Analysis of hand-line fishermen welfare in the Karimunjawa Marine National Park area, Indonesia

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Abstract. Fisherman's exchange rate (FER) is one of the main performance indicators of the Ministry of Marine Affairs and Fisheries to measure the level of fishermen's welfare. Hand-line fishing is a fishing tool that is widely operated by Karimunjawa fishermen. Hand-line fishing business operators in the Karimunjawa Islands have different socio-economic conditions. The amount of fishermen's income will affect the purchasing power of fishing households and the level of welfare of fishing households. This study aims to examine the level of welfare of hand-line fishermen's households based on the FER and analyze the factors that influence the level of welfare of hand-line fishermen in the Karimunjawa Islands. The method used in this research is descriptive survey, through interviews with questionnaires. Determining research respondents used purposive and snowball sampling. The number of research respondents was 160 hand-line fishermen who operate fishing gear in Karimunjawa waters. The data analysis method uses the FER formula and multiple linear regression analysis. The results of the research show that the majority (97.5%) of respondents from hand-line fishermen have a fairly good level of welfare with an FER value > 1. There are 4 variables that partially influence the level of welfare of hand-line fishermen in the Karimunjawa Islands, namely the household expenditure variable (X1), fishing expenses (X2), capture fisheries income (X5) and non-capture fisheries income (X6).
Key Words: artisanal fisheries, fishers exchange rate, household expenditure, Karimunjawa Island.

Introduction. The Karimunjawa Islands area is one of the marine national parks in Indonesia. This area comprises lowland tropical forest ecosystem types, mangrove forests, coral reefs, seagrass beds and a rich habitat for various types of marine biota. There are 9 zones of Karimunjawa National Park, i.e. (1) core zone, (2) jungle zone, (3) marine conservation zone, (4) land use zone, (5) marine tourism utilization zone, (6) marine cultivation zone, (7) religious, cultural and historical zones, (8) rehabilitation zones, and (9) traditional fisheries zones (Madyaningrum et al 2019; BTNKJ 2020).

Karimunjawa is one of the reliable fisheries centers in Central Java, with the majority of the population (60.25%) working as fishermen who depend on fisheries resources as their main earnings. Thus, it is necessary to align the interests of capture fisheries activities with the conditions of Karimunjawa's location as a national park which put more priorities to conservation aspects (Irnawati et al 2011). Therefore, determining fishing gear that is appropriate to sea water conditions based on conservation principles and environmental carrying capacity is essential, especially in water areas that adhere to the concept of conservation and sustainability such as national parks. Not all fishing gear can be operated in Karimunjawa waters as a National Park area (Simbolon et al 2016).

Hand-line fishing gear is the dominant fishing gear operated with mackerel (*Scomberomorus* sp.) and squid (*Loligo* sp.) as the main catch target with gross tonnage (GT) of fishing boat between 1-3 GT. The GT size of boats in Karimunjawa is relatively small, because Karimunjawa fishermen carry out one day fishing trips. Based on a study

conducted by Agustina & Muttaqin (2016), the highest number of fishing trips is also found on hand-line fishing gear with the number of trips between 215-246 trips a year.

Hand-line is a common fishing tool operated by Karimunjawa fishermen (Wibowo et al 2022). Such high use of hand-lines is due to the fact that this fishing gear has a small investment value, is a friendly environment fishing gear, possessing high selectivity level, results of the fish caught are abundant with stable selling price as well as system operation can be done by the fisherman alone without the help of crew members. Thus, profit obtained by fisherman will be maximum. The main structure of hand-line fishing gear consists of hooks, swivels, fishing line, weights and bait (Shadiqin et al 2018). Hand-line fishermen will carry out fishing operations targeting mackerel from morning to evening, and squid as targets for fishing operations carried out at night.

Based on Minister of Marine Affairs and Fisheries Regulation Number 18 Year 2021 concerning the Placement of Fishing Gears and Fishing Aids in the Fisheries Management Areas of the Republic of Indonesia and the High Seas and the Arrangement of Fishing *Andon* (fishing activities), hand-line fishing equipment is an environmentally friendly fishing gear and allowed to be operated because it is a selective fishing tool. Even though a special zone for capture fisheries activities has been given which is quite extensive in artisanal fishing zone, capture fisheries activities in this zone have not been fully carried out optimally. This can be seen from the low access of fishing communities to fish resources as a result of limited information on potential fishing areas, and the use of fishing technology that is still traditional (Simbolon et al 2016), such as the average size of Karimunjawa fishing boats, i.e. 3 GT and the small business capital that will affect the productivity of capture fisheries in the Karimunjawa Islands. In fact, the maximum sustainable yield (MSY) of fisheries in Karimunjawa National Park is 319.02 tons year^{-1} with an optimum fishing effort of 6,453 trips year^{-1}. The utilization rate (E) of fish resources in Karimunjawa National Park is 0.11 with moderate utilization status (E < 0.5), so that fishing effort can be increased (Agustina & Muttaqin 2016).

Hand-line fishing fishermen in the Karimunjawa Islands have different socio-economic conditions. One of the affecting indicators is fishermen income. Working as a fisherman is a job that is full of risks and the catch results obtained is uncertain because it is influenced by seasonal and weather factors. According to Priadana et al (2017), the difference in fishermen's income from one another earned from a fishing business is due to different number of catches. The high and/or low fishermen's income will influence the fulfillment of household needs. This condition will also affect the level of welfare of fishermen's families (Vibriyanti 2019).

