
Adaptation of Coastal Fishermen in Pacitan Regency Due to Climate Change Through the Sustainable Livelihood Framework Approach

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Abstract

The phenomenon of climate change is one of the events that affect the coastal communities of Pacitan Regency, especially their livelihoods as fishermen. The purpose of this study is to analyze the adaptation activities of fishermen due to climate change that affects fishermen's household income using a sustainable livelihood approach. Determination of respondents through purposive sampling technique, where the total sample is 104 fishermen. This study uses a survey method in the field with fishermen based on several questions through questionnaires submitted to coastal fishermen in the District of Pacitan Regency. Factor analysis and multiple regression were used to analyze the data. The results showed that simultaneously the variables of fishermen's adaptation choices, government adaptation choices, education level, age and experience as fishermen, fishermen's distance to the sea, location of mangrove areas, savings, asset ownership, credit, participation in fisherman group organizations, and ownership of tools. Simultaneous capture has a significant effect on the total income of fishermen. Partially, the variable of fisherman adaptation choice, education level, age, the distance of fishermen when fishing, location of mangrove area, savings, asset ownership, credit, and ownership of fishing gear have a significant and positive effect on the total income level of coastal fishermen in Pacitan Regency, while the experience variable as fishermen have a negative and significant effect on the total income level of coastal fishermen in Pacitan Regency.

Keywords: adaptation of coastal fishers, livelihood assets, livelihood outcomes

1. Introduction

The State of Indonesia has two-thirds of the territorial waters with an area of 3.25 million km² and 2.55 million km² which are Exclusive Economic Zones. Indonesia has the largest island in the world from Sabang to Merauke and is entitled to the utilization of living and non-living natural resources in waters covering an area of 7.81 million km² (kkp.go.id, 2020). Indonesia's potential has great opportunities in the marine and fisheries sector. The fisheries sector is a

mainstay in national development. There is a lot of marine product production that is exported and needs to be maintained and maintained, so it needs to be managed and monitored optimally. Coastal communities work as fishermen to fulfill their daily needs to achieve prosperity. The phenomenon of climate change is one of the events that affect coastal communities. Changes due to climate will make coastal communities more vulnerable than changes in the socio-economic environment (Freduah *et al.* 2017). Vulnerability occurs in coastal communities who depend on the fishery sector for their livelihoods.

Coastal communities who depend on the fishery sector for their livelihoods will have a major impact on climate change. Uncertain climatic conditions will result in a change in the monsoon season, known as the east monsoon season and the west monsoon season. The wind season will affect the activities of fishermen in catching fish in the sea and adaptation to nature. The location of the fish gathering also depends on the particular season, the type of fish caught at each location according to natural conditions is ongoing. This is a differentiating factor in the way fishermen work from one place to another, from one season to another (Ansaar, 2019). Changes in seasons require fishermen to have the ability to estimate the location and time of fishing. Climate change that occurs is a natural phenomenon that is always faced by fishermen and is not a new thing in carrying out fishing activities, especially coastal fishermen who only carry out their activities in an area that ranges from one mile from the coast. Strong winds accompanied by large waves on the sea surface cause fishermen to be unable to catch fish, if fishermen are determined to go to sea, the boats they use will face unpredictable weather accompanied by high tidal waves.

Pacitan Regency has a coastal area with resources that can be utilized with an area of 4 nautical miles to 523.82 km², with a beach length that stretches 70.709 km² and is explained further in table 1 (Dinas Perikanan Kabupaten Pacitan, 2020). Areas of activity in the fisheries sector, for capture fisheries in Pacitan Regency, include 7 (seven) coastal sub-districts, namely (1) Pacitan District; (2) Pringkuku District; (3) Kebonagung District; (4) Tulakan District; (5) Ngadirojo District; (6) Sudimoro District; (7) Donorojo District. The following is table 1 for the territorial waters of 7 sub-districts based on the area of authority.

Table 1. Area of Water based on the Territory of Authority

No	Subdistrict	Coastline		Area of Authority				ZEEI	
		(mills)	(km)	4 mill (mill2)	12 mill (km2)	12 mill (mill2)	(km2)	(mill2)	(km2)
1	Donorojo	4.52	8,371	18.08	62.01	186.04	54.24	3,100.62	904
2	my ring	8.52	15,779	34.08	116.89	350.67	102.24	5,844.54	1,704
3	Pacitan	1.39	2,574	5.56	19.17	57,20	16.68	953.41	278
4	Kebonagung	10,17	18,835	40.68	139.53	418.59	122.04	6,976.48	2.034
5	curse	1.94	3,593	7.76	26.62	79.85	23.28	1330.85	388
6	Ngadirojo	5.69	10.538	22.76	78.07	234.20	68.28	3,903.28	1.138
7	Sudimoro	5.95	11,019	23.80	81.63	244.89	71.40	4081.44	1.190
Total		38.18	70.709	152.72	523.82	1,571.44	458,16	26,190.62	7.636

Note: ZEEI = Indonesian Exclusive Economic Zone

Source: Dinas Perikanan Kabupaten Pacitan, 2020.

