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The influence of the amount of live bait and fishing time on pole and line catches in the Maluku Sea, Indonesia

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Abstract

Ternate, North Maluku Indonesia is a water area that has quite large fisheries potential because it is a migration area for various types of large pelagic fish, including tuna (*Thunnus albacares*) and skipjack (*Katsuwonus pelamis*) which is a mainstay commodity for fisheries in Indonesia. Pole and line is a fishing tool consisting of a fishing rod or bamboo, fishing line and fishing rods which are specifically used for catching *K. pelamis*. The research was carried out by participating in pole and line fishing activities from November 2022 to May 2023 at fishing grounds in the Maluku Sea. Composition of caught fish Pole and Line that is *K. pelamis* as much as 22,313 kg, *T. albacares* as much as 5,320 kg, and other fish as much as 68 kg. Fishing was carried out 41 times with a total fishing duration of 2,460 minutes (41 hours) using live sardinella (*Sardinella fimbriata)* and anchovy (*Stolephorus commersonii*) bait as much as 8,358 kg. The relationship between the amount of live bait and fishing duration on catch results, it was found that there was an influence of live bait and fishing duration of 27.2% on catch results. Live bait partially influences the catch, fishing duration has no effect on the catch.

Keywords: Pole and line; Live bait; Fishing time; Anchovies

1. Introduction

North Maluku Province is an archipelagic province with potential fish resources spread from coastal areas to the high seas with production numbers tending to increase every year. Potential fish resources include pelagic fish resources such as bonito (*Euthynnus affinis*), scad (*Decaptured* Sp.), and mackerel (*Rastrelliger* Sp.) as well as demersal fish groups including the snapper (*Lutjanidae*), grouper (*Epinephelinae*) and other types of fish [1] [2]. Ternate is a water area that has quite large fisheries potential because it is a migration area for various types of large pelagic fish such as yellowfin tuna (*Thunnus albacares*) and skipjack tuna (*Katsuwonus pelamis*) which is a mainstay commodity for fisheries in Indonesia [3].

A pole and line is a fishing tool consisting of a fishing rod or bamboo, fishing line and hook. This fishing gear is specifically used to catch *K. pelamis* [4]. This tool, often called a pole and line, is operated throughout the day when there are schools of fish around the ship. This fishing gear is active where the ship will chase schools of fish. The principle of pole and line operation is to collect fish which are stimulated by throwing live bait and water spray [5][6].

Live bait is a limiting factor in catching *K. pelamis*, because the availability of live bait is very limited, seasonal, limited resources, and tends to be expensive [7]. The uniqueness of the pole and line operation is that the bait is not attached to a fishing rod, but is sprinkled into the sea to prevent schools of *K. pelamis* from remaining around the fishing vessel

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because they are attracted to eating the bait provided. Schools of fish should be kept as close to the vessel as possible so that they can be easily caught [8].

The research aimed to analyze the effect of the amount of live bait and fishing time on catch results. That is the importance of live bait in skipjack tuna fishing operations.

2. Material and methods

This research was carried out from November 2022 to May 2023 on a pole and line ship with a fishing area in the Maluku Sea. The tools and materials needed for this research include live bait, buckets, cameras, stationery, and laptop software IBM SPSS 2018.

Figure 1 Pole and line vessels were used during research

2.1. Method of collecting data

2.1.1. Data Primer

Data primer was obtained by making direct observations on a pole and line vessel, following fishing operations using *a pole and liner*. Direct interviews with related parties to facilitate data collection.

2.1.2. Data Seconds

Data obtained from various literature that is closely related to the research theme. This is intended to be a reference as a basis for analyzing the discussion material, by comparing library sources with reality in the field.

2.1.3. Data Analysis Methods

The data that has been processed is then analyzed to produce a conclusion that is in line with the research objectives.

The data obtained in the form of the number of live baits, fishing duration and catches were then analyzed using quantitative methods with multiple linear regression analysis.

