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CLIMATE RESILIENCE OF SMALL-SCALE FISHERMEN ON ENGGANO ISLAND NORTH BENGKULU REGENCY

Ketahanan Iklim pada Nelayan Perikanan Tangkap Skala Kecil di Pulau Enggano Kabupaten Bengkulu Utara

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ABSTRACT

Small-scale fishermen on Enggano Island have a significant contribution to capture fisheries production in North Bengkulu Regency. However, in carrying out fishing activities, fishermen face various complex challenges such as vessel size ≤ 10 Gross Tonnage (GT), traditional fishing gear, and the impact of climate change. This study aims to analyze the level of climate resilience in fishermen and the factors that influence the climate resilience of small-scale capture fishermen on Enggano Island. Exposure, sensitivity, and adaptive capacity are components of measuring the level of climate resilience of fishermen. Social and economic factors, perceptions of climate change, and adaptation strategies are latent variables that influence the climate resilience of fishermen. The determination of 100 respondents was determined by accidental sampling. Analysis of the research data is the Climate Resilience Index (CRI) and Structural Equation Modeling (SEM). The results show that the level of climate resilience of fishermen is 0.57, indicating that the level of climate resilience of fishermen is in the moderate category. Factors that significantly influence the climate resilience of fishermen on Enggano Island are social factors, such as fishermen education, access to fishing information, and social relationships among fishermen. This study emphasizes the importance of strengthening social factors to increase the climate resilience of small-scale fishermen on Enggano Island.

Keywords: Climate Resilience, Small-Scale Fishermen, Climate Change, Enggano Island

ABSTRAK

Nelayan skala kecil di Pulau Enggano memiliki kontribusi besar terhadap produksi perikanan tangkap di Kabupaten Bengkulu Utara. Namun, dalam melakukan aktivitas penangkapan ikan, nelayan menghadapi berbagai tantangan yang kompleks seperti ukuran kapal ≤ 10 *Gross Tonnage* (GT), alat tangkap tradisional, serta dampak perubahan iklim. Penelitian ini bertujuan menganalisis tingkat ketahanan iklim pada nelayan dan faktor yang mempengaruhi ketahanan iklim nelayan perikanan tangkap skala kecil di Pulau Enggano. Keterpaparan, sensitivitas, dan kapasitas adaptasi sebagai komponen pengukuran tingkat ketahanan iklim nelayan. Faktor sosial, ekonomi, persepsi perubahan iklim, dan strategi adaptasi sebagai variabel laten yang mempengaruhi terhadap ketahanan iklim nelayan. Penentuan responden 100 orang ditentukan dengan *accidental sampling*. Analisis data penelitian yaitu *Climate Resilience Index* (CRI) dan *Structural Equation Modeling* (SEM). Hasil penelitian menunjukkan tingkat ketahanan iklim nelayan adalah 0,57 karena nilai tersebut terdapat di rentang nilai 0,50 – 0,75 menyatakan bahwa tingkat ketahanan iklim nelayan berada pada kategori sedang. Faktor yang secara signifikan berpengaruh terhadap ketahanan iklim nelayan di Pulau Enggano yaitu faktor sosial dengan indikator pendidikan nelayan, akses nelayan terhadap informasi melaut dan hubungan sosial antar nelayan. Penelitian ini menekankan pentingnya penguatan modal sosial untuk meningkatkan ketahanan iklim nelayan skala kecil di Pulau Enggano.

Kata Kunci: Ketahanan Iklim, Nelayan Skala Kecil, Perubahan Iklim, Pulau Enggano

INTRODUCTION

Enggano Island is a small island located in the 3T (Frontier, Outermost, and Disadvantaged) region and is geographically surrounded by the Indian Ocean. This geographical condition causes the majority of Enggano Island's population to rely on small-scale capture fisheries for their livelihoods (Amalia et al., 2025). Law No. 7 of 2016 concerning the Protection and Empowerment of Fishermen, Fish Farmers, and Salt Farmers defines small-scale fishermen as those who fish to meet their daily needs, using vessels measuring no more than 10 GT. Fishing activities are still dominated by traditional fishing gear and hunting methods, with fishing grounds being determined based on natural phenomena and the fishermen's experience (Ramadhan, 2025). This high dependence on natural conditions makes fishermen on Enggano Island highly vulnerable to climate change.