The marine area in Pacitan Regency is directly adjacent to the Indonesian Ocean which has rocky characteristics and big waves. These characteristics become a good fishing ground for catching fish and abundant. The number of potential resources on the coast of Pacitan Regency is actually abundant but management is still at a very low level. Fishermen in the coastal area of Pacitan Regency in catching fish are still simple, only using string nets, kredet umbrellas, basic longlines, fishing rods, gill nets and hand lines (Pianto *et al.*, 2017). Several types of tools mentioned above are used to catch different types of fish. Likewise, for many types of fish found on the coast of Pacitan Regency, the catch is only sold traditionally, which means it is only marketed in nearby markets.

The fishing season on the coast of Pacitan Regency occurs from May to November. For another month there is a famine season, fishermen in the coastal area of Pacitan district stop going to sea due to the westerly wind. During this season, only 80% of traditional fishermen catch fish so that income decreases by 20%-25% from the state of fishing season (Pianto *et al.*, 2017). It was explained further because it made the coastal fishing families of Pacitan district to meet their daily needs with debt or using spare money. According to the Marine and Fisheries Training and Extension Center, the work of fishermen is divided into four namely small fishermen, traditional fishermen, labor fishermen, and owner fishermen. On the coast of Pacitan Regency, there are traditional fishermen, small fishermen, labor fishermen and only a few are owner fishermen, so the tools used to catch fish are still relatively simple with relatively low catches and a relatively low level of education.

The majority of coastal communities in Pacitan Regency have a livelihood as fishermen. In 2020 the number of marine fisheries households is 4,540 people (Badan Pusat Statistik Kabupaten Pacitan, 2020). The majority of coastal communities in Pacitan Regency have a livelihood as fishermen. In 2020 the number of marine fisheries households is 4,540 people (Badan Pusat Statistik Kabupaten Pacitan, 2020). According to data Survey Sosio Ekonomi Nasional (SUSENAS) shows fishing as one of the livelihoods with the highest aggregate poverty rate in Indonesia compared to the rural and agricultural sectors (Anna, 2019). The economic level of coastal fishermen in Pacitan Regency is not much different from other regions, it can be said to have a high tendency to poverty levels. The fishermen's poverty rate that occurs provides an understanding that fishermen's income is low and fishermen's vulnerability is high.

The existence of fishermen in Indonesia is evenly distributed, although there are some areas that have a fairly large number of fishermen compared to other areas. Based on data from the Kementrian Kelautan dan Perikanan (2019), it shows that the number of fishermen in East Java Province is the second largest in Indonesia with a total of 213,495 fishermen, Maluku ranks first with 218,981 fishermen. The number of coastal fishermen in East Java Province is proportional to the number of regencies/cities in East Java which are coastal areas. Based on geographical conditions, there are 22 regencies/cities in coastal areas in East Java Province (Dinas Kelautan dan Perikanan Provinsi Jawa Timur, 2018). Where the poverty rate in East Java in 2020 is still quite high. The percentage of poor people in East Java as much as 11.09 percent exceeds the percentage of the national poor as much as 10.19 percent. The number of poor people in East Java until September 2020 was 4,585.97 thousand people (Badan Pusat Statistik Jawa Timur,

2021). In East Java province, the number of poor people in Pacitan Regency is 14.55 percent where there are 80.82 thousand poor people. The Central Statistics Agency (BPS) divides the poverty rate in two areas, including urban and rural areas. Until the writing of this research BPS does not have data on poverty in coastal areas, both national and local level data.

