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PENGARUH LANGSUNG DAN TIDAK LANGSUNG PERSEPSI PERUBAHAN IKLIM TERHADAP HASIL TANGKAPAN NELAYAN

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ABSTRACT

Keywords	Abstract
Hasil Tangkapan; Madura Nelayan; Persepsi; Perubahan Iklim	Sektor perikanan berkontribusi terhadap ketahanan pangan, pengentasan kemiskinan, dan peningkatan kesejahteraan. Akan tetapi, saat ini nelayan menghadapi tantangan serius, salah satunya yaitu perubahan iklim yang dapat mengganggu kegiatan penangkapan ikan. Sehingga, penting untuk mengetahui persepsi nelayan terhadap fenomena perubahan iklim, karena mempengaruhi keputusan beradaptasi mereka. Tujuan penelitian ini untuk mengetahui pengaruh langsung dan tidak langsung persepsi perubahan iklim terhadap hasil tangkapan nelayan di Desa Paconggongan, Kabupaten Sumenep dan Desa Banyuangkah, Kabupaten Bangkalan. Teknik penentuan sampel menggunakan simple random sampling dengan total sampel sebanyak 100 responden. Metode yang digunakan meliputi analisis deskriptif dan analisis jalur (path analysis). Hasil analisis menunjukkan bahwa nelayan di Desa Banyuangkah dan Paconggongan memiliki tingkat persepsi sedang terhadap perubahan iklim dan risikonya. Hasil analisis jalur menunjukkan bahwa persepsi perubahan iklim berpengaruh langsung pada adaptasi dan hasil tangkapan nelayan. Persepsi risiko perubahan iklim berpengaruh langsung pada adaptasi dan berpengaruh tidak langsung pada hasil tangkapan melalui adaptasi. Adaptasi perubahan iklim berpengaruh langsung pada hasil tangkapan sedangkan informasi iklim dan pengalaman nelayan tidak berpengaruh terhadap adaptasi maupun hasil tangkapan nelayan. Sehingga kegiatan penyuluhan mengenai risiko perubahan iklim dan strategi adaptasi harus dilakukan.

ABSTRACT

Keywords:	Abstract
Catch Madura; Fisherman; Perception; Climate Change.	The fisheries sector contributes to food security, poverty alleviation, and improving welfare. However, fishermen face serious challenges from climate change which can disrupt fishing activities. Therefore, its important to know fishermen's perceptions of climate change phenomenon, because it can affect their adaptation decisions. This study aims to determine the direct and indirect effects of climate change perceptions on fishermen's catches in Paconggongan Village, Sumenep and Banyuangkah Village, Bangkalan. The sampling technique used simple random sampling with a total sample of 100 respondents. The methods used include descriptive analysis and path analysis. The analysis shows that fishermen in Banyuangkah and Paconggongan have a moderate level of perception of climate change and its impacts. The results of path analysis show that perception of climate change has a direct effect on adaptation and fishermen's catch. Perception of climate change impacts has a direct effect on adaptation and an indirect effect on catch through adaptation. Climate change adaptation has a direct effect on catch, while climate information and fishermen's experience have no effect on adaptation or catch. Therefore, counseling activities on the impacts of climate change and adaptation strategies must be carried out.

INTRODUCTION

Small-scale fisheries play an important role in strengthening food security, reducing poverty, and improving welfare in developing countries, including Indonesia (N'Souvi et al., 2024). As the largest archipelago, Indonesia depends on the fisheries sector as a source of economic growth, a source of food, and a provider of employment, especially in coastal areas (Kusdiantoro et al., 2019). From 2019 to 2023, the contribution of the fisheries sector to East Java's GRDP in agriculture, forestry, and fisheries increased every year, where in 2023 it contributed 21% after food crops, and livestock (BPS Jawa Timur, 2024). his shows the importance of the fisheries sector in the regional and national economy, as well as its role in supporting food security and the welfare of coastal communities in Indonesia.