Enggano Island is part of North Bengkulu Regency with an area of approximately 400.6 km² consisting of six villages: Kahyapu, Kaana, Malakoni, Apoho, Meok, and Banjar Sari. The scattered population density and approximately 130 km of coastline indicate the characteristics of an isolated coastal area with limited infrastructure access (BPS, 2024). Climate change exacerbates the conditions with high rainfall in certain months on Enggano Island, such as January (698 mm) and July (588 mm), (BPS, 2024). This causes fishermen to face the risk of bad weather and high waves, resulting in unstable catches. Enggano Island contributes 27.89% of capture fisheries production in North Bengkulu Regency, which is vulnerable to climate variability (Cahyadinata et al., 2018). Furthermore, the Meteorology, Climatology, and Geophysics Agency (BMKG) (2025) also issued an early warning of high waves reaching 4 meters around Enggano Island, further restricting fishing activities.

Small-scale fishers are the group most impacted by climate change due to limited capital, technology, and access to weather information. Changing seasonal patterns, rising sea temperatures, and extreme weather conditions cause uncertain catches and pose risks to fishermen's safety (Salama et al., 2025). The fishing gear used by Enggano Island fishermen, such as handlines, gillnets, longlines, and dragnets, is still relatively traditional, requiring a high level of adaptability to climate dynamics. Fishermen's perceptions and awareness of climate change are generally shaped by daily empirical experience, giving small-scale fishers the potential to be important actors in climate change adaptation strategies in the fisheries sector (Hasani et al., 2024).

Understanding the level of climate resilience and the factors influencing it among small-scale capture fishers on Enggano Island is crucial in addressing the increasingly complex impacts of climate change. Previous research has shown that climate change significantly impacts catch declines and uncertainty of fishing seasons (Afifah et al., 2024). Juniarni (2021) found that Enggano Island fishermen are aware of climate change, but their adaptation strategies are relatively low, and there is no significant relationship between climate change perceptions and adaptation strategies. However, empirical studies specifically measuring the level of climate resilience of fishermen using the Climate Resilience Index (CRI) approach and analyzing the relationships between climate resilience determinants using Structural Equation Modeling (SEM) on Enggano Island are still very limited. Therefore, this study was conducted to measure the level of climate resilience of small-scale capture fishers using the CRI and analyze the influence of exposure, sensitivity, and adaptive capacity on their climate resilience using SEM. This study aims to analyze: 1) The level of climate resilience of small-scale capture fishers on Enggano Island, North Bengkulu Regency; 2) Factors influencing the climate resilience of small-scale fisheries fishermen on Enggano Island, North Bengkulu Regency.

RESEARCH METHODS

Place and Time

The location of this research was chosen intentionally, namely on Enggano Island, North Bengkulu Regency (Figure 1), by considering that on Enggano Island, the main livelihood of the community after farmers is fishing with a total of 332, followed by Enggano Island including the only 3T (Underdeveloped, Outermost and Frontier) area in Bengkulu Province. Therefore, Enggano Island is worthy of being chosen as a research location with the criteria of small-scale fishermen who have a boat weight of < 10 GT, one day fishing, using simple fishing gear and willing to be respondents. This research was conducted from June to July 2025.