Based on socio-economic conditions and livelihood problems as fishermen, there is a risk of uncertainty because there is a fishing period. Fishermen must be able to adapt to all changes because fishing is a seasonal job due to climate change. Climate change that occurs is a natural event that occurs naturally and can also arise due to human activities themselves. As climate change is uncertain, fishermen catch fish according to the fishing season. When the west season comes suddenly, the weather conditions are bad, there are big waves due to strong winds causing fishermen not to go to sea. The reduced time spent by fishermen in fishing activities due to climate change has an impact on the decline in fisherman's household income. Climate change that affects the coast is an increase in temperature, an increase in rainfall, and an increase in sea level. With these changes, fishermen must be adaptive to all existing changes. Adaptation activities due to climate change are an inseparable part. Adaptation activities must be developed, strengthened for encouragement to the community, must be endeavored and there needs to be a plan because this event cannot be avoided. If the condition of coastal fishermen is left unchecked without any adaptation activities, the condition will be even more alarming. Adaptation activities due to climate change are an inseparable part. Adaptation activities must be developed, strengthened for encouragement to the community, must be endeavored and there needs to be a plan because this event cannot be avoided. If the condition of coastal fishermen is left unchecked without any adaptation activities, the condition will be even more alarming. Adaptation activities due to climate change are an inseparable part. Adaptation activities must be developed, strengthened for encouragement to the community, must be endeavored and there needs to be a plan because this event cannot be avoided. If the condition of coastal fishermen is left unchecked without any adaptation activities, the condition will be even more alarming.

Adaptation activities due to climate change are an inseparable part, must continue to be developed and strengthened for encouragement to the community, must be endeavored and there needs to be a strategy because climate change events cannot be avoided. This study wants to find out how the adaptation of fishermen due to climate change affects fishermen's household income using a sustainable livelihood approach. Through the Sustainable Livelihood approach, it will describe stakeholders related to vulnerability in the form of shocks, trends and seasons, with the poor having access to livelihood assets to face vulnerability (Kollmair & Gamper, 2002). Livelihood assets to deal with vulnerabilities include human capital, natural capital, financial capital, social capital and physical capital. Where these assets are in the process of obtaining benefits known as livelihood outcomes. Outcomes in the form of greater income, increased welfare, reduced vulnerability, improved food security and also more sustainable use of natural resources (Kollmair & Gamper, 2002). The existence of assets owned by fishermen can contribute to increasing fishermen's income which is a livelihood outcome. Study Stacey *et al.*, (2021) revealed that the sustainable development of coastal livelihoods is essential to support communities escape poverty and to achieve social, economic, environmental goals and to minimize the impact of climate change. Explained further in research Deb & Haque (2017)

Fisherman's coping and adaptation strategies consist of a combination and a series of overlapping complex actions taken by households based on human capital, natural capital, financial capital, social capital, physical capital and the ability of fishermen to achieve a certain level of livelihood.

The purpose of this study is to analyze the adaptation activities of fishermen due to climate change that affects fishermen's household income using a sustainable livelihood approach. The research assets owned by fishermen include human capital assets (education level, age and experience as a fisherman), natural capital assets (distance of fishermen to sea, location of mangrove areas), financial capital assets (savings, asset ownership and credit), social capital assets (participation in fisherman group organizations), and physical capital assets (ownership of fishing gear) to fisherman's household income.

2. Method

2.1 Data Types and Sources

The type of data used in this study can be divided into two based on the grouping, namely (1) Primary data, data obtained through survey results in the field with fishermen based on several questions through questionnaires submitted to coastal fishermen in the Pacitan District; (2) Secondary Data, data obtained from information or research results provided by the relevant agency services, reference books, journals, mass media, internet, and others that support the problems studied. Furthermore, the analysis process is carried out on the data that has been collected, so that the existing data will complement each other.

2.2 Population and Sample

The population is the whole of the object of research. The population in this study were all coastal fishermen of Pacitan Regency. Based on the data obtained, the number of fishermen based on 9 sub-districts in Pacitan Regency is 4,540 people.

The sample is part of the total population to be studied. The sample was selected through a purposive sampling technique, in which the Pacitan sub-district was chosen because it as the largest number of fishermen. The sample is calculated using the Slovin formula, so that jthe number of samples as many as 94 respondents. In this study, 10% of the total sample was added to anticipate drop outs. The total number of respondents who will be sampled in this study is 104 respondents from coastal fishermen in Pacitan District, Pacitan Regency.

2.3 Data analysis method

The data analysis technique used in this research is multiple linear regression equation and Ordinary Least Square (OLS). The multiple linear regression equation model in this study is as follows:

$$F_i = \alpha + \beta_1 F_a + \beta_2 G_a + \beta_3 E_l + \beta_4 A_g + \beta_5 E_f + \beta_6 D_f + \beta_7 L_o_m + \beta_8 S_v + \beta_9 A_o + \beta_{10} C_r + \beta_{11} f_o + \beta_{12} k_o + e$$

F_i = Fishermen's income (Rp per month)

