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The Effect of Climate Change on Captured Fish Production in Batam

Pengaruh Perubahan Iklim Terhadap Produksi Ikan Tangkap Di Kota Batam

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ABSTRACT

Batam is one of the cities in Indonesia which is located in a strategic area which is on international shipping lanes and has a sea area of 3,675 km2, so it has enormous potential in the field of marine fisheries resources. The catch of fishermen is strongly influenced by wind, temperature and rainfall. However, the main factor that is often a problem for fishermen at sea is global warming which is increasing which causes changing patterns of wind, temperature and rainfall to become erratic which makes it difficult for fishermen to catch fish. This study aims to describe the effect of temperature, wind speed and rainfall on capture fish production in the city of Batam. The research method used is quantitative using the time series regression test which was analyzed starting from January 2016 to December 2020 with the variables analyzed being temperature (X_1), wind speed (X_2), rainfall (X_3) and capture fisheries production (Y). The results of the partial test show that the relationship between wind speed (X_2) and rainfall (X_3) to Y is negative, meaning that the higher the wind speed (X_2) and rainfall (X_3), the less catch fish production (Y) will be. While the partial test results show that temperature (X_1), wind speed (X_2) and rainfall (X_3) together have a significant effect on capture fisheries production (Y) in the city of Batam.

ABSTRAK

Kota Batam merupakan salah satu kota di Indonesia yang terletak di wilayah strategis yang berada di jalur pelayaran internasional dan memiliki luas wilayah laut sebesar 3.675 km sehingga memiliki potensi yang sangat besar dalam bidang sumberdaya perikanan laut. Hasil tangkapan nelayan sangat dipengaruhi oleh angin, suhu dan curah hujan. Akan tetapi faktor utama yang sering menjadi permasalahan oleh nelayan dalam melaut adalah pemanasan global yang semakin meningkat menyebabkan pola perubahan angin, suhu dan curah hujan menjadi tidak menentu yang mengakibatkan nelayan sulit melakukan penangkapan ikan. Penelitian ini bertujuan untuk mendeskripsikan pengaruh suhu, kecepatan angin dan curah hujan terhadap produksi ikan tangkap di kota Batam. Metode penelitian yang digunakan yaitu kuantitatif dengan menggunakan uji regresi time series yang dianalisis mulai dari bulan Januari 2016 sampai Desember 2020 dengan variable yang dianalisis adalah suhu (X_1), kecepatan angin (X_2), curah hujan (X_3) dan produksi perikanan tangkap (Y). Hasil pengujian parsial menunjukkan hubungan antara

kecepatan angin (X_2) dan curah hujan (X_3) terhadap Y adalah negatif artinya adalah semakin tinggi kecepatan angin (X_2) dan curah hujan (X_3) maka produksi ikan tangkap (Y) akan semakin sedikit. Sedangkan hasil pengujian parsial menunjukkan bahwa suhu (X_1), kecepatan angin (X_2) dan curah hujan (X_3) secara bersama-sama berpengaruh signifikan terhadap produksi perikanan tangkap (Y) di kota Batam.

Kata Kunci	*Produksi Perikanan Tangkap, Suhu, Kecepatan Angin, Curah Hujan*
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INTRODUCTION

Indonesia is a country that has the largest maritime area in the world, where two-thirds of its total territory consists of waters. Indonesia has 18,306 islands connected by sea with a coastline of 81,000 km. As an archipelagic country, the potential for marine resources in Indonesia is very large, including fish wealth (Widyastini & Dharmawan, 2013). Batam City is one of the cities in Indonesia which is located in a strategic area and is on international shipping routes. This city has a sea area of 3,675 km and has enormous potential in the field of marine fisheries resources (BPS, 2016). Fisheries resources become significant assets for the country if they are managed well and provide optimal benefits to the community (Imelda et al., 2019). Capture fisheries play a very important role in the welfare of society, both at the local and national levels (Cintra et al., 2017), which is reflected in three roles, namely as a source of economic growth, a source of food, especially animal protein, and a provider of labor (Triaso, 2012).