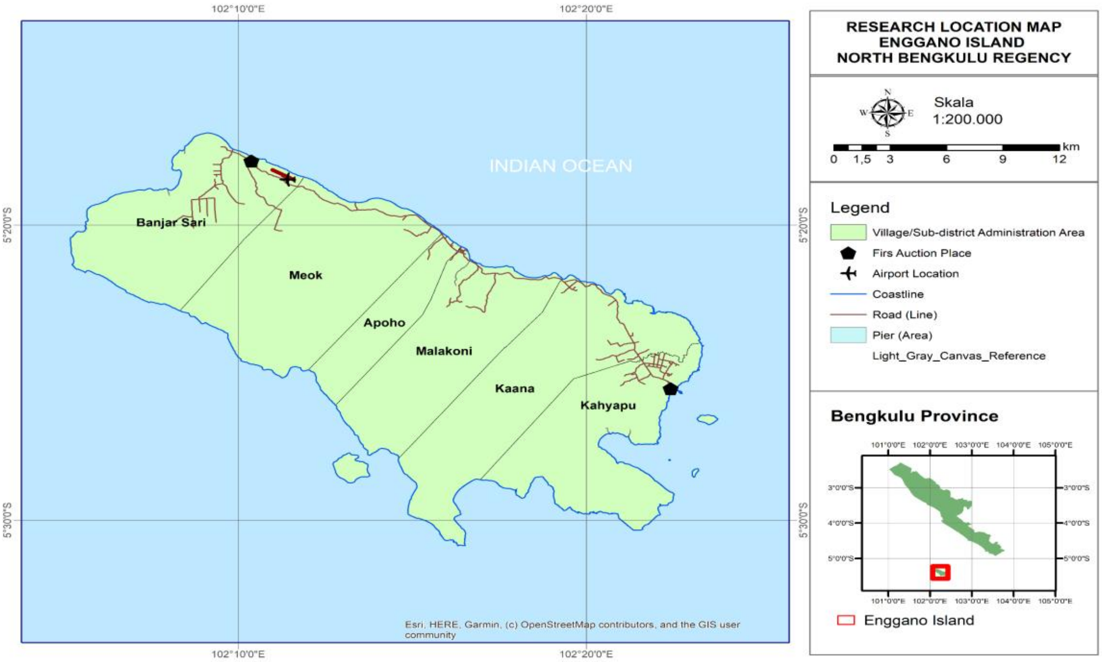

Figure 1. Research Location
Source: Research location processed by the author, 2026

Respondent Determination and Sampling Method

The sampling method used in this study was accidental sampling, a technique whereby the researcher encounters respondents who meet the criteria and are then selected as samples. This technique was chosen because the population size is not known with certainty (Sugiyono, 2016). The number of respondents was calculated using the Virtucio formula:

$$n = \frac{Z^2\ \{p(1-p)\}}{(MOE)^2}\ n\ = \frac{(1{,}96)^2\ \{0{,}5(1-0{,}5)\}}{(0{,}1)^2} = 96{,}04$$

Based on the calculation results, the total number of respondents was 96.04. This number was then rounded up to 100 respondents. Respondents were determined based on the criteria of vessels measuring ≤ 10 GT and carrying out fishing activities in one day (one-day fishing).

Method of collecting data

Primary and secondary data were collected in this study. Primary data, which is data received directly from respondents through interviews using a questionnaire, consists of three parts: the first part discusses the characteristics of respondents. The second part collects information on fishermen's climate resilience with three components: exposure, sensitivity, and adaptive capacity. The third part focuses on social and economic factors, climate change perceptions, adaptation strategies, and fishermen's climate resilience, measured on a Likert scale, with a score of 1-5. Secondary data, which is data that supports the primary data, comes from the Central Statistics Agency (BPS) of Enggano District and Bengkulu Province, relevant research journals, and related books.

Data Analysis

This study uses the Climate Resilience Index (CRI) analysis to measure resilience, involving three components: exposure, sensitivity, and adaptive capacity. The analysis involves the following calculation steps:

Stages of calculating the CRI climate resilience index at the fisherman level

1. Data Normalization

   Each indicator is normalized using a scale of 0-1 with the formula:

$$Xi' = \frac{(Xi - Xmin)}{(Xmax - Xmin)}$$

   Information:

   Xi' = Normalization results with a scale of 0 – 1
   Xi = The value of the i-th indicator
   $Xmin$ = The minimum value of the indicator
   $Xmax$ = The maximum value of the indicator

2. Weighting

   Each dimension of exposure (E), sensitivity (S) and adaptive capacity (AC) is weighted according to its level of influence.

3. Final Calculation

   CRI = (E x 0,4) + (S x 0,3) + (AC x 0,3) (Adger, 2006).

After being calculated, the results of the Climate Resilience Index (CRI) can be categorized according to the level of climate resilience as in table 1.

Table 1. Climate Resilience Index (CRI) Value Categories)

No	CRI Value	Climate Resilience Category
1	> 0,75	High
2	0,50 – 0,75	Medium
3	< 0,50	Low

Source : Adger, 2006

This study also used Structural Equation Modeling (SEM) analysis to analyze factors influencing fishermen's climate resilience. SEM is a multivariate analysis method that simultaneously describes linear relationships between observable variables (indicators) and variables that are difficult to measure directly (latent variables). SEM allows for the identification of interconnected dependencies within a single model (Chomeya et al., 2024).

Testing criteria were determined based on a probability value of p-value <0.05 at a 95% confidence level (Yusuf, 2022). This study involved five latent variables: social factors (X1), economic factors (X2), climate change perceptions (P), adaptation strategies (Z), and climate resilience (Y). The measurement of climate resilience in the SEM model differs from the CRI method. Climate resilience is measured through specific indicators: resilience of marine fish availability, household economic resilience, and environmental sustainability. SEM focuses more on fishermen's perceptions as an operational representation of the conditions identified through the CRI approach. Measurement categories can be seen in Table 2.

Table 2. Climate Resilience Value Categories (Structural Equation Modeling/SEM)

No	Interval	Category
1	1,00 – 2,33	High
2	2.34 – 3,57	Medium
3	3,68 – 5,00	Low

The scale for measuring indicator variables uses an ordinal Likert scale of 1-5, with a value of 1 indicating the lowest level and a value of 5 indicating the highest level. Latent variables and indicators can be seen in Table 3.