α = Constant

β = Regression Coefficient

- Fa = Fisherman adaptation options (Pan= 1: make adaptation choices more than one; Pan = 0: performs one adaptation option)
Ga = Government adaptation options (Pap= 1: make adaptation choices more than one; Pap = 0: performs one adaptation option)
El = Education level (Tp=1: SMA and above; Tp=0: Middle school and below)
Ag = Age (years)
Ef = Experience as a fisherman (years)
Df = distance traveled by fishermen (km)
Lom = Location of mangrove area (Lok=1: mangrove area; Lok=0: no mangroves)
Sv = Savings (Tb=1: have savings; Tb=0: no savings)
Ao = Asset ownership (Kp=1: have more than one asset; Kp=0: have one asset)
Cr = Credit (Cr=1: have credit; Cr=0: no credit)
fo = The participation of fishermen group organizations (ko=1: follow fisherman group organization; ko=0: not following the organization fishing group)
ko = Ownership of fishing gear (ka= 1:one's own; ka=0: Child Ships (ABK))
e = Error

3. Results

3.1 Coefficient of Determination (R²)

The coefficient of determination is used to measure the best accuracy of multiple linear regression analysis. If the R² obtained is close to 1 (one), it can be said that the stronger the model explains the independent variable to the dependent variable. Conversely, if R² is close to 0 (zero), then the weaker the independent variables explain the dependent variable. This means that what percentage of the fisherman's total income variable (Y) can be explained by the fisherman's adaptation choice (X1), the government's adaptation choice (X2), education level (X3), age (X4) and experience as a fisherman (X5), the distance fishermen travel when fishing (X6), location of mangrove areas (X7), savings (X8), asset ownership (X9), credit (X10), participation in fishing group organizations (X11), and ownership of fishing gear (X12).

Table 2. Coefficient of determination test results (R2)

Dependent Variable: Fi

Method: Least Squares

Samples: 1 104

Included observations: 104

Variable	Coefficient	Std. Error	t-Statistics	Prob.
C	-465933.3	511806.6	-0.910370	0.3650
Fa	9979000.9	244598.8	4.079746	0.0001
Ga	130066.4	223574.7	0.581758	0.5622
El	647876.4	219130.5	2.956578	0.0040
Ag	44447.27	14251.26	3.118832	0.0024
Ef	-44520.31	11485.34	-3.876272	0.0002
Df	67554.69	10753.05	6.282378	0.0000
Lom	662799.2	243803.5	2.718579	0.0079
Sv	459594.6	228163.2	2.014324	0.0469
Ao	643148.5	250043.5	2.572147	0.0117
Cr	456941.2	200069.2	2.283916	0.0247
fo	-267111.4	194139.4	-1.375874	0.1722
ko	545720.2	238027.6	2.292676	0.0242
R-squared	0.811388	Mean dependent var		3306731.
Adjusted R-squared	0.786516	SD dependent var		1828049.
SE of regression	844638.3	Akaike info criterion		30.24767
Sum squared resid	6.49E+13	Schwarz criterion		30.57822
Likelihood logs	-1559,879	Hannan-Quinn Criter.		30.38159
F-statistics	32.62258	Durbin-Watson stat		1.886429
Prob(F-statistic)	0.000000			

Source: Output Eviews Version 9

Based on table 4.18 above, the coefficient of determination has an adjusted R square of 0.786516. This means that 78.6% of fishermen's total income (Y) can be explained by independent variables, which can be explained by the variable of fishermen's adaptation choices (X1), government adaptation choices (X2), education level (X3), age (X4) and experience as a fisherman (X5), distance of fishermen when fishing (X6), location of mangrove areas (X7), savings (X8), asset ownership (X9), credit (X10), participation in fishermen group organizations (X11), and ownership of fishing gear (X12). While the remaining 21.4% can be explained by other variables not examined.

3.2 F Test

The F test is a simultaneous test to determine whether the variable fisherman adaptation choices (X1), government adaptation options (X2), education level (X3), age (X4) and experience as a fisherman (X5), distance of fishermen when fishing (X6), location of mangrove areas (X7), savings (X8), ownership of assets (X9), credit (X10), participation in fisherman group

organizations (X11), and ownership of fishing gear (X12) simultaneously have a significant effect on the total income of fishermen. From the results of the analysis can be seen in table 3 below:

