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Time Efficiency Of Unloading Catches From Boat Seine At PPI Batu Kalang Carocok Tarusan, West Sumatra

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Abstract— The efficiency of unloading refers to the process of discharging catch in a manner that optimally utilizes time, ensuring that the catch arrives punctually. Several factors influencing the duration of fish unloading include the quantity of the catch, unloading time, wasted time, the size of the vessel, the experience of the unloaders, and their age. This study aims to assess the efficiency of unloading time for catch from the Boat Seine and to identify the factors that influence this efficiency. The research was conducted from November 17 to December 17, 2024, at Batu Kalang Beach, Ampang Pulai, Pesisir Selatan District, West Sumatra, employing a survey method with a sample size of 10 vessels. The research findings indicate that the effective unloading time averages 3 minutes and 42 seconds, with wasted time averaging 1 minute and 55 seconds, and the overall unloading time averaging 5 minutes and 38 seconds. The efficiency level of unloading time for catch from the Boat Seine at PPI Batu Kalang is deemed insufficient, with an average of 64.18%. The factors that significantly influence unloading efficiency (P < 0.05) are unloading time and wasted time, while the weight of the catch, the number of unloaders, the experience of the unloaders, and the age of the unloaders have an insignificant effect (P > 0.05) on unloading efficiency. It is concluded that the unloading efficiency level is classified as inadequate, registering a value of 64.18%.

Keywords— Keywords— Time Efficiency; Catch Results; Boat Seine

I. INTRODUCTION

South Pesisir Regency is one of the 19 regencies located in West Sumatra Province. Geographically, South Pesisir Regency is situated between 0° 59' - 2° 28' S and 100° 19' - 101° 18' E, encompassing an area of 5,749.89 square kilometers and a coastline stretching 218 kilometers (1). One of the locations designated as a Fish Landing Base (PPI) is found on the Batu Kalang beach, in Nagari Ampang Pulai, Koto XI Tarusan District. The fleet operating in the waters of Batu Kalang is part of the Carocok Tarusan Coastal Fishing Port (PPP). The fishing vessels operating at the Coastal Fishing Port (PPP) Carocok Tarusan include Bagan, Tonda, Boat Seine, and Gillnets (2).

The Boat Seine is a circular purse seine composed of a bag, a body (belly), and wings (flaps) (3). The Boat Seine fishing gear found on Batu Kalang beach operates using traditional fishing vessels. In Carocok Tarusan, the Boat Seine is operated with simple and traditional boats (1). This fishing implement features two wings that serve to guide fish into the bag (4). The catch from the Boat Seine predominantly consists of surface or pelagic fish, such as anchovies (stelephorus sp.), longfin tuna (Thunnus sp.), Mackerel (Scomberomorus guttanus), Sailfish (Lepturacanthus savala) And mackerel tuna (Rastrelliger sp.). The quantity of the catch significantly impacts the efficiency of the unloading process.

The efficiency of the unloading process pertains to the careful execution of offloading the catch in a manner that maximizes time utilization, ensuring that the catches arrive punctually. Several factors influence the duration of fish unloading, including the volume

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of the catch, the unloading time, wasted time, the size of the vessel, the experience of the unloading personnel, and their age. An extended unloading period conducted by fishermen may result in a deterioration of the fish's quality (5). Efficient fish unloading is essential for preserving the integrity and quality of the catch, ensuring that the fish reaches the consumer in optimal condition. At PPI Pantai Batu Kalang, the unloading process commences with the offloading of the catch, followed by the lowering of the catch, which is then immediately auctioned and transported via motorcycle.

The process of landing or unloading fish must be executed swiftly, employing time-efficient methods to maintain the quality of the catch. The operation of gill nets is conducted by small-scale fishermen, with the unloading of the catch at PPI Batu Kalang conforming to communal practices, thereby lacking a standardized unloading protocol. Time inefficiencies during unloading refer to situations where the offloading process is unnecessarily prolonged, resulting in an extended duration beyond what is required. In light of the foregoing, it is imperative to conduct research on the efficiency of the unloading process, aimed at assessing the efficiency of gill net catches and the various factors influencing this efficiency at Batu Kalang Beach, West Sumatra.