2.2. Analysis of the Influence of the Amount of Live Bait and Fishing Time on Catch Results

Data for which the correlation coefficient is known to be at a sufficient or more than sufficient level is then tested again using multiple linear regression. The function of multiple linear regression testing is to predict the state (rise and fall) of a variable *dependent* if variable *independent* manipulated, with the following formula [9]:

$$Y = bo + b_1X_1 + b_2X_2$$

Information:
X_1 = Live Bait
X_2 = Fishing Time
Y = Number of catches
b_1, b_2 = Constant

2.3. Normality Test

The data normality test is carried out to see whether the data comes from the same population and whether the data has the same variants. The results of the normality test carried out by the author show that the data is normally distributed based on decision making. If the sig value is > 0.05 then the data is normally distributed. However, if the sig value is <0.05 then the data is not normally distributed [10].

2.4. Multicollinearity Test

The purpose of using the multicollinearity test in research is to test whether the regression model finds a correlation (strong relationship) between the independent variables or independent variables. A good regression model should not correlate with independent variables or symptoms of multicollinearity [11].

The basis for decision-making in the multicollinearity test with the Tolerance value is as follows:

- If the Tolerance value is greater than 0.10, it means that there is no multicollinearity in the regression model.
- If the Tolerance value is smaller than 0.10, it means that multicollinearity occurs in the regression model.
- Variance Inflation Factor (VIF) shows that there are no independent variables that have a VIF value of more than 10.

So it can be concluded that there is no multicollinearity between the independent variables using the regression model.

2.5. Heteroscedasticity Test

The heteroscedasticity test aims to find out whether there is a conditional relationship between the independent variables. Research is said to be good if there are no symptoms of heteroscedasticity [12]. Characteristics of the absence of symptoms of heteroscedasticity:

- The data points spread above and below or around the number 0.
- The points are not collect only above or below.
- The distribution of data points should not form a wavy pattern that widens then narrows and widens again.
- The distribution of dots is not patterned.

2.6. Linearity Test

The linearity test aims to find out whether two variables have a significant linear relationship or not. A good correlation should contain a relationship. According to [13], the basis for decision-making in the linearity test is by looking at the sig value of deviation from linearity. When Mark Sig. Deviation from Linearity > 0.05 linearity occurs, whereas if the value Sig. Deviation from Linearity < 0.05 there is no linearity.

Based on the SPSS 2018 software analysis. Sig Deviation from Linearity live bait is 0.698 > 0.05 (linearity occurs) and the Sig value Deviation from Linearity duration (minutes) is 0.447 >0.005 (linearity occurs) [14].

2.7. Simultaneous Effect Test (f_{test})

f_{test} is a hypothesis test in multiple linear regression. ftest aims to determine the influence of variable X simultaneously (together or combined) on variable Y. The data has been analyzed with SPSS 2018 software to test can be seen in the "Anova" table. The hypothesis proposed in ftest is that there is the influence of live bait (X_1) and duration (minutes) (X_2) simultaneously on the catch (Y) [15].

Two ways can be used as a template to do f_{test}. First, by comparing the significance value (sig.) or probability value in the "Anova" table output. The second way is to compare the F_{count} with F_{table}. Based on the significance value (sig.), if the sig. value is <0.05 then the hypothesis is accepted, meaning live bait (X_1) and duration (minutes) (X_2) has a simultaneous effect on catch results (Y). If the sig. value is > 0.05 then the hypothesis is rejected, meaning the bait is live (X_1) and duration (minutes) (X_2) simultaneously does not affect catch yield (Y) [16].

2.8. Partial Effect Test (t_{test})

t_{test} is one of the research hypothesis tests in simple linear regression and multiple linear regression analysis. t_{test} aims to find out whether the independent variable or independent variable (X) partially influences the dependent variable or dependent variable (Y) [17]. There are two references used as a basis for decision making, first by looking at the significance value (Sig.), and second by comparing the value t_{count} with t_{table}. Based on the significance value (Sig.) If the

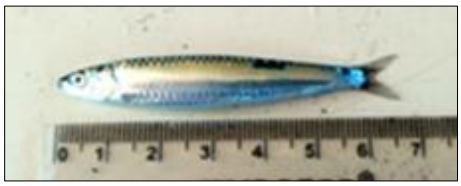
value (sig.) <0.05 then there is an influence of the independent variable (X) on the dependent variable (Y), the hypothesis is accepted. However, if the value (sig.) > 0.05 then there is no influence of the independent variable (X) on the dependent variable (Y), the hypothesis is accepted.