Table 3. F Test Results

Dependent Variable: Fi

Method: Least Squares

Samples: 1 104

Included observations: 104

Variable	Coefficient	Std. Error	t-Statistics	Prob.
Fa	9979000.9	244598.8	4.079746	0.0001
Ga	130066.4	223574.7	0.581758	0.5622
El	647876.4	219130.5	2.956578	0.0040
Ag	44447.27	14251.26	3.118832	0.0024
Ef	-44520.31	11485.34	-3.876272	0.0002
Df	67554.69	10753.05	6.282378	0.0000
Lom	662799.2	243803.5	2.718579	0.0079
Sv	459594.6	228163.2	2.014324	0.0469
Ao	643148.5	250043.5	2.572147	0.0117
Cr	456941.2	200069.2	2.283916	0.0247
fo	-267111.4	194139.4	-1.375874	0.1722
ko	545720.2	238027.6	2.292676	0.0242
R-squared	0.811388	Mean dependent var		3306731.
Adjusted R-squared	0.786516	SD dependent var		1828049.
SE of regression	844638.3	Akaike info criterion		30.24767
Sum squared resid	6.49E+13	Schwarz criterion		30.57822
Likelihood logs	-1559,879	Hannan-Quinn Criter.		30.38159
F-statistics	32.62258	Durbin-Watson stat		1.886429
Prob(F-statistic)	0.000000			

Source: Output Eviews Version 9

From the output results in table 4.17 that the value of Prob. (F-Statistic) is 0.000000 where the value is $0.000000 < 0.05$, then there is a simultaneous influence from fishermen's adaptation choices (X1), government adaptation choices (X2), education level (X3), age (X4) and experience as a fisherman (X5), distance of fishermen when fishing (X6), location of mangrove areas (X7), savings (X8), ownership of assets (X9), credit (X10), participation in fisherman group organizations (X11), and ownership fishing gear (X12) to the total income of fishermen (Y). This shows that the independent variables simultaneously and jointly have a significant effect on the dependent variable.

3.3 t test

The t-test was used to examine the effect of the independent variables (fishermen's adaptation choices, government adaptation choices, education level, age and experience as a fisherman, fishermen's distance to sea, location of mangrove areas, savings, asset ownership, credit, participation in fisherman group organizations, and ownership of fishing gear) on the dependent variable (total fisherman income) partially (to test whether or not each independent variable is significant to the total income of fishermen) using a significant level of 0.10. The significant value of the t test in this study is shown in table 4 as follows:

Table 4. Significant Value of t Test

Dependent Variable: Fi

Method: Least Squares

Samples: 1 104

Included observations: 104

Variable	Coefficient	Std. Error	t-Statistics	Prob.
Fa	9979000.9	244598.8	4.079746	0.0001
Ga	130066.4	223574.7	0.581758	0.5622
El	647876.4	219130.5	2.956578	0.0040
Ag	44447.27	14251.26	3.118832	0.0024
Ef	-44520.31	11485.34	-3.876272	0.0002
Df	67554.69	10753.05	6.282378	0.0000
Lom	662799.2	243803.5	2.718579	0.0079
Sv	459594.6	228163.2	2.014324	0.0469
Ao	643148.5	250043.5	2.572147	0.0117
Cr	456941.2	200069.2	2.283916	0.0247
fo	-267111.4	194139.4	-1.375874	0.1722
KA	545720.2	238027.6	2.292676	0.0242
R-squared	0.811388	Mean dependent var		3306731.
Adjusted R-squared	0.786516	SD dependent var		1828049.
SE of regression	844638.3	Akaike info criterion		30.24767
Sum squared resid	6.49E+13	Schwarz criterion		30.57822
Likelihood logs	-1559,879	Hannan-Quinn Criter.		30.38159
F-statistics	32.62258	Durbin-Watson stat		1.886429
Prob(F-statistic)	0.000000			

Source: Output Eviews Version 9

The results of the partial regression analysis above can be concluded that:

- a. Fisherman's Adaptation Choice (X1) on the total income of fishermen (Y)
Significant value on fisherman's adaptation choice of $0.0001 < 0.05$, it can be concluded that the choice of adaptation of fishermen has a positive and significant effect on the total income of fishermen.