II. METHODOLOGY

A. Location and Time

This study was conducted from November 17 to December 17, 2024, at Batu Kalang Beach, Ampang Pulai, in the Southern Coast District of West Sumatra.

B. Materials and Equipment

The materials utilized in this study consist of gill net catches unloaded at PPI Batu Kalang. The equipment employed includes gill net boats, writing instruments, a stopwatch for time measurement, and documentation tools such as a camera (smartphone).

C. Methodology

The methodology adopted for this research is a survey approach, involving the selection of 10 vessels as samples, alongside observations and interviews to gather information regarding the unloading activities of gill net catches. The field surveys were conducted during the fishermen's unloading operations following their fishing activities.

D. Data Analysis

Determining the Level of Efficiency

The efficiency of the fish unloading process is calculated using formula (6), as follows:

$$\mathbf{E = \frac{WE}{WP} X\ 100\%}$$

Explanation:

E = Efficiency of time (%)

WE = Effective time utilized solely for the fish unloading activity

WP = Time measured from when the vessel docks until the completion of the unloading process.

Based on the obtained efficiency level, the type of fish unloading efficiency is subsequently determined using the criteria outlined in (6) in Table 1.

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Table 1. Criteria for Fish Unloading Efficiency

No	Tingkat Efisien	Nilai Efisien
1	Efisien	75% Hingga 100 %
2	Kurang Efisien	50% Hingga 74,99%
3	Tidak Efisien	25% Hingga 49,99%
4	Sangat Tidak Efisien	<25%

Analysis of Factors Influencing the Efficiency of Fish Unloading Time

The analysis of factors affecting the efficiency of fish unloading time is conducted using a multiple regression analysis equation, with the fish unloading time as the dependent variable (Y) and the catch amount (kg), unloading time (minutes), wasted time (minutes), number of unloading personnel (individuals), experience of unloading personnel (years), and age of unloading personnel (years) as independent variables. Regression analysis is a statistical data analysis technique employed to understand the relationship between the dependent and independent variables (7) is as follows:

$$\mathbf{Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6}$$

Description:

Y = Unloading time efficiency (%)

X1 = Amount of catch (kg)

X2 = Unloading time (minutes)

X3 = Wasted time (minutes)

X4 = Number of unloading personnel (individuals)

X5 = Experience of unloading personnel (years)

X6 = Age of unloading personnel (years)

a = Constant

b = Regression coefficient

Composition of Catch

The composition analysis is conducted to determine the type and weight/mass of the catch, using the following equation (8):

$$\boldsymbol{Pi = \frac{ni}{N} X\ 100\%}$$

Description:

Pi = Composition of catch species (%)

ni = Amount of catch (kg)

N = Total amount of catch (kg)

III. RESULT AND DISCUSSION

General Condition of the Research Location

The research was conducted at the Batu Kalang Fish Landing Base, situated in the Kanagarian of Ampang Pulai, Koto XI Tarusan District, South Pesisir Regency. The surrounding topography comprises coastal areas, river basins, and hills. A map of the research location can be found in Figure 1.

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Figure 1. Map of the Research Location

The Batu Kalang Fish Landing Base (PPI) is located along the coastal waters of the Pesisir region, approximately 56 km from the city of Padang, along the transit route to Padang Painan. The Nagari of Ampang Pulai encompasses an area of 489 hectares, with geographical coordinates ranging between 100°24'52.67" E - 100°27'41.17" E and 1°14'52.95" S - 1°16'11.59" S. It shares its northern boundary with the Nagari of Setara Nanggalo, its southern boundary with the Indian Ocean, its western boundary with the Nagari of Carocok Anau, and its eastern boundary with the Nagari of Jinang Kampung Pansur (9).

Results of the Boat Seine Catch

The catch obtained from the Boat Seine fishing gear, collected during the research activities conducted on 10 vessels, is presented in Table 2.

