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Adaptation Strategies for Fishermen's Food Security in Facing Climate Change in the Coastal Village of Malabro, Bengkulu City

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ABSTRACT

Climate change affects fishermen's food security in Bengkulu City, especially in the Malabro urban village. The condition of small fishing communities experiencing climate change due to extreme weather has reduced fish production. As a result of the impact of climate change, small fishermen cannot go to sea. This research aims to determine the adaptation strategy for fishermen's food security in facing climate change in Malabro urban village, Bengkulu City. The research method uses a quantitative descriptive approach. Sampling techniques in this study use observation, documentation, and interview techniques. aiming at 100 people who were taken, namely small fishermen/fishing laborers in the Malabro village of Bengkulu city. To determine the respondents depth interview. The results of the research indicate that the food security of fishermen in Malabro villages is not food resistant, where the Income of fishermen is generated when the weather is bad. The presentation of low fishermen's Income is 32%, categorized as Income with average results below the minimum wage of Rp. 1000,000. 41% fishermen have with incomes come with an average income of Rp.1300,000, - Rp. 2000,000. 23% of income in the high category with an average income of around Rp.2000,000- Rp.4,500,000, and finally, 4% of Income in the very high category with an average income of Rp. 4,500,000- Rp. 6,000,000. Fishermen's Food Security Level in the category of food availability in fish production when experiencing climate change, the amount of fish obtained from fishing amounts to 50-60kg, and fish production when not experiencing climate change, the results obtained range from 100 kg-150 kg. in food access. The fishing community in Malabro especially small fishermen do not have agricultural land and do not produce food directly so it can be concluded that fishermen's food security can be categorized as not food resistant.

Keywords: food security adaptation strategies, climate change impacts

INTRODUCTION

Fishing communities living in coastal areas depend on marine resources for fish as the main source of Income. The difference between the two phenomena, in general, can be seen, the first is that the management of coastal and marine natural resources has not been carried out properly, and the second is that the coastal areas of Bengkulu City have suffered damage, such as coastal degradation, damage to Mangrove forests and Coral reefs, decline in coastal forests and irregular settlement arrangements on the beach. Climate change is believed to affect fisheries productivity because it damages

mangrove forest ecosystems and coral reefs due to rising sea surface temperatures and changes in groundwater. Climate change is defined as changes in climate that occur over time, whether caused by human activities or naturally occurring[1] Climate change causes sea level rise and increased seawater temperature[2] increased ocean acidity[3] changes in ocean circulation patterns and process [4]

Bengkulu's current climate change conditions, such as the southeast season, have strong winds from the southeast, clear weather, high waves, and strong winds. This poses a threat to fishermen and requires sustainable development and adaptation strategies for fishermen to support food security and food independence.

The study was conducted ecological changes in coastal areas affect the socio-economic life of fishermen which is strongly influenced by the adaptation strategies of fishermen to climate change[5] As a result, a decrease in Income as a result of climate change has caused people to be on the verge of poverty. Climate change affects changes in the fisheries sector is the most affected by climate change. The impact of climate change affects the food system including food production, storage, access and price stability[6] As a result, research on food security and climate change is interesting to discuss because the climate in Indonesia is experiencing significant changes. With the results of previous thesis research on fishermen's fishing gear and Income, it shows that the relationship is very strong. Because the type of fishing gear will affect the income level of fishermen. Fishermen's income levels also affect the conditions of climate change in Bengkulu, where many fishermen cannot go to sea due to erratic climate change.

Bengkulu city fishermen are a community of fishermen who usually live on the coast and sea. The most important elements in fishermen's food security are food availability and proper access for everyone. Food availability is linked to food production, distribution and trade, including the organization of community reserves. The population's access to food is related to the food production obtained in accordance with the climatic conditions of Bengkulu and family income. Therefore, this research is intended to describe the form of "Adaptation strategies of fishermen communities towards food security in the face of climate change in the coastal fishermen village of Malabero sub-district, Bengkulu city".

MATERIALS & METHODS

Research location

The research location is in the Coastal Fishermen Village of Malabro Village, Bengkulu City, with samples taken from the Fishermen Community of Malabro Village, Bengkulu City. The location was chosen based on the Fishermen's Food security Adaptation Strategy in the face of climate change.