3. Results and discussion

3.1. Types of bait used during research

The types of fish that are often used as live bait during research in the Maluku Sea can be seen in Figure 1 below:

Stolephorus commersonii



Sardinella fimbriata

Figure 2 Types of bait used

In general, anchovies (*S. commersonii*) are the best type of fish to use as live bait [18]. This is because these fish have a long life expectancy when crowded in a bait tank are of the appropriate size and remain active when thrown into the sea. Judging from the eating behaviour of skipjack tuna, the size of the gliding type is the bait that suits the tastes of skipjack tuna, with a silvery white colour when exposed to sunlight [19]. *S. fimbriata* and *S. commersonii*) are a type of fish that is widely used as live bait [20].

3.2. Composition of Catch

The catch during the research was 26,907 kg with the composition of ~~skipjack tuna~~ *K. pelamis* at 22,313 kg (81%) ~~yellowfin tuna~~ *T. albacares* at 5,320 kg (19%) and ~~lemadang~~ *C. hippurus* fish 68 kg (0%) using 8,358 kg live bait. The following is a pie chart of catch composition.

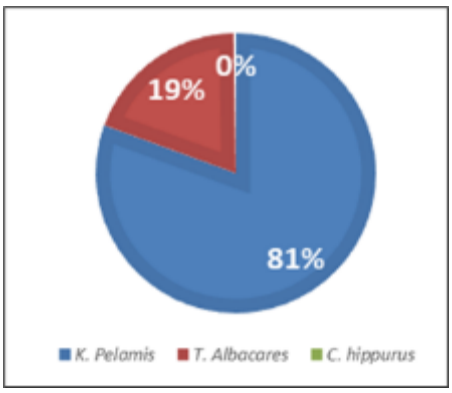


Figure 3 Composition of catch during research

3.3. Analysis of the Effect of Live Bait and Fishing Time on Catch Results

Regression in the modern sense according to [21], is a study of the dependence of a variable on one or more other variables. Statistical analysis is used to determine the relationship between live bait and fishing time on catches. The variables analyzed include live bait (X_1) and duration (X_2) is the independent variable while the catch (Y) is the dependent variable.

The relationship between live bait and duration on catch results was analyzed using multiple linear regression *software* SPSS 2018. Before carrying out regression, there are several classic assumptions that must be met by research data to obtain a good regression model, namely: data normality test, multicollinearity test, heteroscedasticity test and linearity test. The following are the results of the classic assumption test for data from research.

Table 1 The catch is based on the amount of live bait and fishing time on the catch

No	Setting (times)	Bait quantity (kg)	Catches (kg)		
			K. pelamis	***T. albacares***	**Total**
1	5	990	2,469	90	2,567
2	6	687	2,569	200	2,128
3	7	1,662	2,692.6	517.7	2,210
4	5	1,182	1,679.7	120	1,696
5	8	1,095	3,134.3	185.5	3,320
6	5	1,359	8,397	3200	11,609
7	5	1,383	2,371.4	1006.6	3,377
Total	41	8,358	22,313	5,320	26,907

3.4. Normality Test

Based on the results of the testing carried out by the author using *the software* SPSS 2018. Obtained asymp value results. Sig. 0.082 > 0.05 means the research data conducted by the author is normally distributed. For more clarity, see table 2.

Table 2 Normality Test

One-Sample Kolmogorov-Smirnov Test		**Unstandardized Residual**
N		**41**
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	1.85490191E3
Most Extreme Differences	Absolute	.197
	Positive	.197
	Negative	-.100
Kolmogorov-Smirnov Z		1.263
Asymp. Sig. (2-fish)		.082
a. Test distribution is Normal.		
b. Calculated from data.		

3.5. Multicollinearity Test

Based on the multicollinearity t_{table}, the tolerance value for live bait and duration is 0.986 > 0.10, so there is no multicollinearity between the two independent variables. So the research data that the author got can be analyzed using

multiple linear regression. Based on the VIF value (*Variance Inflation Factor*) is 1.015 more than 10. So it can be concluded that there is no multicollinearity between the independent variables using the regression model.

