#2272 Summary

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Submission

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Status

INTRODUCTION

Climate change has become a serious global issue in recent decades due to human activities, such as fossil burning and deforestation, which have fueled temperature increases since the Industrial Revolution (Malau, 2024). These changes are characterized by long-term trends that include increases in global temperatures, changes in precipitation patterns, and changes in ambient environmental pressure and humidity (Abbass et al., 2022). Weather conditions based on rainfall, wind direction, and wind speed have a significant impact on the survival of fishermen, especially small-scale fishermen (Alberth et al., 2022). About 90% of the 3.7 million Indonesians who work as fishers are small-scale fishers who depend on coastal and marine resources for their livelihoods (Quina et al., 2022).

Small-scale fishers in the tropics are characterized by diversity in fishers' composition, target species, and types of fishing gear used (Arkham et al., 2019). This makes them increasingly vulnerable to damage to their facilities from extreme weather (Mulyasari, et al., 2020). These changes affect not only the fishing process, but also the distribution of marine products, which ultimately impacts the welfare of fishers and their families (Maurizka & Adiwibowo, 2021). The increasing frequency of large waves poses a challenge for fishers in reaching fishing locations. Unfavorable weather conditions often force fishermen to postpone fishing, which impacts their income. As a result, fishers and their families must adapt to cope with climate change (Samah & Shaffril, 2020). Fishers' responses to past changes serve as valuable tools for adapting to future changes (Powell et al., 2022). This suggests the importance of utilizing prior knowledge and experience as a strategy to improve preparedness for future changes.

Fishermen have an important role in formulating effective adaptation strategies to the impacts of climate change to minimize its impact, which requires appropriate knowledge, attitudes and skills (Sanjoto et al., 2021). Adaptability is an important aspect of dealing with climate change, which includes adjustments in natural or human systems in response to actual or expected climate change and its impacts. This adaptation aims to reduce adverse impacts or exploit existing opportunities (Okezie et al., 2021). In the context of fishermen on Madura Island, adaptation to climate change involves strategies developed based on experience and knowledge.

Interestingly, it has been suggested that older fishers tend to have more extensive experience in dealing with changing weather and uncertain sea conditions. This long experience allows them to develop a diverse portfolio of solutions, which become part of their social-ecological memory (Barnes et al., 2020). For example, experienced fishers have faced a variety of extreme situations in the past, so they tend to be better prepared and more able to adapt to changes that occur. Fishers have the ability to identify weather patterns and predict ocean conditions based on their experience, which helps them plan fishing activities more effectively.

Fishers have an important role in formulating effective adaptation strategies to the impacts of climate change and to minimize these impacts, appropriate knowledge, attitudes and skills are required (Sanjoto et al., 2021). On the other hand, although young fishers have limited experience, they have great potential to adapt to climate change. Repeated and prolonged experience in a job can increase the level of skills and knowledge (Alberth et al., 2022). The younger generation tends to be more open to the use of new technologies and more modern fishing methods, which can help them cope with the challenges caused by climate change (Sahendra et al., 2023). However, the greater vulnerability of these young fishers is also a concern, as their lack of experience may make them more susceptible to the impacts of climate change, which may ultimately reduce their motivation to continue engaging in the fisheries sector.

This research will explore how differences between older and younger fishers in terms of experience, knowledge and skills affect their adaptation strategies to climate change. In addition, this research will look at how collaboration between the older and younger generations can create more effective and sustainable adaptation strategies in the face of future climate change challenges. This research will focus on the adaptability to climate change among young and old fishermen on the coast of Madura Island.

Previous research Uman, (2020); Priyanto et al., (2021); Jabbar et al., (2023) explained the dynamics of climate change, as well as adaptation strategies carried out due to the impact of climate change. This research will focus on the adaptability to climate change among young and old fishermen in coastal areas especially in Madura Island. The findings from this study can be used as a basis to formulate policies that support the strengthening of fishermen's adaptive capacity, as well as to develop more effective training programs. This can help young fishers improve their skills and knowledge in facing the challenges of climate change. In addition, this study is also expected to contribute to the existing literature on climate change adaptation in the fisheries sector, particularly in tropical regions such as Indonesia. This study aims to analyze the adaptability to climate change among young and old fishers in coastal Madura Island.

RESEARCH METHODS

Location and Time of Research

The research was conducted in two locations, namely Banyusangkah Village in Tanjung Bumi Sub-district, Bangkalan District, and Pasongsongan Village in Pasongsongan Sub-district, Sumenep District. According to Lenaini (2021) purposive sampling is a non-random sampling method by selecting samples based on characteristics that are in accordance with the research objectives, so that it is expected to be able to answer research questions more precisely. The selection of these two villages is based on certain criteria that are relevant to the focus of the research, so that more representative information is obtained. The purposive location selection was based on the fact that Sumenep and Bangkalan districts are the first and second largest fish producers on Madura Island, contributing 42.7% and 23.8% of the total fish catch in the region, respectively (BPS East Java, 2024). In addition, both villages have fishing ports, namely UPT PPP

Pasongsongan and PPI Banyu Sangkah, which are the center of fishermen's economic activities and have abundant fishery potential. This research was conducted in June-September 2024.