Fishermen's catches are greatly influenced by wind, temperature and rainfall. When sailing, fishermen pay close attention to weather conditions so they can catch lots of fish and not face storms/bad weather when going to sea. However, the main factor that often causes problems for fishermen when going to sea is global warming which of course can affect fishermen's production or catches because the effects of global warming result in shifts in seasons due to climate change (Azizi et al., 2017). Climate change manifests itself in the form of increasing water temperatures, changes in rainfall and water availability, increasing the frequency and intensity of storms, and so on. All of this has an impact on fisheries production (both capture and cultivation) and fish biodiversity (Rahardjo, 2014). As a result of increasing global warming, changing patterns of wind, temperature and rainfall become erratic, making it difficult for fishermen to catch fish.

The urgency in this research is the uncertain weather conditions so that fishermen find it difficult to understand the weather conditions when they want to catch fish at sea. As a result, many fishermen find that when they catch fish, fish production is not optimal due to sudden changes in weather. Research needs to be conducted on the influence of climate change on fishermen's fish catches in the city of Batam so that it can be taken into consideration by fishermen in understanding weather conditions to be able to produce fish more optimally. So this research will explain how climate change affects the production of caught fish in Batam.

METHODS

Time and Place Reseach

The location in this research is the marine waters of the city of Batam. The data used is secondary data originating from the relevant agency, namely the Central Statistics Agency (BPS) of Batam city. The data collected includes temperature, rainfall, wind speed and caught fish production taken from 2016 – 2020.

Data analysis

This research includes quantitative research using time series regression analysis with several test requirements that must be met, namely: descriptive analysis, normality test, heteroscedasticity test and multicollinearity test. The variables in this research are temperature (X1), wind speed (X2), rainfall (X3) and capture fisheries production (Y). The hypothesis is as follows:

H1 : Temperature (X1) significantly influences capture fisheries production (Y).
H2 : Wind speed (X2) significantly influences capture fisheries production (Y).
H3 : Rainfall (X3) significantly influences capture fisheries production (Y).
H4 : Temperature (X1), wind speed (X2) and rainfall (X3) together significantly influence the production of capture fisheries (Y).

Based on the hypothesis above, it can be depicted in the following diagram:

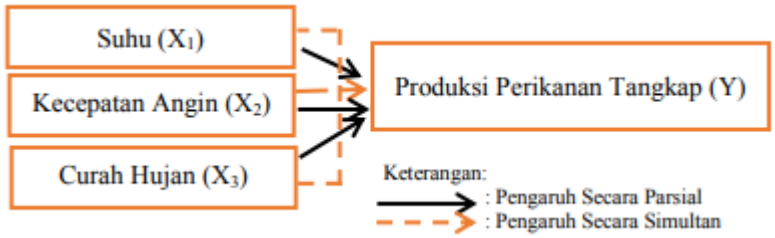

Figure 1. Research Diagram

RESULT AND DISCUSSION

Result

After the data is obtained, it is then processed and interpreted with the following explanation:

Descriptive Analysis

Table 1. Descriptive Analysis

	X1	X2	X3	Y
Mean	27.77367	4.506667	178.7967	2948.267
Median	27.72500	4.000000	177.8500	555.5000
Maximum	29.20000	8.720000	483.6000	15155.00
Minimum	26.23000	1.000000	7.400000	10.00000
Std. Dev.	0.609248	1.696739	114.0603	4234.149
Skewness	0.215612	0.782681	0.513043	1.288676
Kurtosis	3.014304	3.133345	2.648325	3.221139
Jarque-Bera	0.465395	6.170354	2.941318	16.72910
Probability	0.792393	0.045722	0.229774	0.000233
Sum	1666.420	270.4000	10727.80	176896.0
Sum Sq. Dev.	21.89979	169.8565	767575.2	1.06E+09
Observations	60	60	60	60