Population and sample

The population in this study is the fishing community, namely small fishermen whose food security faces climate change. This researcher will take a sample of fishermen who work as fishing laborers / small fishermen and live in the malabro village of bengkuly city, the sample is selected by purposive sampling. To determine the sample size of the subject less than 100, it is better to take all the research If the subject is larger, it can be taken between 20-25 percent[7] . Based on Arikunto's formula (2002), 100 fishermen were selected as research samples and settled in Malabero urban village and climate change in the fishing village of Bengkulu city.

Data collection techniques

The data collection technique used in this research is descriptive quantitative. Data collection tools in the form of questionnaires are arranged based on the problems in the study. The data source of this research consists of primary data sources and secondary data. Primary data in this study were obtained from research subjects through interviews with respondents using

the in-depth interview method and seeing directly, because the object of research obtained data on fishermen related to Income, availability and food stability.

Data analysis

Data analysis is carried out using quantitative descriptive statistical methods. Data must be presented in the form of minimum, maximum, number, average, and percentage. Data is interpreted and described descriptively to make it more meaningful. This measurement combines two indicators of food security, namely the share of consumption and food expenditure. The percentage calculation is carried out using the following formula.

1. Income and expenses:

Income: calculate the total Income from fishing with the formula used:

$$PRN = PDM + PLM$$

PRN is fishermen's Income, PDM is Income from fishing activities, and PLM is Income from outside fishing activities.

Expenditure: calculates total expenditure on food and non-food items:

$$TPN = PUP + PNP$$

TPN is total family expenditure, *PUP* is food expenditure and *PNP* is non-food expenditure.

2. Food expenditure share (PPP)

Calculated to determine the proportion of food expenditure to total fisher household expenditure.

Food security

PPP to determine the proportion of food expenditure to total household expenditure:

$$PPA = \frac{PBP}{TPR} \times 100\%$$

Based on the PPP calculation can be categorized as:

Panngan endurance
Food resistant: if the proportion of food expenditure < 60%
Food insecure: if the proportion of food expenditure >60%

RESULT

Adaptation strategies for food security in the face of climate change in fishing communities in the Malabro urban village of Bengkulu City have an adverse effect on catch income. The effects of climate change, Bengkulu on the community include

a. The occurrence of weather changes such as hot afternoons and afternoons to nights of rain that occur in the region is caused by the orographic rain factor where there is solar energy that causes the occurrence of pengupan both from lakes and others so that the results of pengupan formed clouds that move according to the direction of the wind in the upper layer. so that high rainfall results in excess water in agricultural water sources and can cause flooding and landslides.
b. The amount of rainfall in Bengkulu Province depends on the altitude of the place, the presence of ranges and mountains, distance and land area.
c. A weather shift from El Nino to La Nina will occur between July and August 2024.
d. Bengkulu has a long coastline, sea level rise causes beach erosion, affects marine habitats and threatens coastal settlements.
e. Bengkulu has a coastline that is exposed to climatic conditions including rising water levels, which can have a major impact on communities living around coastal ecosystems.
f. Environmental damage and *overfishing*
g. Increasing rise in fish due to impacts of climate change
h. Change in catch production

Income is the total receipt of a person or group in the form of money or goods from their own sources or the results obtained in the form of money or goods within a certain period of time.

The income level of fishermen is measured using the following indicators:

a. Low Income earns below the minimum wage, i.e., IDR 1,000,000 per month.

b. Medium Income with an average income between Rp. 1,300,000 - Rp. 2,000,000 per month
c. High Income with an average income of Rp. 2,000,000 - Rp. 4,500,000 per month
d. Very high Income with an average income of Rp. 4,500,000- Rp. 6,000,000

To find out the Income of fishermen with good weather or experiencing climate change, researchers use a Likert scale. Likert scale is used to measure a person's attitude, Income and perception.