Research Population and Sample

The population includes fishermen who live in Banyusangkah Village as many as 4,000 fishermen and Pasongsongan Village as many 1,274, who meet the criteria as respondents as many as 217 fishermen with the Slovin formula. Criteria for old fishermen aged 41 years and over, and for young people aged 40 years and under. The sampling technique uses a simple random sampling method. Based on the population, a random sample is selected so that all elements of the population have the same opportunity. According to Syaputra (2022) Simple Random Sampling is a sample selection technique in which each member of the population has an equal chance of being selected as part of the sample.

Types and Sources of Data

This study relies on one type of data collection, namely from primary sources. According to Nurkholis et al. (2020) data sources that directly provide information to researchers without going through intermediaries. In this study, primary data was collected directly at the research location by interviewing fishermen face-to-face. This method allows researchers to obtain accurate and in-depth information, because the data obtained comes directly from individuals who are the subject of research.

Data Analysis Method

The data analysis method used was independent t-test using the Stata14 application. This test was used to determine the difference between two age groups, namely young and old fishermen of Banyusangkah Village and Pasongsongan Village. According to Palupi et al. (2021) the Independent Sample T-test method is a statistical test used to compare the averages of two groups that are not related to each other. This unrelatedness means that the test is carried out on two groups of samples from different subjects.

Priyasudana & Cholik (2016), state that the t test is carried out with a significance level of 0.05 (α = 5%). If the significant value > 0.05, Ho is rejected (there is no difference between the adaptation of old and young fishermen). If the significant value <0.05, Ha is accepted (there is a difference between the adaptation of old and young fishermen). The formula of the t-test is as follows:

$$t = \frac{X_1 - X_2}{\sqrt{\frac{(n_1-1)s_1^2 + (n_1-1)s_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}+\frac{2}{n_2}\right)}} \tag{1}$$

Description
X_1 : Average sample of old age fishermen
X_2 : Average sample of young fishermen
s_1^2 : Sample variance of old age fishermen

s_2^2 : Variance of young fishermen sample
n_1 : Number of samples of old age fishermen
n_2 : Number of samples of young fishermen

RESULT AND DISCUSSION

Characteristics of Young and Old Fishermen

The number of fishermen consists of 107 young and 110 old fishermen. The education level of fishermen varied, ranging from no schooling to a master's degree. Fishermen's work experience ranged from a low of 20 years to a high of 39 years. Fishermen's literacy skills, i.e. the ability to read and write, were measured using dummy variables, where a value of 0 indicates "no" and a value of 1 "yes".

Table 1. Characteristics of Young Fishermen and Old Fishermen

Fisherman Category	Young		Old		Overall	
	Mean	SD	Mean	SD	Mean	SD
Age	31.355	5.130	49.090	6.680	40.345	10.697
Education	8.925	2.421	6	3.147	7.442	3.166
Experience	12.308	5.699	27.054	10.686	19.783	11.321
Able to Read (dummy)	1	0	0.854	0.354	0.926	0.261
Able to Write (dummy)	0.981	0.136	0.836	0.371	0.907	0.289

Source: Processed Primary Data (2024)

Table 1 explains that young fishers have a lower age and higher education level than old fishers, while old fishers have much more experience. Reading and writing skills are more dominant in the young fishermen group, while the old fishermen show a slight decline in both aspects. Overall, the mean scores on each variable reflect the combined characteristics of both groups, with some scores closer to the younger group, especially on education and literacy.

Fishermen's Adaptation to Climate Change

Adaptation to climate change is a major challenge in the fisheries sector, especially for fishermen who are directly affected by changes in weather patterns and sea conditions. Therefore, adaptation strategies need to be implemented by fishermen to deal with climate change conditions.

Table 2. Fishermen Adaptation Indicators

Indicators	Percentage (%)	
	Young	Old
Customizing fish species caught, fishing gear, and fishing locations	24.42	75.58
Developing boats that are more robust against extreme weather and large waves	67.74	32.26
Involving family members in the work	74.19	25.81
Using different types of fishing gear	58.99	41.01
Adjusting fishing time to weather conditions	11.98	88.02

| Adding various types of fishing gear (compa, gancip, rawe, etc.) | 58.06 | 41.94 |
| Having insurance or BPJS | 28.11 | 71.89 |

Source: Processed Primary Data (2024)

Adaptation strategies include adjusting the fish species caught, fishing gear, the use of different types of fishing gear, and fishing locations to match changes in sea temperature that affect fish migration. This is in accordance with Young et al. (2019) that fishers adjust the species of fish caught, fishing gear, fishing location, and change the type of fishing gear according to the availability of fish and changes in environmental conditions. In addition, the development of stronger boats to deal with extreme weather is needed to improve safety at sea. Forms of adaptation in developing stronger boats to face extreme weather and large waves such as carrying used drums, and adding oil to the engine because it affects engine speed when dealing with currents (Hariyati et al., 2023). Ernawati (2023) Fishermen's adaptation to climate change requires the role of all family members in managing resources for survival, by involving wives, children, and other members according to their skills and education. Having insurance or BPJS for fishermen is an important step in improving their protection and welfare, given the high risks faced when going to sea. According to Sari et al. (2022) insurance for fishermen can avoid the risk of losses due to bad weather, boat accidents, as well as pollution of the marine environment, which can cause accidents, physical injuries, and ultimately reduce or lose the income they rely on to meet family needs.