- b. Government Adaptation Options (X2) to the total income of fishermen (Y)
Significant value on government adaptation options of $0.5622 > 0.05$, it can be concluded that the government's choice of adaptation has a positive and insignificant effect on the total income of fishermen.
- c. Education Level (X3) to the total income of fishermen (Y)
Significant value in education of $0.0040 < 0.05$, it can be concluded that the level of education has a positive and significant effect on the total income of fishermen.
- d. Age (X4) to the total income of fishermen (Y)
Significant value at age of $0.0024 < 0.05$, it can be concluded that age has a positive and significant effect on the total income of fishermen.
- e. Experience as a fisherman (X5) to the total income of fishermen (Y)
Significant value on experience as a fisherman is $0.0002 < 0.05$ then it can be concluded that experience as a fisherman negative and significant effect on the total income of fishermen.
- f. The distance of fishermen (X6) to the total income of fishermen (Y)
Significant value for fishermen's distance is $0.0000 < 0.05$ then it can be concluded that fishing distance positive and significant effect on the total income of fishermen.
- g. Location of mangrove area (X7) to the total income of fishermen (Y)
The significant value at the location of the mangrove area is $0.0079 < 0.05$ then it can be concluded that location of mangrove are a positive and significant effect on the total income of fishermen.
- h. Savings (X8) to the total income of fishermen (Y)
Significant value in savings is $0.0469 < 0.05$ then it can be concluded that savings positive and significant effect on the total income of fishermen.
- i. Asset ownership (X9) to total income of fishermen (Y)
Significant value in asset ownership is $0.0117 < 0.05$ then it can be concluded that asset ownership positive and significant effect on the total income of fishermen.
- j. Credit (X10) to the total income of fishermen (Y)
Significant value on credit of $0.0247 < 0.05$ then it can be concluded that credit positive and significant effect on the total income of fishermen.
- k. Participation in fishermen's group organizations (X11) on the total income of fishermen (Y)
Significant value on participation in fishermen group organizations is $0.1722 > 0.05$ then it can be concluded that k participation in fisherman group organizations negative and insignificant effect on the total income of fishermen.

1. Ownership of fishing gear (X12) to the total income of fishermen (Y)
Significant value in ownership of fishing gear is $0.0242 < 0.05$ then it can be concluded that fishing gear ownership positive and significant effect on the total income of fishermen.

4. Discussion

4.1 The Influence of Fisherman's Adaptation Choices on Fishermen's Total Income

The results of the research that have been carried out show that the variable of fisherman's adaptation choice has a positive and significant effect on the total income of coastal fishermen. The more adaptation choices you make, the higher the total income of coastal fishermen in Pacitan Regency. Adaptation options for coastal fishermen in Pacitan Regency include diversification of income sources (business other than in sectors other than fishermen), diversification of fishing gear, changing fishing periods and changing fishing locations. The results of this study are in line with research Mills et al. (2017) who argues that diversifying income sources in the short term builds household income security and food supply. Based on research results Biso et al. (2017) fishermen in Bahoi Village, Likupang Barat District, North Minahasa Regency carry out business activities to earn more income other than as fishermen. The research results are also supported by Bell et al. (2018) argues that diversification of fishing gear, changing fishing periods and changing fishing gear locations are adaptation strategies to increase fishery resilience to fluctuations in fishery resources and can become alternative sources of income.

4.2 Effect of Government Adaptation Choices on Total Income of Fishermen

The results of the research that have been carried out show that the government's adaptation choice variable has a positive and insignificant effect on the total income of coastal fishermen. The government's adaptation options accepted by coastal fishermen in Pacitan Regency include participating in entrepreneurship training, being given an insurance policy and having credit facilities. Of the three adaptation options, the government dominates the fishermen's adaptation choices, namely participating in entrepreneurship training. There are various kinds of entrepreneurship training received by coastal fishermen in Pacitan Regency, but there is no follow-up from fishermen to carry out entrepreneurial activities. As for the viber service training, there were only 4 fishermen out of 59 fishermen who participated in entrepreneurship training and continued to serve as a diversified source of income.

The next government adaptation option is the activity of providing insurance policies from the government related to fishing routines by minimizing risk. Insurance is used to anticipate weather-related disasters that occur suddenly and will provide protection in the short and long term due to unforeseen consequences (Linnerooth-bayer & Mechler, 2011). In the Coastal District of Pacitan, many fishermen do not receive an insurance policy because they do not know information about granting insurance policies to fishermen. There are 104 respondents who are sampled in this study, only 26 respondents who get insurance. Another reason fishermen do not receive insurance is because there are many requirements that cannot be met by fishermen on the coast of Pacitan Regency.

Another adaptation option, namely the provision of credit facilities from the government, is not accepted by the coastal fishermen of Pacitan Regency. Having a credit facility provides an effective solution for fishermen because they will get some money with the post-disaster recovery process (Shaffril et al. 2017). There are only a few coastal fishermen in Pacitan Regency who receive credit facilities because most fishermen do credit to informal institutions. Fishermen assume that credit made in formal institutions will be difficult to obtain because fishermen need fast capital for fishing. Informal credit sources are the fishermen's choice to obtain loans because they are considered to have easy access (Mueller & Quisumbing, 2010) and requires no collateral, no interest, and a flexible return system (Kristianti *et al.*, 2014).

4.3 The Effect of Education Level on Fishermen's Total Income

Based on the research that has been done, it shows that the education level variable has a positive and significant effect on the total income of coastal fishermen. The higher the education level, the higher the total income of coastal fishermen in Pacitan Regency. The results of this study are in accordance with the research conducted Konoralma *et al.*, (2020) that the level of education has a positive and significant effect on fishermen's income. According to Fernando (2016) Education level is an important thing in a person's life to compete in the job market. A person's level of education will increase knowledge, understanding and be able to develop themselves in improving infrastructure suggestions so as to support the addition of fishermen's income.