Table 2. Boat Seine Catch Results

No	Fish Name	Scientific Name	Weight (kg)	Percentage (%)
1	Anchovy	*Stolephorus sp.*	1437	79,09
2	Skipjack Tuna	*Thunnus sp.*	170	9,36
3	Mackerel	*Rastrelliger sp.*	65	3,58
4	Yellowfin Tuna	*Thunnus albacares*	40	2,20
5	Needlefish	*Strongylura leiurus*	36	1,98
6	Wolf Herring	*Chirocentrus dorab*	19	1,05
7	Ribbonfish	*Trichiurus sp.*	18	0,99
8	Sardine	*Sardinella sp.*	18	0,99
9	Indo-Pacific King Mackerel	*Scomberomorus guttatus*	14	0,77
	Total		1817	100

Based on the findings of the study, nine fish species were captured using the Boat Seine fishing gear, including the anchovy *(Stolephorus sp.),* The Skipjack Tuna (Thunnus sp.), the Mackerel (Rastrelliger sp.), the Yellowfin Tuna (Thunnus albacares), the Needlefish (Strongylura leiurus), the Wolf Herring (Chirocentrus dorab), the Ribbonfish (Trichiurus sp.), the Sardine (Sardinella sp.), and the Indo-Pacific King Mackerel (Scomberomorus guttatus). Typically, the net captures the Ribbonfish (Trichiurus sp.), Mackerel (Rastrelliger sp.), Anchovy (Stolephorus sp.), and Indo-Pacific King Mackerel (Scomberomorus guttatus) (10). The catch obtained is the result of the sorting of fish species conducted by the fishermen during the hauling process.

General Conditions of the Unloading Participants

The research findings reveal that the crew members aboard the Boat Seine consist of 120 individuals, with the number of crew members on each vessel ranging from 8 to 12. The individuals involved in the unloading of the catch at PPI Batu Kalang are part of the crew of the Boat Seine itself.

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A. Unloading Participants by Age

As the age of the workforce increases, their productivity tends to decline (11). The age distribution of the unloading participants is illustrated in Table 3.

Table 3. Age of the Unloading Participants

No	Age (years)	Number of Unloading Personnel (individuals)	Percentage (%)
1	19 - 21	13	10,83
2	22 - 24	9	7,50
3	25 -27	19	15,83
4	28 - 30	35	29,17
5	31 - 33	9	7,50
6	34 - 36	14	11,67
7	37 - 39	5	4,17
8	40 - 42	16	13,33
	Total	120	100

According to Table 3, it is observed that there are 13 unloading participants aged 19-21 years, accounting for 10.83%, 9 participants aged 22-24 years, representing 7.50%, 19 participants aged 25-27 years, which constitutes 15.83%, and 35 participants aged 28-30 years, making up 29.17%. Additionally, there are 9 participants aged 31-33 years, corresponding to 7.50%, 14 participants aged 34-36 years, equating to 11.67%, 5 participants aged 37-39 years, accounting for 4.17%, and finally, 16 participants aged 40-42 years, representing 13.33%. From these results, it can be inferred that the age of the unloading participants is predominantly suitable for work, especially as it is primarily concentrated in the 28-30 year age range. Workers in the productive age group (15-60 years) exhibit a positive correlation with labor productivity, indicating that when workers fall within the productive age category, their productivity tends to increase. This is attributed to their heightened creativity and engagement with their tasks during this vital phase of their careers (12).

B. Work Experience of Unloading Participants

The work experience of fishermen significantly influences their skills in fishing, thereby affecting the quantity and quality of the catch they obtain. The work experience of the unloading participants is detailed in Table 4.

Table 4. Work Experience of the Unloading Participants

No	Experience (years)	Number of Unloading Personnel (individuals)	Percentage (%)
1	1 - 2	8	6,67
2	3 - 4	6	5,00
3	5 - 6	24	20,00
4	7 - 8	22	18,33
5	9 - 10	26	21,67
6	11 - 12	1	0,83
7	13 - 14	5	4,17
8	15 - 16	28	23,33
	Total	120	100

According to Table 4, it is evident that unloading participants with 15-16 years of work experience represent the highest percentage, standing at 23.33%, which corresponds to 28 individuals. In contrast, the lowest percentage is observed among fishermen with 11-12 years of experience, totaling just 1 person, amounting to 0.83%. As the years of experience accumulate, the influence on their proficiency in performing their tasks becomes increasingly pronounced. The extensive experience of fishermen not only enhances their skills but also enables them to identify and seize opportunities during the fishing process, thereby impacting the volume of their catch (13).