Table 3. Latent and Indicator Variables

No	Latent Variables	Indicator
1	Social Factors (X1)	X1.1= Fishermen education
		X1.2= Fishermen's access to sea information
		X1.3= Social relations between fishermen
2	Economic Factors (X2)	X2.1= Fishermen's income
		X2.2= Diversification of livelihoods
		X2.3= Access to the fish auction site (TPI)
3	Climate Change Perceptions (P)	P1= Understanding climate change
		P2= Impact of climate change
		P3= Preparedness for climate change
4	Adaptation Strategy (Z)	Z1= Ecological adaptation
		Z2= Social adaptation
		Z3= Economic adaptation
5	Climate Resilience (Y)	Y1= Resilience of fish availability in the sea
		Y2= Household economic resilience
		Y3= Environmental sustainability

The variables and indicators compiled in the climate resilience model for small-scale capture fishers are described in Figure 2.

Figure 2. SEM PLS Structural Model

RESULT

1. Characteristics of Small-Scale Capture Fishermen

The characteristics of small-scale capture fishers are reviewed based on age, formal education, fishing experience, number of dependents, and vessel weight, as presented in Table 4.

Table 4. Characteristics of Small-Scale Capture Fishers on Enggano Island

No	Variables	Maximum	Minimum	Average	Standar Deviasi
1	Age (years)	54	23	38,48	6,55
2	Formal education (years)	12	6	6,99	1,98
3	Experience as a fisherman (years)	25	4	13,05	5,07
4	Number of family dependents (people)	5	0	2,48	0,99
5	Ship weight (GT)	3,50	1,80	2,16	0,42

Source: Processed primary data, 2026

2. Climate Resilience Levels of Small-Scale Capture Fishermen

The level of climate resilience of fishermen was measured using the CRI method, which encompasses three main components: exposure, sensitivity, and adaptive capacity. The measurement results are presented in Table 5.

Table 5. Results of the Climate Resilience Index Measurement for Small-Scale Capture Fishermen

No	Variables	Maximum	Minimum	Average	Category
1	Exposure	0,91	0,36	0,64	Medium
2	Sensitivity	0,78	0,33	0,54	Medium
3	Adaptive Capacity	0,70	0,30	0,51	Medium
Climate Resilience (CRI)		0,75	0,40	0,57	Medium

Source: Processed primary data, 2026

The results of the climate resilience index using the CRI method show a climate resilience index of 0.57, categorized as moderate. This indicates that fishermen are not vulnerable but also lack strong adaptive capacity to face the risks of climate change. The calculation of each component of climate resilience can be seen in the following figure, which will be explained in detail.