Bangkalan and Sumenep are districts that contribute to the fisheries Gross Regional Domestic Product (GRDP) in East Java. This is because both districts are located near the coast, so they have considerable potential for fishery products (Az Zachra et al., 2023; Ramdhani et al., 2024). The high potential of fisheries can be seen through the total production of capture fisheries in 2022, where Sumenep district contributed 42.7% and Bangkalan district contributed 23.8% of the total fish catch on Madura Island (BPS Jawa Timur, 2024). This is the first and second highest production compared to other districts in the Madura region. However, small-scale fishers in Sumenep and Bangkalan face serious challenges.

One of the challenges faced by fishers is climate change. Risks from climate change, such as rising sea temperatures, changing rainfall patterns and sea level rise, pose significant risks to Indonesia's marine economy. These phenomena result in changes in fishing season patterns, fishing locations, as well as increased risk of going to sea due to extreme weather (Madhanagopal & Pattanaik, 2020). In addition, changes in ocean temperature and salinity affect fish move to cooler waters, which in turn puts fishers' production and income at risk (Donadi et al., 2023; Febryanti, 2023). Climate change risks not only threaten the sustainability of fisheries resources but also affect the livelihoods and food security of small-scale fishers who depend on the fisheries sector. Therefore, effective mitigation and adaptation measures are needed to ensure the sustainability of fisheries as well as the welfare of fishers in the future (Muringai et al., 2022).

It is important to know how fishers perceive climate change, because fishers' perceptions are very influential in designing effective adaptation strategies and will affect fishers' decisions whether to adapt or not (Ayisi et al., 2024; Rais et al., 2024). According to Bradley et al. (2020) climate change perception is how a fisher assesses the threat posed by climate change. If a fisherman perceives climate change as a threat and disrupts fishing activities, then the fisherman has a high climate change risk perception. The higher the risk assessment of climate change by fishers, the more likely they are to take adaptation actions. Therefore, perceptions play an important initial role in assessing climate change threats and influence how fishers will respond or psychologically adapt to the challenges faced. Lack of awareness, information, and knowledge about climate change will result in failure in the adaptation process (Mulyasari et al., 2021). Fishermen who implement adaptation strategies to climate change generally experience positive risks to their income, so adaptation strategies play an important role in fishermen's income (Rahman et al., 2021).

Research that addresses the influence of climate change perceptions on fishermen's catches, both directly and indirectly, is still limited. Previous studies, such as those conducted by Ayisi et al. (2024); Metcalfe et al. (2020); Mulyasari et al. (2023); Silga et al. (2021), show that fishers have realized the existence of climate change that causes fluctuations in fish catches. Fishermen's perception of climate change is also considered the main factor that encourages fishermen to carry out adaptation responses. Meanwhile, Rahman et al., (2021), explained that adaptation strategies have a positive and significant impact on catches. However, these studies have not examined how fishermen's perceptions of climate change can influence their adaptation decisions, as well as how these adaptations can affect fish catches. Based on this background, this study aims to analyze the direct and indirect effects of climate change perceptions on fishers' catches in Paconggongan Village, Sumenep District and Banyuangkah Village, Bangkalan District.

METHODS

This research was conducted in Banyuangkah Village, Bangkalan District and Paconggongan Village, Sumenep District with fishermen respondents. The location selection

was done purposively with the consideration that Sumenep and Bangkalan districts are the districts with the first and second highest production on Madura Island, which amounted to 42.7% and 23.8% of the total fish catch on Madura Island (BPS Jawa Timur, 2024). Paronggongan Village and Banyurangkah Village were chosen because the entire Paronggongan and Banyurangkah communities work as fishermen, and there are fishing ports located in both villages, namely UPT PPP Paronggongan and PPI Banyurangkah, so there are fishermen's economic activities and have abundant fishery potential (Sinthia et al., 2023). This research was conducted in August-December 2024.

In this study, the data used consisted of primary data and secondary data. Primary data were obtained through interviews by asking questions in accordance with the questionnaire to collect data on fishermen's perceptions of climate change phenomena, climate change risks, the amount of catch, and fishermen's adaptation strategies. Secondary data were obtained through literature studies and related agencies, such as the Sumenep and Bangkalan District Marine and Fisheries Offices, and the Meteorology, Climatology and Geophysics Agency (BMKG), to collect weather data.