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Efficiency of Unloading Time for Boat Seine Catches

The efficiency of unloading time refers to the ability to execute the unloading process of the catch swiftly and effectively. The unloading and auctioning of the catch occur directly at the water's edge following the docking of the vessels. Throughout the course of the study, 30 data points were collected from 10 Boat Seine boats engaged in the unloading of fish at PPI Batu Kalang. The efficiency of unloading time is presented in Table 5.

Table 5. Level of Efficiency in Unloading Time for Fish Catches

No	Vessel Name	Downtime (Minutes)	Effective Time (Minutes)	Unloading Time (Minutes)	Efficiency (%)	Desc
	Arabella	02:24	02:05	04:30	46,30	I
1	Arabella	02:18	02:32	04:50	52,41	LE
	Arabella	01:01	04:49	05:50	82,57	E
	Elok Saba 07	02:43	04:25	07:08	61,92	LE
2	Elok Saba 07	00:47	02:47	03:34	78,04	E
	Elok Saba 07	02:47	01:00	03:47	26,43	I
	Andre 02	02:08	04:31	06:40	67,75	LE
3	Andre 02	04:10	02:08	06:18	33,86	I
	Andre 02	01:05	06:38	07:43	85,96	E
	Umega	01:36	04:09	05:45	72,17	LE
4	Umega	01:07	07:17	08:25	86,53	E
	Umega	02:01	02:40	04:41	56,94	LE
	KM Urek Malintang	02:06	01:14	03:20	37,00	I
5	KM Urek Malintang	02:44	01:58	04:43	41,70	I
	KM Urek Malintang	01:01	02:25	03:26	70,39	LE
	Lintas Laut	03:10	04:39	07:50	59,36	LE
6	Lintas Laut	01:12	06:04	07:16	83,49	E
	Lintas Laut	01:00	04:49	05:50	82,57	E
	Shadin Husein	02:53	02:06	05:00	42,00	I
7	Shadin Husein	01:28	02:29	03:57	62,87	LE
	Shadin Husein	00:46	05:29	06:16	87,50	E
	Rifky	04:46	03:02	07:38	39,74	I
8	Rifky	01:29	03:15	04:44	68,66	LE
	Rifky	01:06	02:12	03:19	66,33	LE
	Bajak Laut	01:35	07:07	08:42	81,80	E
9	Bajak Laut	02:52	01:49	04:41	38,79	I
	Bajak Laut	00:20	05:17	05:38	93,79	E
	Buyuang Lasak	03:02	05:06	08:09	62,58	LE
10	Buyuang Lasak	01:01	03:49	04:51	78,69	E
	Buyuang Lasak	01:03	03:35	04:38	77,34	E
Average		01:55	03:42	05:38	64,18	LE

Description: E = Efficient

LE = Less Efficient

I = Inefficient

a. Wasted Time

Wasted time refers to the duration spent outside the fish unloading activities. In Table 5, it can be observed that the wasted time across 30 data points from 10 vessels averages 1 minute and 55 seconds, with the longest wasted time recorded on the vessel Rifky during the first iteration at 4 minutes and 46 seconds, while the shortest wasted time occurs on the vessel Bajak Laut during the

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third iteration, lasting merely 20 seconds. Wasted time at PPI Batu Kalang predominantly transpires when the vessel is docked, and unloading personnel do not immediately commence the offloading of catches. This delay is attributed to the queue awaiting the agent to facilitate the auctioning process.

b. Effective Time

Effective time refers to the duration exclusively allocated for the process of unloading fish at the Batu Kalang Fish Landing Base. According to Table 5, the average effective time is calculated to be 3 minutes and 42 seconds, with the longest effective time recorded on the vessel Umega during the second iteration at 7 minutes and 17 seconds, while the shortest effective time is observed on the vessel Elok Saba 07 during the third iteration, lasting merely 1 minute. Effective time is the duration utilized in the activities of landing and unloading the catch, measured from the preparatory phase of offloading until the caught fish are distributed to the auction venue (14).