4.4 Effect of Age on Fishermen's Total Income

The most dominant age of fishermen on the coast of Pacitan Regency is 49-54 years old, which is a productive age. Based on the results of the study, it showed that the age variable had a positive and significant effect on the total income of coastal fishermen. The more mature the fishermen are, the higher the total income of coastal fishermen in Pacitan Regency. The results of this study are in accordance with the research conducted Konoralma *et al.*, (2020) that age has a positive effect on the total income of coastal fishermen. The level of maturity of a person's age affects skills and abilities in catching fish. On the coast of Pacitan Regency, the productive age of a fisherman is influential because the power is still strong so that they can try harder to get catches and work other than fishing to get an abundant total income. This is in accordance with the opinion Sari & Rauf (2020) The age of the fisherman has an effect on income because at the productive age fishermen can do more work because they have more energy than the non-productive age.

4.5 The Effect of Experience as a Fisherman on the Total Income of Fishermen

The results showed that the experience as a fisherman variable had a negative and significant effect on the total income of coastal fishermen. Experience as a fisherman on the coast of Pacitan Regency has a negative effect, which means that although he has long experience, his income has decreased. This happens because according to experience as fishermen, they do not want to take the risk of going to sea when the western season occurs. This research is in accordance with the results of research conducted by Rahim & Hastuti (2016) The experience of fishermen at sea has a negative and significant effect on fishermen's income.

4.6 The Effect of Mileage of Fishermen on Total Income of Fishermen

The results showed that the mileage variable had a positive and significant effect on the total income of coastal fishermen. The farther the distance of fishermen when they go to sea, the total income of coastal fishermen in Pacitan Regency is getting higher. The results of this study are in accordance with the research conducted Konoralma *et al.*, (2020) that the distance of fishermen has a positive effect on the total income of coastal fishermen. The farther the fishermen travel, the more varied the types of fish caught. Various types of available fish can be caught by fishermen resulting in increased income. Coastal fishermen of Pacitan Regency predominantly cover distances of 10-28 km using outboard motor boats. The further ships can venture from the port of origin, the more fish they will catch. Marine fish resources in offshore waters are assumed to be abundant and underutilized, while fish stocks in nearshore areas have been overexploited (Nguyen *et al.*, 2019).

4.7 Effect of Mangrove Area Location on Fishermen's Total Income

The location of the mangrove area is closely related to the availability of fish as a feeding ground area and a spawning area for various aquatic biota including fish, shrimp and shellfish that live in coastal and offshore waters. Based on the results of the study showed that the variable location of the mangrove area had a positive and significant effect on the total income of coastal fishermen. Coastal fishermen in Pacitan district who catch fish in mangrove areas have higher total income. The results of this study are in accordance with the research conducted Hafni (2016) that mangrove forests that are not maintained and not conserved will threaten the sustainability of fishermen's incomes which are decreasing. The decline in fishermen's income is due to the decreasing area of mangrove forests in Lubuk Kertang Village.

On the coast of Pacitan Regency, the location of the mangrove area is still relatively narrow, but some fishermen have felt the benefits, namely the increase in catches so that their income also increases. Of the 104 fishermen studied, 20% of fishermen have received benefits from the mangrove area, namely being able to catch fish with various types of fish so as to support fishermen's income. Mangrove area affects the diversity and number of marine biota on the entire food chain ladder. The research results are in accordance with Ikbal *et al.*, (2019) the damage to the mangrove forest ecosystem resulted in a decrease in species, the number of marine biota caught by fishermen, which directly resulted in a decrease in the household income of fishermen in the research location.

4.8 The Effect of Savings on Fishermen's Total Income

The results of the research that have been carried out show that the savings variable has a positive and significant effect on the total income of coastal fishermen. This is in accordance with Keynes' theory in Mankiw (2013) that an increase in income will have an impact on high consumption and public saving, an increase in public saving will in turn have an impact on high capital accumulation so that business capital will also increase along with an increase in income and savings. The income of fishermen in the Coast of Pacitan Regency comes from income from fish catching businesses and from outside businesses as fishermen, while the increase in the family economy includes meeting the daily needs of the community, increasing business capital, and increasing savings.