The sampling method, using the simple random sampling method, where the entire population is known and has the same opportunity to be selected as a sample (Sekaran & Bougie, 2016). This method was chosen because it is the simplest method, can overcome biases that arise in the sampling process, and can generalize the research results (Hair et al., 2020). The population of this study were all fishermen in Paronggongan Village, Sumenep Regency and Banyurangkah Village, Bangkalan Regency, namely 1,274 in Paronggongan Village and 4,000 in Banyurangkah Village, so that the total population of fishermen was 5,274 people. Then from the population, a sample of 100 fishermen was taken. The amount was obtained through calculation using the Slovin formula. Where n is the number of samples, N is the population, and e is the critical value (error limit) (Amin et al., 2023).

The data analysis method in this research is adjusted to the research objectives. The first method is descriptive quantitative. Descriptive analysis is used to explain or describe the information that has been obtained in accordance with the results in the field, in order to answer fishermen's perceptions of climate change phenomena that occur. The second method is quantitative analysis, to determine the effect of climate change risk perception on fishermen's catch. The method used is path analysis with the help of Stata 14 application for data analysis processing. According to Ghodang, (2019), path analysis is a development model of multiple regression used to analyze the relationship between independent and dependent variables that not only measures the direct effect of one variable on another, but also the indirect effect of these variables. Path analysis is used because it can explain more deeply the cause-and-effect relationship between several variables, this analysis is usually described by a path diagram. Table 1 shows the variables used in this study.

Table 1
Variable Description

Variables	Description	Measurement
PR	Production	Fishermen's catch in 1 month (Kg)
CCA	Climate Change Adaptation	Adaptations made by fishermen to deal with climate change with indicators including adjustments to fish species, fishing gear and locations, development of extreme weather resistant boats, variations in fishing gear, adjustments to fishing time, family involvement, and insurance ownership (1 if adapted, 0 if not adapted).
AW	Awareness	Fishermen's perception of climate change phenomena with indicators including the frequency of long droughts, heavy rains, storms, changes in wind speed, sea level height, coastal erosion, sea surface temperature, and tidal flooding (1 if greatly decreased to 5 if greatly increased).
RP	Risk Perception	Fishers' perceptions of climate change risks with indicators including decreased fish catch, changes in fish distribution and population, risk of tidal waves, disturbance due to coastal erosion and tidal flooding, and the importance of external support for fishers' adaptation (1 if disagree to 5 if strongly agree). adaptation (1 if strongly disagree to 5 if strongly agree)
CI	Climate Information	1 if fishermen get climate information 0 if fishermen do not get climate information
EXP	Experience	Number of years working as a fisherman (years)

Path analysis is said to be valid if it meets the classical assumption test, namely normality test, heteroscedasticity test, and multicollinearity test. The normality test aims to determine whether the data is normally distributed, with the criteria that the Kolmogorof Smirnov value> 0.05, the data is normally distributed. The heteroscedasticity test is carried out to state the difference in variance in the residuals, with the criteria if the sig value> 0.05 then there is no heteroscedasticity. Multicollinearity test is used to determine the correlation between independent variables, with the criteria that the VIF (Varian Inflation Factor) value is < 10 and the tolerance value is > 0.1, then there is no multicollinearity (Nugraha, 2022). After the classical assumption test is fulfilled, the next step is to conduct path analysis with the R test (coefficient of determination), F test (simultaneous), and T test (partial) to determine the relationship between the independent (X) and dependent (Y) variables. The basis for decision making to answer the objectives of this study is if the sig value <0.05 then the variable has an effect, otherwise if the sig value> 0.05 then the variable has no effect (Nabila et al., 2023).

The first stage in this analysis is to test the influence of climate change perception variables, climate change risk perception, climate information, and fisher experience on

adaptation. Next, analyze the influence of variables of perceived climate change, perceived risk of climate change, climate information, fisher experience, and adaptation on catch. After that, determine the variables that indirectly affect the catch through adaptation.

RESULT AND DISCUSSION

Perception of Climate Change Phenomenon

Based on the results in Table 2 regarding fishermen's perceptions of climate change phenomena, it can be seen that the majority of fishermen have realized an increase in the frequency of long droughts, heavy rains, storms, wind speed, sea level rise, and sea temperature changes with an average value above 50%. According to fishermen in Banyurangkah Village and Paronggongan Village, the dry season lasts longer than in previous years, so the frequency of dry season is more than rainy season. In line with BPS data, rainfall from 2005 to 2023 decreased by 29.7% (BPS Jawa Timur, 2024). However, when entering the rainy season, the intensity of rainfall becomes heavier.