Comparative Analysis of Adaptation of Young and Old Fishermen

The test results of this analysis show that the data distribution in the young and old fisher groups follows a normal pattern, and the variance between the two groups can be considered homogeneous. With these assumptions met, the t-test analysis showed a significant difference in adaptability between young and old fishermen to climate change.

Table 3. Normality and Homogeneity Test

Variables	Obs	z	Prob>z	f value	2*Pr(F > f)
Young Age	107	1.198	0.11542	1.4553	0.0527
Old Age	110	0.073	0.52914		

Source: Processed Primary Data (2024)

In Table 3, the normality test obtained a significance value of 0.11 for the young fishermen group and 0.52 for the old fishermen group. These results indicate that the distribution of data in both groups can be considered to follow a normal distribution, as the significance value is above the commonly used limit of 0.05. Thus, the data fulfills the normality assumption required for independent t-test analysis. The Variance Ratio Test results obtained an f value of 1.4553 with a significance value on a two-sided test of 0.0527. Given that this value is slightly greater than the significance limit used of 0.05. This result indicates that the variance between the young fishermen and old fishermen groups can be considered homogeneous.

Table 4. Results of Independent T-Test Analysis of Young and Old Fishermen

Group	n	Mean	Std. Err.	Std. Dev.
Young Fishermen (0)	107	3.5607	0.1555	1.6088
Old Fishermen (1)	110	3.9636	0.1272	1.3336
Combined	217	3.7650	0.1009	1.4861
Difference (0 - 1)		-0.4029	0.2004	
t value : -2.0107		Df.: 215		P-value *(Two-tailed)* : 0.0456

Source: Processed Primary Data (2024)

Based on table 4, the p-value (two-tailed) shows a result of 0.0456, which is below the commonly used significance limit of 0.05. This result rejects the null hypothesis (H$_0$) which states that there is no average difference between the young and old fishermen groups, and accepts the alternative hypothesis (H$_a$) which states that there is an average difference. This shows that there is a difference between the adaptations made by young and old fishermen. The mean value of young fishermen is 3.5607 and the mean value of old fishermen is 3.9636. The average difference is -0.4029, so it can be concluded that the average value in the young fishermen group is lower than the old fishermen in the ability to adapt to climate change on the north coast of Madura Island. This is contrary to previous research which states that fishermen who are younger tend to be more adaptive (Rahman & Toiba, 2021; Rais et al., 2024; Samah, Azril, et al., 2019). This is because although older fishers have higher levels of adaptability and experience, they may be less likely to adopt new technologies or actively participate in decision-making (Brown et al., 2018; Cohen et al., 2016; Barnes et al., 2020). However, there are earlier studies that suggest age is considered to influence fishers' adaptation practices, where older fishers are considered to have better climate change adaptation capabilities compared to younger fishers. This is due to the extensive knowledge and experience they have gained in fishing during climate change (Shaffril et al., 2015; Ramli et al., 2018; M. Islam et al., 2014). It is necessary to increase the knowledge and experience of younger fishers in order to create more effective and sustainable adaptation strategies in facing the challenges of climate change.

CONCLUSION AND SUGGESTION

Conclusion

The conclusion of this study is that there are differences in the ability to adapt to climate change between young and old fishermen on the north coast of Madura Island. Younger fishers tend to be more adaptive to the use of new technologies and modern methods, while older fishers rely on experience and traditionally acquired skills to deal with changing weather and sea conditions. However, older fishers show higher adaptability in some instances as their long experience helps in recognizing changing weather patterns.

Suggestion

The research limitations do not consider important factors such as government policy support, economic conditions, and fishers' access to the latest technology and information that may affect their adaptation to climate change. Another limitation is the use of descriptive method, which only describes current adaptation without evaluating changes in adaptation over the long term or quantitatively measuring the impact of climate change on fishermen's catch or income over time. Future research is recommended to include an in-depth analysis of external factors that influence fishermen's adaptation to climate change, such as government policy support, access to technology, and economic conditions that can significantly affect their adaptation ability. Future research is also recommended to adopt a longitudinal approach to observe the development of fishers' adaptation over time, which will provide a clearer picture of the long-term impact of climate change on fishers' catch and income. In addition, the development of a community-based adaptation model that involves interactions between young and old fishers, as well as the active role of all family members in facing the challenges of climate change, is essential to create a more sustainable and inclusive solution.

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