Table 1. Level Score

No.	Income Level	Score
1	Lowest Income	1
2	Medium Income	2
3	High Income	3
4	Very high Income	4

Based on the Research Results, Fishermen's Income is presented in the form of a data grouping table in the form of a Frequency distribution table using SPSS in table 2

Table 2 Income Frequency with *SPSS*

Statistics					
		Low Income earns below the minimum wage, i.e., IDR-1,000,000 per month.	**Medium Income with an average income between Rp. 1,300,000 - Rp. 2,000,000 per month**	**High Income with an average income of Rp. 2,000,000 - Rp. 4,500,000 per month**	**Very high Income with an average income of Rp. 4,500,000- Rp. 6,000,000**
N	Valid	32	41	23	4
	Missing	68	59	77	96
Mean		1,00	2,00	3,00	4,00
Std. Deviation		,000	,000	,000	,000
Variance		,000	,000	,000	,000
Minimum		1	2	3	4
Maximum		1	2	3	4
Sum		32	82	69	16
Percentiles	25	1,00	2,00	3,00	4,00
	50	1,00	2,00	3,00	4,00
	75	1,00	2,00	3,00	4,00

Primary data source 2024

Economic vulnerability can affect the Income of fishermen in Malabro village divided into two internal factors including age factors and external factors, namely natural and technological factors. The results of table 2 of the income level score with a linkert scale by taking data through using SPSS it is known that the average Income of fishermen once at sea in the face of climate change is low 32% which is categorized as Income with an average result below the minimum wage of Rp. 1000,000, -. 41% of fishermen's Income with moderate Income with an average income of Rp.1300,000, - Rp. 2000,000, -. 23% of Income in the high category with an average income of around Rp.2000,000- Rp.4,500,000 and finally 4% of Income in the very high category with an average salary of Rp. 4,500,000- Rp. 6,000,000.

1. Food availability in fish production

Table 3. Potential fisheries production of Bengkulu city in 2024

No.	Description	Sea water	Fresh water	Brackish water
1.	Capture fisheries	46,145ton/year		
2.	cultivation	500 ha	1.30. ha	300 ha
3.	Other public waters		1500 tons/year	
4.	Pond			100 ha

Source: Diskan Kota Bengkulu 2023

Table 4. Fish production in Malabro village

No.	Description	Total
1.	Fish production during climate change	50kg-60 kg
2.	Fish production when not experiencing climate change	100 kg-150 kg

Source: Primary Data 2024

2. Food access

Table 5. Fishermen's fishing income and Income from non-fishing activities

Description	Average Income/Month (IDR)
Income from fishing	Rp. 2,565,263.00
Income Outside of fishing	IDR 1,151,500.00
Total Income of Fishermen	Rp. 3,716,763.00

Primary data source 2024

The condition of fishermen's food security based on the comparison of expenditure on food and non-food needs.

Proportion of fishermen's food expenditure	Respondent fishermen's average expenditure					average proportion of food expenditure
	Number of households	% Tase	Food	Non-food	Food and non-food	
≥60% of total expenditure		60%	IDR 1,646,428	Rp.478,333	Rp. 2,124,761	77%
<60% of total expenditure		40%	Rp. 953. 750	Rp.246. 153,85	IDR 1,199,903.85	79%

Source: Primary data, processed 2024.

DISCUSSION

D *Impacts of climate change*

Climate change is felt by some areas of Indonesia geographically has a high vulnerability[5][8] . the impact of climate change is the economy, one of which is the background of fishermen as their livelihood when the climate comes. The problem that is experienced is the difficulty in fulfilling fish production in fulfilling family and consumer life. the impact of climate change has an impact on socio-economic life in determining the timing of the arrival of fish because of high wave rainfall it is difficult to predict the fishing season and sea surface temperature and wave height reduce fish catches. the impact of climate change in the malabro village of Bengkulu city because the subsidized diesel fuel system is difficult so that fishermen who own boats find it difficult to get fuel to go to sea so that small fishermen who come with boat owners finally fishermen cannot go to sea.

Fishermen's Income

Income is the total receipt of a person or group in the form of money or goods from their own sources or the results obtained in the form of money or goods within a certain period of time.

