajectory, the greater the wasted time. When viewed from the coefficient of determination obtained (R2 = 0.784), it shows that the factors of the amount of sea supplies (fuel, clean water, ice blocks), the number of crew members, the tonnage of the ship, and the length of the track for filling sea supplies affect 78.4% of the wasted time when filling sea supplies for hand line ships.

The relationship between factors and wasted time cannot be discussed one by one, because all these factors occur within the same time span. So the discussion must be comprehensive and simultaneous. The coefficient of determination (R2 = 0.784) indicates that the amount of supplies at sea accounts for 78.4% of the time wasted when filling supplies at sea on handline vessels. This means that 21.6% of the time is wasted by other factors not examined in this study, such as smoking, waiting for the arrival of fuel officers, waiting for the arrival of ice blocks, and drinking breaks.

4. Conclusion

The results of the study indicate that the efficiency of filling supplies at sea for handline vessels at PPS Bungus is 70.84%, which is classified as less efficient. The efficiency of filling time for handline vessels is influenced by the time wasted, as shown by the determination coefficient (R2 = 59.5%). The amount of wasted time is influenced by the amount of fuel, block ice, and clean water, ship tonnage, number of crew, length of fishing trip, and length of track (block ice, fuel, water, and food). The most influential factor in wasted time is the length of the foodstuff track, with a coefficient of 0.2936.

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