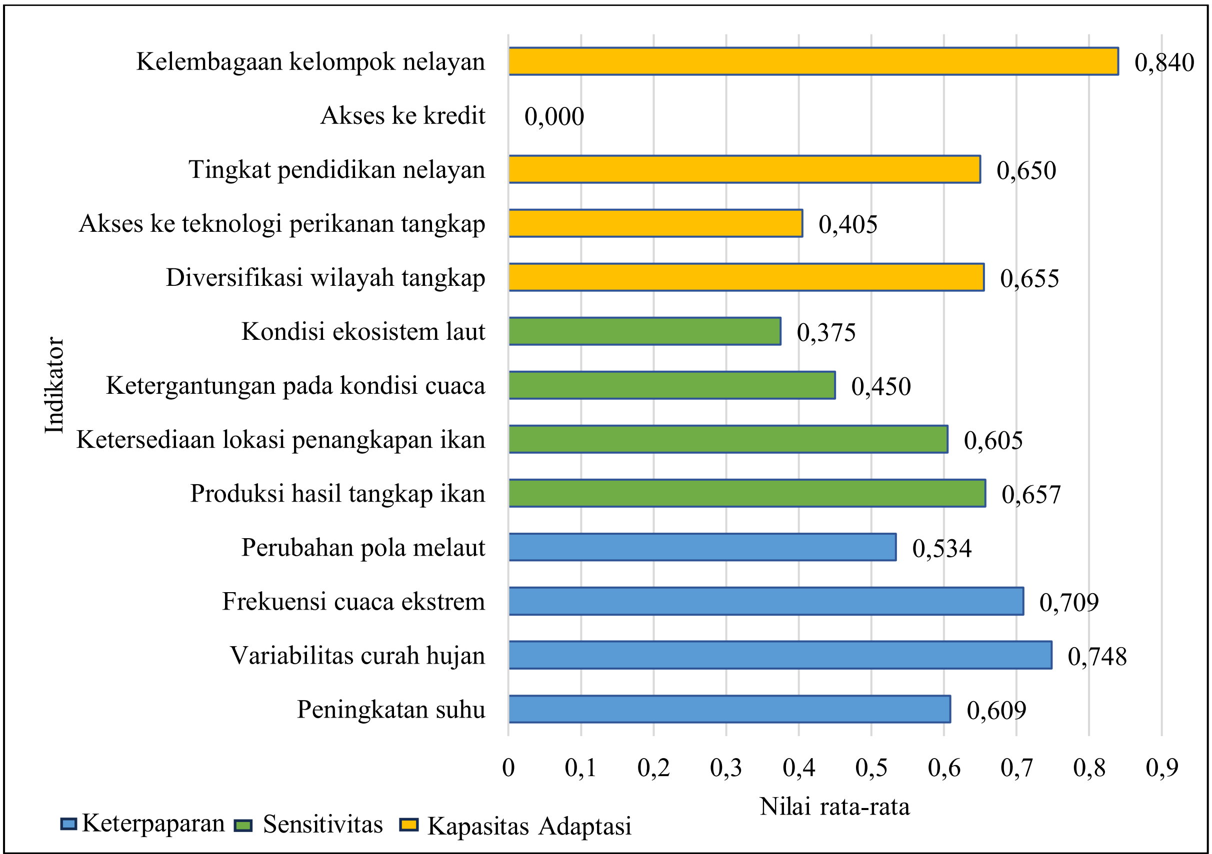

Figure 3. Average Values of Exposure, Sensitivity and Adaptive Capacity Indicators
Source: Processed primary data, 2026

Nilai indikator pada keterpaparan memperlihatkan bahwa variabilitas curah hujan merupakan indikator yang paling dirasakan dampaknya oleh nelayan dengan nilai tertinggi, diikuti frekuensi cuaca ekstrem dan peningkatan suhu. Sementara itu, perubahan pola melaut memiliki nilai terendah namun tetap menunjukkan adanya dampak terhadap aktivitas nelayan. Indikator pada sensitivitas memperlihatkan bahwa produksi hasil tangkap ikan dan ketersediaan lokasi penangkapan merupakan indikator tertinggi yang paling dipengaruhi oleh perubahan iklim. Ketergantungan pada kondisi cuaca dan ekosistem laut menunjukkan nilai lebih rendah, namun tetap mempengaruhi aktivitas nelayan. Indikator ketahanan iklim menunjukkan bahwa kelembagaan kelompok nelayan memiliki nilai tertinggi, yang mencerminkan adanya dukungan kelembagaan yang cukup kuat. Sebaliknya, akses ke kredit memiliki nilai terendah menyatakan keterbatasan nelayan dalam memperoleh permodalan.

Table 6. Results of Climate Resilience Measurement of Small-Scale Capture Fishermen (SEM)

No	Variables	Value	Category
1	Climate Resilience (SEM)	3,54	Medium

Source: Processed primary data, 2026

Table 6 shows that with a value of 3.54, fishermen on Enggano Island have sufficient capacity to deal with climate change, but still need to be improved.

3. Factors Affecting Climate Resilience of Small-Scale Capture Fishermen

The climate resilience of small-scale capture fisheries was analyzed using the SEM method. The analysis results included Construct Reliability and Validity values, as well as Path Coefficients. This test aimed to determine the factors influencing climate resilience among small-scale capture fishers on Engggano Island, North Bengkulu Regency.

Table 7. Reliability and Validity

No	Variables	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
1	Economic Factors	0,715	0,929	0,812	0,595
2	Social Factors	0,804	0,814	0,885	0,719
3	Climate Change Perceptions	0,859	1,002	0,911	0,774
4	Adaptation Strategy	0,875	0,889	0,923	0,799
5	Climate Resilience	0,793	0,841	0,871	0,693

Source: Processed primary data, 2026

Based on Table 7, all variables have Cronbach's Alpha and Composite Reliability values above 0.70, thus being considered reliable. Furthermore, the AVE value is greater than 0.50, indicating that the construct meets convergent validity criteria.