The income level of fishermen is measured using the following indicators:

e. Low Income earns below the minimum wage, i.e., IDR 1,000,000 per month.
f. Medium Income with an average income between Rp. 1,300,000 - Rp. 2,000,000 per month
g. High Income with an average income of Rp. 2,000,000 - Rp. 4,500,000 per month
h. Very high Income with an average income of Rp. 4,500,000- Rp. 6,000,000

To find out the Income of fishermen with good weather or experiencing climate change, researchers use a Likert scale. Likert scale is used to measure a person's attitude, Income and perception.

Table.4.3 Level Score

No.	Income Level	Score
1	Lowest Income	1
2	Medium Income	2
3	High Income	3
4	Very high Income	4

[9] The factors that affect the Income of fishermen in malabro village are divided into two, namely internal factors including age factors and external factors, namely natural and technological factors. Based on the results of the research table 3 income level score with a Linkert scale by taking data through a questionnaire along with interviews and calculated using *SPSS*, it is known that the average Income of fishermen once at sea is good in dealing with climate change the number of low fishermen's Income is 32% which is categorized as Income with average results below the minimum wage of Rp. 1000,000, -. 41% of fishermen's Income with moderate Income with an average income of Rp.1300,000, - Rp. 2000,000, -. 23% of Income in the high category with an average income of around Rp.2000,000- Rp.4,500,000 and finally 4% of Income in the very high category with an average salary of Rp. 4,500,000- Rp. 6,000,000.

Fisheries production of kelurahan malabro kota Bengkulu

Bengkulu city fisheries production in table 4.4 shows that Bengkulu's fisheries potential comes from seawater capture fisheries, in accordance with its location on the coast of the Indonesian ocean with a coastline of about 17.5 km in length[10] . The production potential of Bengkulu city fisheries capture fisheries is 46,145 tons / year, seawater aquaculture is 500 ha, freshwater 1030 ha and brackish water 300 ha, other public waters in freshwater as much as 1500 tons / year while ponds are 100 ha in brackish water. fisheries production produced by fishermen in Malabro village has decreased every year due to climate change and other factors. However, the office of the Mayor of Begkulu's regulation No. 44/2016 stipulates that certain areas are to assist fisheries production so that fisheries production does not decline every year and this will have an impact on the food security of fishermen and the food security of the entire Bengkulu city community. Fish production in the face of climate change, fishermen only get 50-60 kg at sea, unlike when there is no climate change, fishermen get 100 kg to 150 kg at sea.

Food security condition of fishermen

Based on the results shown in table 4.4.5, it is known that 60% (Respondents) are known to have a Proposition of food expenditure ≥60.0% with an average expenditure of Rp.1,646,428 / month, and the average consumption expenditure for non-food Rp. 478,333 / month. The research shows that the average proportion of expenditure of these respondents is 77%/month. Thus, the proportion of expenditure of fishermen in Malabro sub-district, especially fishermen respondents, is categorized as high, because ≥60% of the total expenditure of fishermen, the food security of fishermen is classified as Food Insecure.

While 40% (respondents) have food expenditure <60% with an average of Rp. 953. 750 / month, and the average non-food fisherman is Rp.246. 153.85 / month. The results showed that the expenditure of 20 fishermen Respondents, thus the proportion of fishermen's expenditure is categorized as 60% of the total expenditure of fishermen, thus food security is not food resistant. so that it gets special attention from various parties, the condition of food insecurity is a concern because it is influenced by many factors including the low quality of education of fishermen and substandard income conditions, which will have an impact on the daily habits of fishermen's families, especially in terms of fulfilling nutritious food. this is one of the causes of food insecurity risk. [11]

Adaptation strategies for fisher food security in climate change

Social cultural adaptation of Bengkulu city fishermen community

Economic activity

The problem experienced by fishermen is the difficulty in fulfilling fish production for the needs of their families and consumers. Switching jobs to become fishermen in malabro village The needs of life began to improve because of the additional Income earned as a fisherman in malabro village, namely fishermen have two professions, namely as fishermen and traders. Fishermen utilize their coastal village as a tourist attraction where visitors come every day and the fishermen community as part of a sweet shop trader and as a driver. The Fishermen's Profession in dealing with climate change includes

a. Opening sales such as dried fish salted fish)
b. Opened a business because it is near tourist attractions
c. Become a parking attendant
d. Construction laborer

Social activities

The relationship between the social conditions of fishermen in Malabro village is fairly upholding kinship and cooperation with the existence of small fishermen groups that were established and held meetings once a month. The fishermen group is not only a small fishermen group but there are many other fishermen groups so that the social conditions are getting closer and there are community meetings between groups fostered by the relevant government, namely the Bengkulu City Fisheries Service. There are many activities including socialization related to climate change, socialization of assistance to small fishermen and the existence of government programs of the fisheries agency.