c. Unloading Time

Unloading time at the Batu Kalang Fish Landing Base refers to the duration from the moment the vessel docks or approaches the shoreline until the completion of the unloading process and the transfer of the catch to the auction house. As indicated in Table 5, the average unloading time is 5 minutes and 38 seconds, with the longest unloading time occurring on the vessel Bajak Laut during the first iteration at 8 minutes and 42 seconds, while the shortest unloading time is recorded on the vessel Rifky during the third iteration at 3 minutes and 19 seconds. During the study, the brevity of unloading time can be attributed to the proximity of the shoreline to the auction venue, along with several vessels conducting direct sales right at the beach. The landing or unloading activities encompass all operations related to the disembarkation of the catch, commencing with the unloading of fish from the fishing vessel and their subsequent transportation to the Fish Auction Site (TPI) or Fish Landing Base (PPI) (15).

Efficiency Level of Unloading Time for the Boat Seine Catch

The duration of fish unloading significantly influences the efficiency of the catch unloading process. The efficiency level of unloading the Boat Seine catch at the Batu Kalang Fish Landing Base, as presented in Table 5, averages 64.18%. This indicates that the unloading efficiency for Boat Seine catch is deemed suboptimal. This efficiency criterion aligns with the established benchmarks, where a rating between 50% and 74.99% is classified as inefficient (6). A pivotal aspect of efficiency is the time taken for landing or unloading fish. The more efficient the unloading process is, the less likely the fish are to undergo spoilage, thereby ensuring the maintenance of quality for the landed catch (16).

Analysis of Factors Influencing the Efficiency of Unloading Time for the Boat Seine Catch

The factors affecting the efficiency of the unloading time for the Boat Seine catch include the weight of the catch, unloading duration, idle time, the number of unloading crew members, their experience, and their age. A detailed analysis of these factors influencing unloading efficiency on Boat Seine vessels is presented in Table 6.

Table 6. Results of the Analysis of Factors Affecting the Efficiency Level of Unloading Time

Variable	Coefficients	*P-value*
Intercept (α)	57,529	$1,29x10^{-06}$
X1 Weight of Catch (kg)	0,044	0,334
X2 Unloading Time (Minutes)	6,389*	$4,33x10^{-9}$*
X3 Downtime (Minutes)	-16,831*	$2,95x10^{-14}$*
X4 Number of Unloading Personnel (Individuals)	-1,138	0,446
X5 Experience of Unloading Personnel (Years)	0,717	0,265
X6 Age of Unloading Personnel (Years)	-0,057	0,876
R square = 0,936		

Note: *Significant at α = 5%

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Table 6 reveals an R-square value of 0.936, indicating that 93.6% of the efficiency in unloading time for the Boat Seine catch at PPI Batu Kalang is influenced by independent variables, while the remaining 6.4% is affected by other factors not examined in this study. The R-square value is a metric that illustrates the extent to which the dependent variable is influenced by changes or variations in the independent variables (17). This value ranges from 0 to 1; a lower R-square signifies a weaker relationship between the variables, whereas a value approaching 1 indicates a stronger correlation (18).

The regression coefficient test results indicate that the P-value demonstrates significance at $\alpha = 5\%$. This means that with a 95% confidence interval, factor X2 (unloading time) and X3 (wasted time) have a significant partial impact on the efficiency of unloading time for Boat Seine vessels, with P-values less than 0.05. Conversely, the factors of catch weight (X1), number of unloaders (X4), unloader experience (X5), and unloader age (X6) have P-values greater than 0.05, indicating they exert an insignificant influence on unloading time efficiency.

Based on the analysis results presented in Table 6 regarding the factors affecting the efficiency of unloading Boat Seine catches, the following equation can be derived:

$$\mathbf{Y = 57{,}529 + 0{,}044\ X1 + 6{,}389\ X2 - 16{,}831\ X3 - 1{,}138\ X4 + 0{,}717\ X5 - 0{,}057\ X6}$$

Based on the aforementioned equation derived from the regression results, it can be stated that an increase in X3 (wasted time), X4 (number of unloaders), and X6 (age of unloaders) will lead to a decrease in unloading time efficiency. Conversely, an increase in X1 (catch weight), X2 (unloading time), and X5 (unloader experience) will enhance the efficiency of the unloading process.