The research results are also in line with Dance (2020) fishermen's income resulted in an increase in community economic activities. The level of total income of fishermen both from fishing and outside business as fishermen will have an impact on increasing the fishermen's economy, increasing the fulfillment of daily needs, increasing savings, and increasing business capital. This condition also affects when fishermen's income decreases, there will be a decrease in the economic level of the community. The coastal fishermen of Pacitan Regency who dominate are fishermen who do not have savings. Fishermen's expenditures are mostly used for consumption activities and asset enhancement to support fishing activities by maximizing total income, while saving is the last step if the income is sufficient for daily activities.

4.9 Effect of Asset Ownership on Total Income of Fishermen

The results of the research that have been carried out show that the asset ownership variable has a positive and significant effect on the total income of coastal fishermen. The more assets owned by fishermen, the higher the total income of coastal fishermen in Pacitan Regency. The results of the study are in line with research conducted by Mahpud *et al.*, (2016) Asset ownership has a positive and significant effect on fishermen's income. On the coast of Pacitan Regency, fishermen's assets include livestock, land, vehicles, jewelry and so on.

Research result also supported by Trijayanti & Mutaali (2018) Assets owned by fishermen greatly affect the income and economy of fishermen's households, where fishermen who have large incomes will have fixed assets. Ownership of fishermen's assets is obtained by fishermen through the ability of fishermen to carry out fishing activities and activities outside the sea to increase income. As for what dominates the coastal fishermen of Pacitan Regency, fishermen have more than one asset.

4.10 The Effect of Credit on Fishermen's Total Income

The results of the research that have been carried out show that the credit variable has a positive and significant effect on the total income of coastal fishermen. The results of this study are in line with research conducted by Ismail & Yulianto (2017) credit has a positive and significant effect on fishermen's income. Coastal fishermen of Pacitan Regency who have credit receive a larger total income than those who do not have credit, where credit made by fishermen is used for capital for fishing activities. Credit distribution to fishermen on the coast of Pacitan Regency Most of them are not from the formal sector but come from non-formal sources in the form of cooperatives and ship owners. The existence of credit received by fishermen gives fishermen the responsibility to try harder to get the catch to return the credit received.

The results of this study are in line with research Thakur (2018) said that credit is one of the factors to increase the productivity and income of fishermen. Credit plays an important role for coastal fishermen in Pacitan Regency for fishing productivity, including buying various types of fishing gear so that fishermen can also catch various types of fish. This is in accordance with the opinion Nadjib (2013) availability of capital can improve technology that can develop fishing business activities. Credit is a facility to get out of poverty and has the potential to increase income (Li *et al.*, 2011).

4.11 The Effect of Participation in Fisher Group Organizations on Fishermen's Total Income

The results of the research that have been carried out show that the participation variable in the organization of fishermen groups has a negative and insignificant effect on the total income of coastal fishermen. Research results are not in line with research Norman *et al.*, (2022) explained that fishing households that follow fishing communities have a significant effect on income. This is also further explained by Maas *et al.*, (2015) that the participation of social organizations can lead to reciprocity and networks in the form of community bonds that can increase community efficiency by facilitating cooperation to increase productivity, income and capital owned now and in the future, by not relying solely on natural resources. The insignificant result is thought to be due to the use of organizational membership for fishing households to obtain loans. In addition, there is social capital which has experienced a shift in general policy to negative social capital due to limited access for outsiders and information imbalances among members of fishing groups so that the implications of efforts to utilize social capital are not implemented (Yuniarti *et al.*, 2017).

4.12 Effect of Fishing Equipment Ownership on Fishermen's Total Income

The results of the research that have been carried out show that the variable ownership of fishing gear has a positive and significant effect on the total income of coastal fishermen. On the coast of Pacitan Regency, the owner of the fishing gear is a tool to catch fish and has a boat to go to sea. The more fishing gear owned by fishermen, the higher the income of coastal fishermen in Pacitan Regency. The results of this study are in line with the results of the study Matera (2016) boat owners have a significant effect on fishermen's household income. Fishermen who have fishing gear will receive a higher total income than crew members (ABK). Of the 104 coastal fishermen of Pacitan Regency studied, 57% are owners of fishing gear. Each ship has 2-3 crew members where only half gets a share of the catch and the other half goes to the ship owner.

Research from Agunggunanto & Arianti (2015) ownership of fishing gear has a positive and significant effect on fishermen's income. If the boat owned by fishermen is getting bigger, the distance will be longer and the fishing gear used to catch fish is getting more sophisticated. Sophisticated fishing gear has a relatively high and expensive price and affects the quality of the fish caught. The existence of good quality types of catch fish certainly has a relatively high selling price. This research is in accordance with the research conducted Nguyen *et al.*, (2019) states that sophisticated fishing gear produces a greater output that affects catches and income.

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