Table 3 Multicollinearity Test

Coefficients[a]								
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**	**Collinearity Statistics**	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-282.485	675.975	.	-418	.678		
	Live bait	8.546	2.342	.509	3.649	.001	.986	1.015
	Duration	3.564	7.366	.067	.484	.631	.986	1.015
a. Dependent Variable: catch								

3.6. Heteroscedasticity Test

The following table is the result of the heteroscedasticity test by looking at the scatterplot image pattern resulting from the SPSS output.

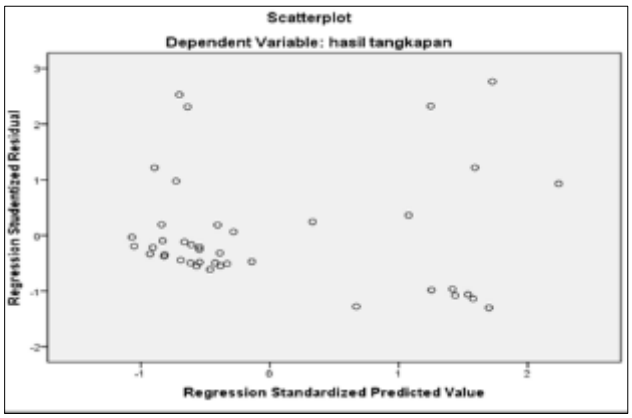


Figure 4 Heteroscedasticity test results

3.7. Linearity Test

So the data that the author has meets the classic assumptions for carrying out regression.

Table 4 Live Bait Linearity Test

ANOVA TABLE							
			Sum of squares	**Df**	**Mean square**	**F**	**Sig**
catch* live bait	between groups	J_x (combined)	1.51238	31	4875968.877	1.160	.432
		L_i linearity	5.05037	1	5.05037	12.018	.007
		Deviation from linearity	1.00737	30	3355283.520	.799	.698
	within group		3.78237	9	4201773.127		
	Total		1.89038	40			

Table 5 Duration Test (Fishing times)

Anova table							
			sum of squares	**Df**	**Mean square**	**F**	**Sig**
Catch* duration minutes	between groups	Jx (combined)	1.45338	30	4843253.025	1.109	.457
		Li linearity	3126166.024	1	3126166.024	.716	.417
		Deviation from linearity	1.42238	29	4902462.922	.1.123	.447
	within group		4.36737	10	4367340.258		
	Total		1.89038	40			

3.8. Simultaneous Effect Test (F_{test})

Based on the comparison of F_{count} against F_{table}, if $F_{count} > F_{table}$ then the hypothesis is accepted, meaning the bait is live (X_1) and duration (minutes) (X_2) simultaneously influences the catch (Y). On the other hand, if $F_{count} < F_{table}$, then the hypothesis is rejected, meaning the bait is live (X_1) and duration minutes (X_2) simultaneously does not affect the catch (Y).

Table 6 ANOVA

ANOVA[b]						
Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
1	Regression	5.13437	2	2.56737	7.088	.002[a]
	Residual	1.37638	38	3621748.531		
	Total	1.89038	40			

Based on the SPSS output table above, it is known that the sig value is 0.002. So the sig. value is 0.002 < 0.05, it can be concluded that the hypothesis is accepted where live bait (X_1) and duration (minutes) (X_2) simultaneously influence the catch (Y). For comparison value of F_{table} of 7.088 and a F_{table} 3.24 then 7,088 > 3.24 it can be concluded that the hypothesis is accepted or in other words live bait (X_1) and duration (minutes) (X_2) simultaneously influence the catch.

After knowing whether there is a relationship between live bait (X_1) and duration (minutes) (X_2) on the catch, the next step is to determine what percentage (%) influences the live bait variable (X_1) and duration variable (minutes) (X_2) simultaneously (together) on the catch variable (Y). For this reason, we refer to the R square value contained in the results of the multiple linear regression analysis in the "model summary" table, for more details, see the following:

Table 7 Model Summary (F_{test})

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	521[a]	0,272	0,233	1903.08921

Based on the SPSS "Model Summary" output table above, it is known that the coefficient of determination or R Square value is 0.272. The value of the coefficient of determination (R Square) is 0.272 or equal to 27.2%. This number means that the live bait variable (X_1) and duration (minutes) (X_2) simultaneously had an effect of 27.2% on catch results. Meanwhile, the remaining 72.8% was influenced by other factors that were not researched.