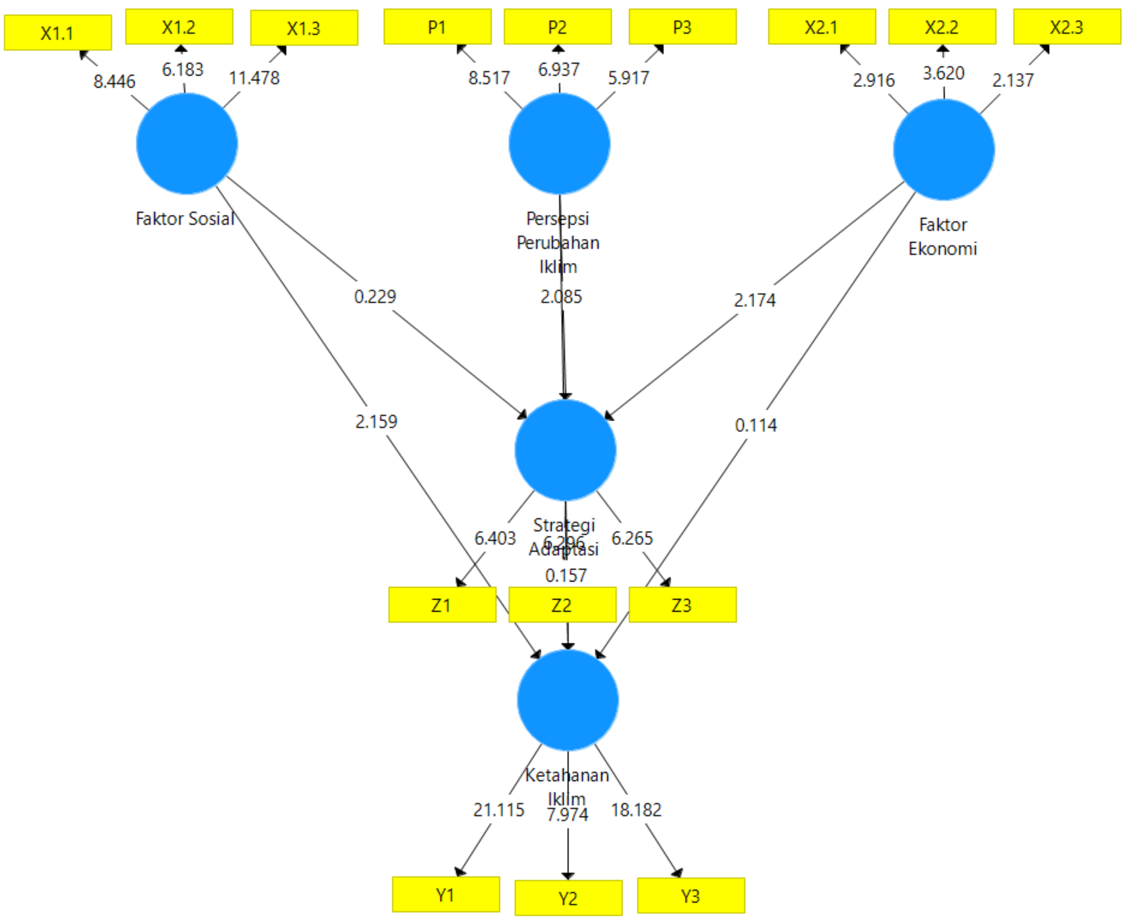

Figure 4. Path Coefficients Model Results
Source: Processed primary data, 2026

Table 8. Path Coefficients

No	Variable Relationship	Original Sample (O)	Sample Mean (M)	T Statistics	P-Value
1	Social Factors → Adaptation Strategies	0,028	0,040	0,229	0,819
2	Social Factors → Climate Resilience	0,214	0,236	2,159	0,031*
3	Economic Factors → Adaptation Strategy	0,306	0,299	2,174	0,030*
4	Economic Factors → Climate Resilience	-0,022	-0,010	0,114	0,909
5	Climate Change Perception → Adaptation Strategies	-0,216	-0,213	2,085	0,038*

6	Climate Change Perception → Climate Resilience	0,109	0,080	0,844	0,399
7	Adaptation Strategy → Climate Resilience	0,018	0,013	0,157	0,875

Description: * = Significant 5% (α = 0.05)
Source: Processed primary data, 2026

Table 8, states that economic factors and climate change perception factors have a significant influence on adaptation strategies, while fishermen's climate resilience is significantly influenced by social factors with a p-value of < 0.05.

DISCUSSION

1. Characteristics of Small-Scale Fishermen

The average age of small-scale capture fishers in Table 4 is 38 years, indicating that they are in the middle productive age group, ideal for physical activities such as fishing at sea. According to Aprilyanti (2017), productive fishers tend to be willing to learn new things, even if they lack sufficient experience.