Normalitas Test

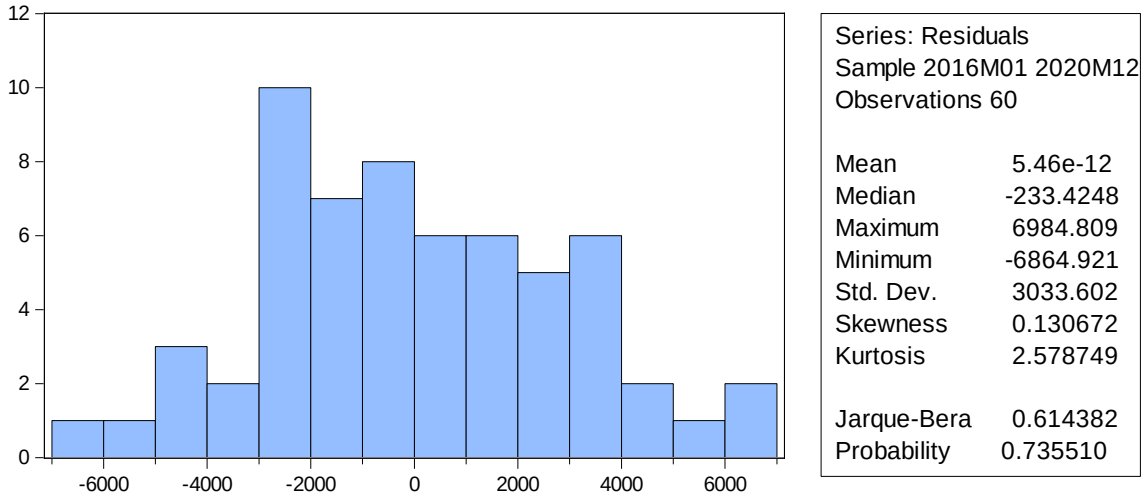

Figure 2. Normality Test Results

In regression analysis, normality testing is carried out on the residuals. The results of the classical assumption of normality test on residuals in this study obtained a significance value of 0.73 (0.73 > 0.05). So it can be concluded that the data used in this research follows a normal distribution.

Heteroscedasticity Test

Table 2. Heteroscedacticity Test

Heteroskedasticity Test: Glejser

F-statistic	4.630035	Prob. F(3,56)	0.0058
Obs*R-squared	11.92453	Prob. Chi-Square(3)	0.0076
Scaled explained SS	10.18474	Prob. Chi-Square(3)	0.0171

Test Equation:
Dependent Variable: ARESID
Method: Least Squares
Date: 06/08/23 Time: 16:38
Sample: 2016M01 2020M12
Included observations: 60

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11653.29	12009.50	0.970339	0.3361
X1	-391.1657	425.7868	-0.918689	0.3622
X2	-328.4034	444.6940	-0.738492	0.3010
X3	-1.876972	2.282796	-0.822225	0.4144

Based on Table 2 above, it can be seen that the regression significance value using the residual absolute value as the dependent variable has a significance value for all variables greater than 0.05. This shows that heteroscedasticity does not occur in the regression model, so the model is suitable for use in testing.

Multicollinearity Test

Table 3. Multicollinearity Test

	Correlation		
	X1	X2	X3
X1			
X2	0.240309	1.000000	-0.254425
X3	-0.583352	-0.254425	1.000000

Based on Table 3 above, the test results show that the correlation of all independent variables has a value smaller than 0.5. This means that the variables in this study do not show any symptoms of multicollinearity in the regression.