3.9. Partial Effect Test (t_{test})

Based on a comparison values of t_{count} with t_{table}. If the value of $t_{count} > t_{table}$ then there is an influence of the independent variable (X) on the dependent variable (Y) or the hypothesis is accepted. If the value of $t_{count} < t_{table}$ then there is no influence of the independent variable (X) on the dependent variable (Y) or the hypothesis is rejected. In this research there are two hypotheses, namely, H_0 there is an influence of live bait on catches and H_1 There is an influence of duration (minutes) on catch results.

Based on data analysis carried out using SPSS 2018 software, the value (sig.) for live bait is 0.001 where 0.001 < 0.05 so accepting H_0, there is an influence of duration (minutes) on fish catches. For analysis of duration data (minutes), a value (sig.) of 0.631 was obtained, where 0.631 > 0.05, so reject H_1, there is no effect of duration (minutes) on catch results.

Based on a comparison of t values count with ttable results obtained for live bait (X_1) is 3,649 with value a t_{table} 2.024 then 3.649 > 2.024 accept H_1, there is an influence of live bait on catches. For value the t_{count} duration (minutes) (X_2) is 0.484 with value a t_{table} 2.024 then 0.484 < 2.024 reject H_2, there is no effect of minute duration on catch results. For more details on the values (sig.) and t_{count} can be seen in the following table:

Table 8 Partially Effect (t_{test})

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	-282.485	675.975		-0,418	0.678
	Live bait	8.546	2.342	0,509	3.649	0.001
	Duration (minutes)	3.564	7.366	0,067	0.484	0.631

Based on the table above, it can be concluded that live bait partially influences the catch, while duration (minutes) does not affect the catch. According to [22], Fishing time has a very small coefficient of determination so this relationship cannot be used to estimate fishing speed based on fishing time.

Table 9 Model Summary (t_{test})

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	521[a]	0.272	0.233	1903.08921

In accordance with the results of regression analysis with SPSS 2018 software, H_1 It is accepted that live bait influences catch results. The magnitude of the effect can be seen in R_2 namely 0.272 or 27.2%. These results are by research.

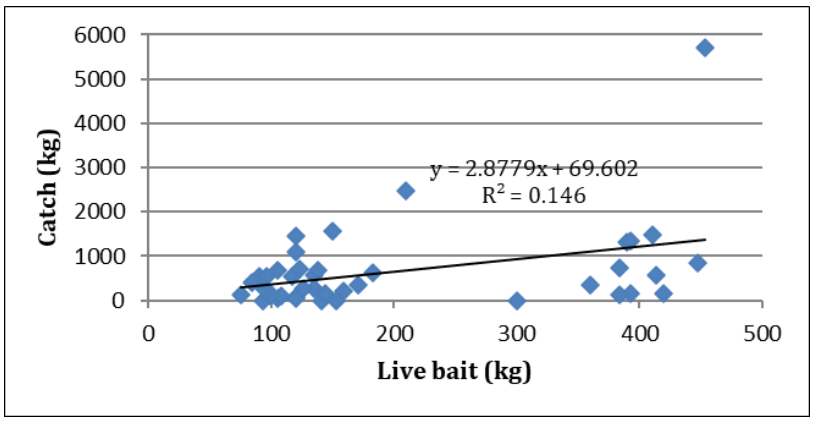


Figure 5 Graph of live bait against catch.

In the graph above, H_1 is accepted stating that live bait influences catch results. According to [23], Live bait is a limiting factor in catching *K. pelamis*. Based on the results of regression analysis with SPSS 2018 software, H_2 is rejected So it was concluded that there was no influence between the duration of fishing and the catch. According to [24], Fishing time has a very small coefficient of determination so this relationship cannot be used to estimate fishing speed based on fishing time.

4. Conclusion

Based on research conducted, live bait and fishing duration simultaneously had a 27.2% influence on catch results. Live bait partially influences the catch. The duration of fishing does not affect the catch.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclose.

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