The average formal education of fishermen is 6 years, indicating that most fishermen on Enggano Island have only completed elementary school. Consistent with Irawan et al.'s (2017) book on education on Enggano Island, fishermen's awareness of the importance of continuing education remains low, and educational facilities on Enggano Island are inadequate. Low levels of education limit fishermen's understanding of modern climate information, leading to greater reliance on local knowledge for adaptation. However, the local knowledge currently possessed by fishermen is not always relevant to uncertain conditions. Therefore, local knowledge needs to be balanced with global knowledge. Experience refers to the length of time a fisherman has been fishing at sea. Table 4 shows an average of 13 years of experience for fishermen on Enggano Island. This demonstrates that fishermen are a relatively experienced group, mastering fish migration patterns in Enggano Island waters. However, they still need support in climate adaptation, as they rely solely on experiential knowledge. This aligns with research by Mulyasari et al. (2023) that found that the understanding of climate change in traditional Bengkulu fishing communities is based on experience, not the latest science.

The average number of dependents in a fishing family is two, demonstrating the economic burden on households amidst uncertain catches due to climate change. This finding aligns with Hanum (2018) who stated that the greater the number of dependents, the heavier the economic burden on fishing households. If not balanced with sufficient income, this will reduce the family's ability to meet basic needs and restrict fishermen's consumption patterns.

Vessel weight is measured in Gross Tonnage (GT), which is used by fishermen, with an average of 2 GT. This is in line with Halim et al., (2020), who stated that small-scale fishers in Indonesia generally use vessels under 10 GT, characterized by limited fishing range and household-scale operations, categorized as small-scale fishers. Research (Gustika et al., 2023) stated that fishers using small vessels are more vulnerable to extreme weather and high waves, thus limiting their mobility in near-shore waters.

2. Resilience Level of Small-Scale Capture Fishermen on Enggano Island

The results of measuring the climate resilience of small-scale capture fishers using the Climate Resilience Index (CRI) method, which uses three components: exposure, sensitivity, and adaptive capacity, showed a CRI of 0.57, placing the climate resilience level in the moderate category. This condition indicates that fishers are not vulnerable to climate change, but they also lack strong adaptive capacity to face the risks of ongoing climate change. These results indicate that small-scale capture fishers continue to be under pressure from climate change, primarily due to high levels of exposure and sensitivity that are not matched by adequate adaptive capacity. According to Adger (2006), climate resilience is determined not only by the level of risk exposure but also by the ability of communities, economies, and institutions to respond to change. Therefore, to increase fishers' resilience to climate change, the focus must be placed on enhancing their adaptive capacity through increased access to technology, capital, and strengthening fisher institutions. This strategy is crucial to reducing fishers' vulnerability to the future impacts of climate change.

The average exposure value of 0.64 indicates that fishers are highly affected by the impacts of climate change, particularly changes in weather and ocean conditions. Figure 3 shows the level of exposure of fishermen, showing that rainfall and the frequency of extreme weather events are the indicators with the highest values. High levels of these two indicators indicate that fishermen face numerous challenges during the fishing season, impacting their safety and fishing productivity. Limited technology and dependence on natural conditions make small-scale fishermen highly vulnerable to climate change (Darmono et al., 2025). Furthermore, (Perdana et al., 2015) stated that uncertainty in fishermen's income and the risk of failure to go to sea increase due to climate variability. Although the indicator for changes in fishing patterns has a lower average value, it still indicates that fishermen's behavior changes rapidly in response to changing conditions at sea. This finding aligns with research (Maurizka et al., 2021), which states that fishermen often have to change their fishing times and locations in response to climate change, but these changes do not necessarily increase fishermen's economic resilience.

Figure 4 shows that the level of sensitivity of fishermen, with an average of 0.54, indicates that fishermen are highly dependent on their natural environment. Relatively high values are seen in the indicators of fish catch production and fishing ground availability. Climate change directly affects fish catches and fishermen's access to fish resources. Climate instability and environmental damage increase fishermen's sensitivity, as demonstrated by their dependence on weather and marine ecosystem conditions. (Alif et al., 2022) reinforce this finding by stating that small-scale fishermen are more limited than industrial fishermen in addressing changes in the marine ecosystem.

Fishermen's ability to adapt to climate change remains relatively low, as shown in Figure 5, with an average adaptive capacity score of 0.51. The institutionalization indicator for fishers' groups has the highest score, indicating that the existence of fishers' groups plays a crucial role in facilitating adaptation through information sharing, collaboration, and access to assistance programs. Conversely, indicators such as access to capture fisheries technology and access to credit indicate major weaknesses in fishers' adaptive capacity. Fishermen are unable to improve business efficiency and mitigate climate change risks due to a lack of capital and technology. This aligns with research by Novianti et al. (2016), which states that access to financing and technology is a critical component in increasing the climate resilience of coastal communities. Adaptation strategies and social capital are crucial for increasing resilience, as demonstrated by indicators such as fishers' education level and fishing area diversification. According to Rais et al. (2024), fishers with better education and knowledge tend to be better able to adapt to environmental changes.