Education

Statistics				
		Elementary School	**Junior High School**	**High School**
N	Valid	1	1	1
	Missing	0	0	0
Mean		52.00	36.00	12.00
Median		52.00	36.00	12.00
Minimum		52	36	12
Maximum		52	36	12
Sum		52	36	12
Percentiles	100	52.00	36.00	12.00

Primary Source 2024

The low education of fishermen, the high population of fishermen while the fishing area is limited from the coastline. The condition of limited knowledge and skills of some fishermen due to their low formal education affects the level of productivity of fish catches. As for the training conducted by the agency, according to them, it is inadequate because what they only need is not training but such as assistance funds to be raised again. Utilizing capture fisheries technology The fishing community of Malabro village utilizes capture fisheries technology provided by the Bengkulu city fisheries and maritime affairs office, although in terms of knowledge there are still many small fishermen who do not understand the fishing gear provided because only fishermen group administrators and boat owners participate in this training.

Adaptation strategies in terms of government in dealing with climate change in Malabro village fishermen

Safety and security for fishermen is certainly an appeal to fishermen not to go to sea by not fishing fishermen there is no income from efforts in the government, especially the Bengkulu City Fisheries Service. The fisheries service consists of several fields in handling this problem, especially in the field of small management where the field of

small management fosters fishermen when dealing with climate change that handles production. The fisheries service also provides funding assistance and business partnerships to the fishing communities of Malabro village, among others:

Providing fishing gear such as: edge trawl, net, fishing rod, traps, nets.

a. Providing a Registration Certificate for small fishing communities in the form of a card programmed by the relevant agency, namely the KUSUKA card. This kusuka card is in the form of an ATM so that these small fishing communities can save when the weather is good and fish production is flooded. The relevant agencies provide assistance in the form of funding through the KUSUKA card when climate change occurs. This KUSUka card was established in 2019.
b. creating law enforcement systems and social institutions
c. Creating a marine and fisheries information system
d. Fostering entrepreneurial insights in the field of marine and fisheries to the people of Malabro village, especially small fishermen.

CONCLUSION

Adaptation strategies for fishermen's food security in the face of climate change in Malabro Outlet, Bengkulu City The form of climate change experienced by fishing communities The occurrence of weather changes such as hot afternoons and afternoons to nights of rain that occur in the region is caused by the orographic rain factor where there is solar energy that causes pengupan both from lakes and others so that the results of pengupan form clouds that move according to the direction of the wind in the upper layer. so that high rainfall causes excess water for agriculture, water resources and can cause floods and landslides.

a. The amount of rainfall in Bengkulu Province depends on the altitude of the place, the presence of ranges and mountains, distance and land area.
b. Weather change from EL Nino to La Nina in July to August 2024
c. High sea levels in Bengkulu cause erosion, affecting marine habitats and threatening coastal settlements.
d. Climate conditions in Bengkulu affect coastal conditions because climate change such as sea level rise can affect coastal conditions.
e. Environmental damage and *overfishing*
f. Increasing rise in fish due to impacts of climate change
g. Change in catch production
h. Economic vulnerability

Some of the factors that influence the changes in fish production experienced by small fishermen in Malabro village affect the weather conditions and the second thing that disturbs small fishermen is that there are still many large fishermen who use Trawl.

The impact of marine ecosystems is an increase in the frequency of high waves and storms as a result of sea level rise. Malabro Village's fishing communities, especially small-scale fishermen, are traditional and unprepared to deal with storm surges.

The impact of climate change also has an impact on the health of the fishing community, which is a factor of life; in Malabro Village, at a vulnerable age or elderly age due to the impact of climate change, the elderly force themselves to keep working to fulfill their daily needs so that they experience deteriorating health conditions. In dealing with climate change, fishermen's activities include trading preserved fish, trading in tourist spots such as selling food and drinks and knick-knacks such as corals obtained from fishing.