The constant value (a) in the aforementioned regression equation is 57.529. The coefficient for catch weight (X1) is 0.044, accompanied by a P-value of 0.334, which is greater than 0.05 (indicating it is not significant at the $\alpha = 5\%$ testing level) concerning unloading time efficiency. The positive value of the catch weight implies that as the weight of the catch increases, the efficiency of unloading time improves by 0.044%. This stands in contrast to the findings of study (5), which asserts that the volume of catch can influence the efficiency of unloading time; specifically, as the volume of catch landed increases, more time is consumed, leading to greater fatigue among unloaders and consequently slowing down the unloading process. Thus, a greater weight of fish landed corresponds to an increase in the efficiency of the time utilized (19).

The coefficient for unloading time (X2) is 6.389, with a P-value of 4.33×10^{-9}, which is less than 0.05 (indicating significance at the $\alpha = 5\%$ testing level). The positive coefficient suggests that as unloading time increases, the efficiency of unloading time rises by 6.389%. This constitutes a primary factor influencing the efficiency of the unloading process for the catch. Unloading time refers to the duration spent on unloading activities, measured from the moment the vessel is docked until the unloading is fully completed (20).

The coefficient for wasted time (X3) is -16.831, accompanied by a P-value of 2.95×10^{-14}, which is less than 0.05 (indicating significance at the $\alpha = 5\%$ testing level). The negative coefficient indicates that as wasted time increases, the efficiency diminishes by 16.831%. This aspect emerges as a principal factor affecting the efficiency of the unloading process for the catch. Wasted time may arise from various activities such as smoking, taking breaks, waiting for carts, and other similar distractions (16). Consequently, the greater the amount of time wasted, the lower the efficiency of unloading time (19).

The coefficient for the number of unloading workers (X4) is -1.138, with a P-value of 0.446, which is greater than 0.05 (indicating no significance at the $\alpha = 5\%$ testing level) concerning the efficiency of the unloading process, where the coefficient is negative. This suggests that as the number of unloading workers increases, the efficiency of the unloading process decreases by 1.138%. This phenomenon may occur because, although the number of unloading workers rises, not all engage in the unloading activities. The addition of more laborers does not enhance the efficiency of the landing process, as it can impede the movement of workers aboard the vessel. The skill and strength of the workers play a more crucial role than merely increasing the number of participants. A smaller group of workers with superior strength and capability will yield better results than a larger group with limited mobility (21). Conversely, contrasting findings from a study conducted by (16) suggest that an increased number of unloading workers results in less time spent on the unloading process, and vice versa.

The coefficient for the experience of unloading workers (X5) is 0.717, with a P-value of 0.265, which exceeds 0.05 (indicating no significance at the α = 5% testing level) regarding unloading time, where the coefficient is positive. This implies that as the experience of unloading workers increases, the efficiency will rise by 0.717. However, the experience of unloading workers does not significantly affect the efficiency of the landing process; this may be attributed to the reliance on coordination and teamwork; if the team does not operate optimally, the experience of the workers becomes irrelevant (15).

The coefficient for the age of unloading workers (X6) is -0.057, with a P-value of 0.876, also exceeding 0.05 (indicating no significance at the α = 5% testing level) concerning the efficiency of unloading time, where the coefficient is negative. This suggests that as the age of unloading workers increases, the efficiency decreases by 0.057%. This decline may occur due to factors such as fatigue and physical decline. The age of unloading workers shows a weak correlation with the efficiency of the unloading process (22).

IV CONCLUSION

The level of unloading time efficiency is deemed inadequate, with an average value of 64.18%. The factors that significantly influence the efficiency of unloading time are the unloading duration and wasted time, while the weight of the catch, the number of unloading workers, the experience of those workers, and their age exert no significant impact on unloading time efficiency.

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