In addition, sea water temperatures are also hotter than in previous years. According to fishermen, storms also often occur with higher intensity such as strong winds that create high waves and damage fishing boats. Meanwhile, the indicator of changes in the frequency of tidal flooding and coastal erosion has decreased with an average value of less than 50%. According to fishermen in Banyurangkah Village and Paronggongan Village, tidal floods and erosion have not occurred in these villages for a long time, so according to them the frequency of tidal floods and erosion has decreased.

Table 2
Perception of Climate Change

Indicators	Mean	Validity
Current frequency of long dry spells	4,64	0,220
Current frequency of heavy rain	3,89	0,493
Current storm changes	3,84	0,248
Current change in wind speed	3,84	0,324
Current sea level change	3,4	0,577
Frequency of problems such as beach erosion in coastal areas	2,02	0,721
Current change in sea surface temperature	4,33	0,712
Current frequency of tidal flooding	1,65	0,720
Reliability Test	0,614	

Notes. Terms valid if validity> 0.197, terms reliable if reliability> 0.6

Perceptions of Climate Change Risk

Based on the results in Table 3 regarding fishermen's perceptions of climate change risks, it can be seen that the majority of fishermen perceive risks from climate change that cause a decrease in catch or hinder fishing activities. Where the majority of fishermen feel the risk due to changes in rainfall, sea water rise, temperature changes, high waves, wind direction, and storms, as well as external support with an average value of more than 50%. According to the fishermen, the risk of these changes causes less fish in the sea, because when the dry season and sea water temperature increase, the fish will hide in the deeper sea or even move to other locations. This is because fish will tend to look for cooler areas.

realized the risks of climate change will try to minimize these risks, so they tend to use more adaptation strategies.

Climate Change Adaptation

The results of the path analysis on the effect of climate change perception, climate change risk perception, climate information, fishermen's experience, and adaptation on fishermen's catch, show that climate change adaptation has a sig value of 0.001 <0.05 (Figure 1). This means that the more fishermen apply climate change adaptation strategies, the catch increases. This shows that climate change adaptation has a positive effect on fishermen's catch, which means that the more fishermen apply adaptation strategies, the catch will increase. In line with Rahman et al. (2021), who said that adaptation strategies have a positive and significant risk to fishermen's catch and income. This means that adaptation strategies can increase fish catchability and risk an increase in fishermen's income. This is because adapted fishers usually use a variety of fishing gear according to the fish species, fishers also usually change the time and adjust the location of fishing. According to Mabe & Asare (2020), the more adaptations made by fishermen, it will increase the fishing power of these fishermen.
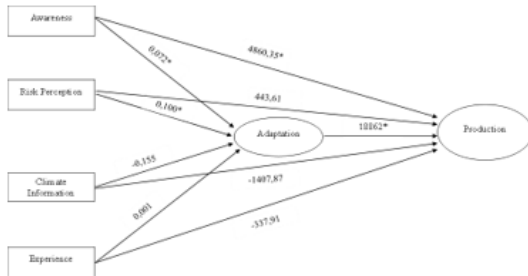

Notes: *significant at p-value level < 0.05

Figure 1
Path Analysis Results

CONCLUSION

The analysis shows that fishermen in Banyusangkah Village and Parangsongan Village are aware of climate change and its risks at a moderate level. Furthermore, path analysis shows that climate change perception variable has a direct effect on climate change adaptation, and indirectly affects fishermen's catch. Climate change risk perception variable directly affects climate change adaptation, and indirectly affects fishermen's catch through adaptation. Then the adaptation variable has a direct effect on fishermen's catch.

Meanwhile, climate information and experience variables have no effect on climate change adaptation and fishermen's catch.

RECOMMENDATION

It is recommended that village administrators conduct counseling activities on climate change risks and adaptation strategies. This counseling is expected to increase fishermen's understanding and awareness of climate change risks and the importance of adapting to climate change to maintain their catch. For future research, it is recommended to analyze factors that influence climate change perception and adaptation, such as education level, age, and income.

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