The Income of fishing communities is categorized with low, medium, high Income and very high Income based on the results of research using frequency tables with spss fishermen's Income with low Income below the minimum wage, namely Rp.1000,000 with a presentation of low fishermen's Income of 32% which is categorized as Income with average results below the minimum wage of Rp. 1000,000, -. 41% of fishermen's Income with medium Income

with an average income of Rp.1300,000, - Rp. 2000,000, -. 23% of Income in the high category with an average income of around Rp.2000,000- Rp.4,500,000 and finally 4% of Income in the very high category with an average income of Rp. 4,500,000- Rp. 6,000,000. Fishermen's Food Security Level in the category of food availability in fish production when experiencing climate change the amount of fish obtained from fishing amounts to 50-60kg and fish production when not experiencing climate change the results obtained range from 100 kg-150 kg. in food access. The fishing community in Malabro especially small fishermen do not have agricultural land and do not produce food directly.

Fish food is food obtained by producing it yourself by going to sea. Fishermen's Income in Fishermen's activities outside of fishing amounted to Rp. 1,151,500.00 / month. Income outside of fishing is done by fishermen such as: parking attendants, trading sweet stalls, trading processed fish products that are dried and other activities. Based on the research results of Rp. 3,716,763.00 / month. Based on the fishermen's food expenditure with an average of Rp. 650,250 / month with the proportion of food expenditure in the fishermen's total consumption of 65%. While for non-food expenditures with an average of Rp. 348,300 / month. in accordance with the results of the study, the proportion of fishermen's expenditures for food and non-food needs to total Income of Rp. 998,550.- based on the table by considering the table in general, the food expenditure of fishermen in Malabro village is 65%, this can be interpreted as high fishermen's food expenditure from <60% of total fishermen's expenditure) this shows the degree of food security of the fishing community in Malabro village is categorized as not food resistant. The condition of food security is known that 60% (Respondents) have a proportion of food expenditure ≥60.0% with an average expenditure of Rp.1,646,428 / month, and the average consumption expenditure for non-food Rp. 478,333 / month. The research shows that the average proportion of expenditure of these respondents is 77%/month. Thus, the proportion of expenditure of fishermen in Malabro sub-district, especially fishermen respondents, is categorized as high, because it is ≥60% of the total expenditure of fishermen, thus the food security of fishermen is categorized as Food Insecure. While 40% (respondents) have food expenditure <60% with an average of Rp. 953. 750 / month, and the average non-food fishermen Rp.246. 153.85 / month.

The results showed that the expenditure of 20 fishermen Respondents, thus the proportion of fishermen's expenditure is categorized as 60% of the total cost of fishermen's expenses, meaning food security is not food resistant. People who work as fishermen are mostly found with the last education, namely elementary school (SD) with a presentation of 52% and junior high school 36% and high school 12% in the adaptation strategy for economic activities of the fishing community utilizing their coastal village as a tourist attraction where every day visitors arrive so that the fishing community switches professions as stall traders, parking attendants, and centers for dried fish souvenirs as a typical form of Bengkulu city food.

Social activities in the form of adaptation strategies by holding socialization meetings between fishermen groups that have been formed by government programs that hold socialization and provide assistance from government programs to overcome climate change that cannot go to sea. As for the adaptation strategy in terms of the government handling climate change in Malabro village fishermen, namely

i. Providing fishing gear such as: edge trawl, net, fishing rod, traps, nets.
j. Providing a Registration Certificate for small fishing communities in the form of a card programmed by the relevant agency, namely the KUSUKA card. This kusuka card is in the form of an ATM so that these small fishing communities can save when the weather is good and fish production is flooded. The relevant

agencies provide assistance in the form of funding through the KUSUKA card when climate change occurs. This KUSUka card was established in 2019.

k. Develop law enforcement systems and community institutions
l. Develop a marine and fisheries information system
m. Fostering entrepreneurial insights in the field of marine and fisheries to the people of Malabro village, especially small fishermen.

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