Time Series Regression Analysis

The method used in this research is time series regression. The data used is monthly data, namely data from January 2016 to December 2020. The data is shown in Table 4 below:

Table 4. Time Series Regression Analysis

Dependent Variable: Y
Method: Least Squares
Date: 06/08/23 Time: 14:49
Sample: 2016M01 2020M12
Included observations: 60

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23331.40	23266.02	1.002810	0.3203
X1	-956.8858	824.8772	-1.160034	0.2510
X2	-1656.850	248.7561	-6.660540	0.0000
X3	-7.124188	1.422464	-5.008343	0.0018

R-squared	0.686684	Mean dependent var	2948.267
Adjusted R-squared	0.659185	S.D. dependent var	4234.149
S.E. of regression	3113.799	Akaike info criterion	18.98942
Sum squared resid	5.43E+08	Schwarz criterion	19.12904
Log likelihood	-565.6825	Hannan-Quinn criter.	19.04403
F-statistic	17.69819	Durbin-Watson stat	1.649360
Prob(F-statistic)	0.000000		

Regression analysis is used to predict how far the value of the dependent variable (Y) changes, if the value of the independent variable (X) changes. The regression results in this study are shown as follows:

$$Y = 23331.4 - 956.8858\ X1 - 1656.85\ X2 - 7.124188\ X3$$

Partial Test Results

Based on the results of the partial test, the independent variable (X) that significantly influences the dependent (Y) is wind speed (X2) and rainfall (X3) with a significance value of less than the real level (0.05). The coefficients of wind speed (X2) and rainfall (X3) are negative, which means the relationship between wind speed (X2) and rainfall (X3) on

capture fisheries production (Y) is negative, meaning the higher the wind speed (X2) and rainfall (X3), the production of caught fish (Y) will be less.

Simultaneous Higher

Simultaneous test results show that the variables temperature (X1), wind speed (X2) and rainfall (X3) have a significant influence simultaneously on Y. This can be seen from the significance value being smaller than α or 0.05, which indicates that temperature (X1), wind speed (X2) and rainfall (X3) together have a significant effect on capture fisheries production (Y) in Batam city.

Disscusuion

Based on the results of the data analysis above, it is clear that the higher the wind speed (X2) and rainfall (X3), the less fish production will be. This is in line with the statement Sari et al., (2022) which explains that one of the factors causing a decrease in fish catches is wind speed. Wind speed is directly proportional to wave height, the greater the wind speed, the higher the waves formed and vice versa. The size of the waves can affect fishing operations because they can prevent ships from going on fishing trips, thus affecting the frequency of fishing operation trips. This statement is reinforced by Prasetyo et al., (2017) who explains that fish production increases when wind speed decreases, conversely if wind speed is high then fish production decreases.

Meanwhile, the next factor that influences the production of caught fish is rainfall, because rainfall greatly influences the number of trips and fish catches. If it rains during fishing operations, it will have an impact on the amount of setting and hauling carried out so that fish catches can decrease. So, increasing rainfall intensity will cause fish catches to decrease (Rais et al., 2015). This statement is in line with Lukum et al., (2023) who explains that high rainfall can have an impact on fisheries catches being reduced due to bad weather in the middle of the sea such as waves in the sea becoming high due to currents and winds around the sea making fish swim. rather deep to avoid accumulation of fresh rainwater.

Yogiswara & Sutrisna (2021) explained that wind speed and rainfall also affect fishermen's safety because high wind speed causes an increase in sea wave height which can have a negative impact on fishermen's catches and have a negative impact on fishermen's safety. High waves can also destroy boats and can cause boats used by fishermen to capsize. The same thing also applies to high rainfall which can cause fishing boats to sink because they accommodate too much water discharge from rain and water discharge from sea water entering from between the boats, and another problem is that during high rainfall fishermen will be more it is difficult to see the conditions around it. These factors cause fishermen to be reluctant to go to sea on rainy days, and ultimately fish production will decrease due to high rainfall. Lusiani et al., (2018) added that the impact of climate change on fishing communities is changes in the volume of catch each month and changes in the number of months at sea, with months not going to sea for fishermen making fishermen have no income, causing economic losses.

CONCLUSSION AND SUGGESTION

Partial test results show that the relationship between wind speed (X2) and rainfall (X3) on Y is negative, meaning that the higher the wind speed (X2) and rainfall (X3), the lower the production of caught fish (Y). Meanwhile, partial test results show that temperature (X1), wind speed (X2) and rainfall (X3) together have a significant effect on capture fisheries production (Y) in Batam city.

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