Table 6 shows a climate resilience (SEM) value of 3.54, categorized as moderate, as measured by indicators of capture fisheries production resilience, household economic resilience, and environmental sustainability, which will be used in the SEM method. These indicators reflect the actual conditions directly experienced by fishermen in facing climate change. This result aligns with the CRI value of 0.57, also categorized as moderate. The CRI is compiled based on the components of exposure, sensitivity, and adaptive capacity, which describe the general climate resilience conditions of Enggano Island. This indicates that the indicators used in the SEM method are able to consistently represent the climate resilience conditions of fishermen, namely in the moderate category.

3. Factors Affecting the Climate Resilience of Small-Scale Capture Fishermen on Enggano Island

The reliability and validity tests in Table 7 show that all constructs have Cronbach's Alpha and Composite Reliability values above 0.70, and Average Variance Extracted (AVE) values exceeding 0.50. This indicates that the constructs in the study have good internal consistency and meet convergent validity criteria, thus the measurement model is considered suitable for use in testing the structural model.

Table 8 shows that social factors have no significant effect on adaptation strategies (p-value > 0.05), indicating that fishermen's adaptation decisions are largely influenced by other factors. However, social factors do significantly influence fishermen's climate resilience (p-value < 0.05). This is because fishermen on Enggano Island reported that community support, social networks, and the role of fishing groups significantly contribute to their ability to face the risks of climate change, as assistance is obtained through fishing groups. These findings align with research by Wulansari (2022), which emphasized that social capital and local institutions contribute to the capacity of coastal communities to respond to environmental pressures and climate change, including through mechanisms for sharing information, experiences, and assistance.

Economic factors significantly influence fishermen's adaptation strategies (p-value <0.05). This means that income levels and financial capacity influence fishermen's ability to adjust adaptation strategies to climate change. Common adaptations undertaken by fishermen on Enggano Island include reducing fishing hours and changing fishing schedules according to weather conditions. These results align with Cinner et al. (2018), who emphasized that economic capacity is a crucial element supporting coastal households' ability to respond to environmental pressures. However, economic factors were not shown to have a significant direct effect on climate resilience (p-value >0.05). This can be explained by the fact that most fishermen on Enggano Island do not diversify their work beyond fishing. To meet their daily household needs, they continue fishing. High dependency, resulting in improved economic conditions, does not necessarily directly increase climate resilience. Research by Rahim et al., (2025) revealed that small-scale fishermen in Indonesia are vulnerable due to a lack of diversification, with extreme weather forcing the continuation of activities despite high risks, so that economic factors do not directly strengthen fishermen's resilience.

Fishermen's perceptions of climate change also significantly influenced adaptation strategies (p-value <0.05). The negative coefficient indicates that increased perceptions of climate change risks are not always accompanied by increased adaptation efforts, particularly when fishers face limited capital, information, or resource access. This finding aligns with Christiaw et al. (2025), who explained that high risk perceptions do not necessarily encourage adaptive action if individuals feel they lack the capacity to respond to the threat. Fishermen on Enggano Island demonstrated that climate change perceptions function more as a trigger for awareness, rather than a direct determinant of climate resilience. This is reflected in the results, which show that climate change perceptions did not significantly influence fishermen's climate resilience (p-value >0.05).

Furthermore, adaptation strategies themselves did not significantly influence fishermen's climate resilience (p-value >0.05). This indicates that the forms of adaptation strategies currently implemented by small-scale fishers on Enggano Island who undertake adaptive actions are limited due to the lack of skills other than fishing, and the limited employment opportunities that force them to remain in a single profession. Other strategies are also limited, short-term, and have not yet significantly impacted climate resilience. This is in line with research by Sartika et al. (2024), which states that adaptation strategies that are not supported by strong policies, technological support, and institutions tend to be less effective in strengthening long-term climate resilience. In other words, individual adaptation and simple technical adjustments are not enough to significantly reduce fishers' vulnerability.

CONCLUSION

The results of the study indicate that the climate resilience level of small-scale capture fishers on Enggano Island is 0.57, categorized as moderate, indicating that fishermen have sufficient adaptive capacity but are still vulnerable to the impacts of climate change. Furthermore, the results also indicate that social factors are the only factor that significantly influences fishermen's climate resilience, reflecting the importance of education, access to information, and social relationships in supporting the adaptive capacity of small-scale fishermen.

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