Measuring the level of fishermen's welfare can use indicators based on the fisherman's exchange rate (FER). FER is the ratio between the price index received by fishermen (It) and the price index paid by fishermen (Ib). FER is a measuring tool that calculates total income from capture fisheries and non-fisheries income as well as expenses on food and non-food in fishermen's households (Bleaney & Greenaway et al 2001; Anna et al 2019). This income is used by fishermen to meet all family needs and to increase the business scale. The amount of fishermen's income will influence the purchasing power of fishermen's households and the level of fishermen's household welfare.

This study aimed to examine the level of hand-line fishermen household welfare based on the FER and to analyze the factors which influence the level of hand-line fishermen welfare in the Karimunjawa Islands. There are six indicators used to analyze factors affecting the level of fishermen's welfare, i.e. household expense, non-food expense, work experience as a fisherman, number of family members, capture fisheries income and non-capture fisheries income.

Material and Method

Description of the study sites. This study was conducted from July to August 2023 and took place at Karimunjawa Islands, where hand line fishing gear is the predominant fishing gear utilized by fishermen on the Karimunjawa Island (Wibowo et al 2022; Wijayanto et al 2023). The location of this study is presented in the following Figure 1.
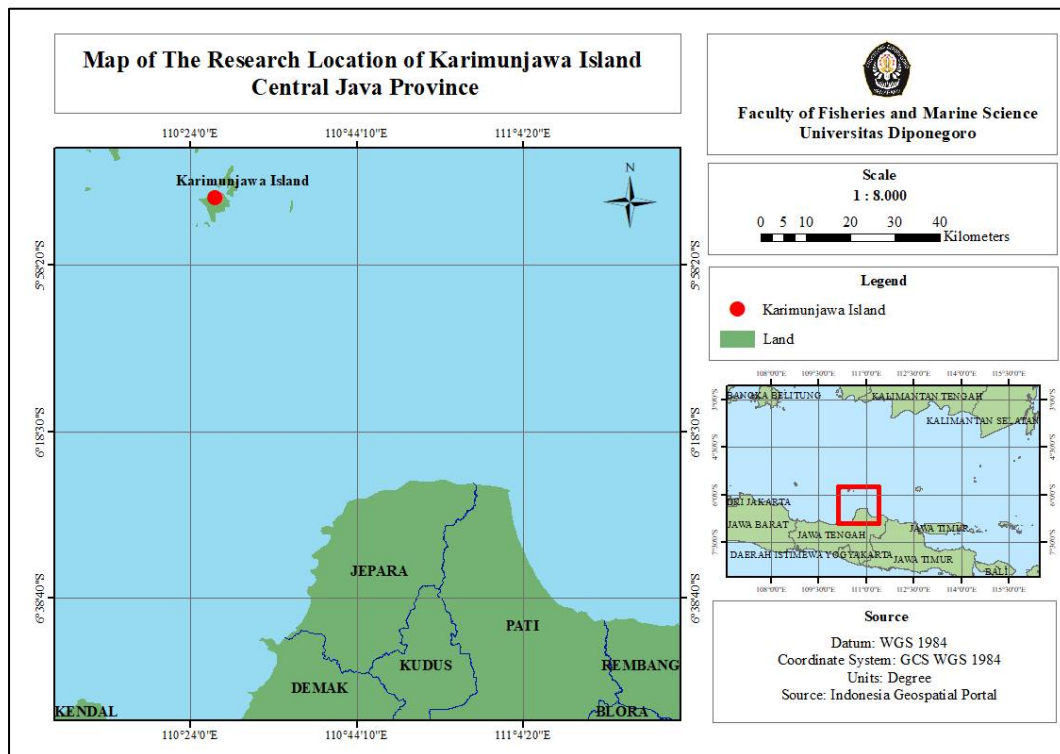
Figure 1. Research location.

Data collection. This study used a survey method. There were 160 hand-line fishermen as the respondents. In addition, purposive sampling was used to determine research respondents and then snowball sampling was applied after determining key person respondents (Nurdiani 2014; Yusuf 2016). The key respondents selected were fishermen who own a handline fishing fleet in the Karimunjawa Islands and are still actively carrying out fishing activities. Furthermore, the key respondents were asked to name other respondents with the same specifications, since they usually know each other. Primary data were obtained by interviewing and filling out questionnaires to gain information regarding technical fishing gear in the form of vessel size, size and number of fishing gears, season and fishing area, number of trips, catch composition and socio-economic aspects including age, education level, work experience, and number of family members, investment capital, maintenance costs, fishing operational costs, food consumption expenditure and non-food expenditure, and household income.

The fishermen terms of trade analysis. Fisherman's exchange rate is the ratio of total income to total expense of fishermen's households during a certain period of time. In this case, this fishermen's household income is referred to gross income. FER can be formulated as follows (Koeshendrajana 2012; Hapsari et al 2019):

$$FER = Yt / Et$$
$$Yt = YFt + YNFt$$
$$Et = Eft + EKt$$

where: FER = fishermen's exchange rate;
$\quad$ Yt = total of fishermen's income;
$\quad$ Et = total of fishermen's expense;
$\quad$ Yft = total of fishermen's income from fisheries business;
$\quad$ YNFt = total of fishermen's income from non-fisheries business;
$\quad$ Eft = total of fishermen's expense for fisheries business;
$\quad$ Ekt = total of fishermen's expense for fishermen's families consumption;
$\quad$ t = time period (month, year, etc.).

Criteria:
- if FER > 1, the fishermen's household has a sufficient level of welfare to meet primary needs and has the potential to be able to meet non-primary needs or saving and invest;
- if FER = 1, the fishermen's households are only able to meet primary needs;
- if FER < 1, the fishermen's households have a low level of welfare, unable to meet primary needs.

Determinants of fish farmers' welfare. The welfare of fishermen can be influenced by fishermen's income and expense factors. The factors used are household expenses (X1), fishing expenses (X2), work experience as a fisherman (X3), number of family members (X4), fishing income (X5) and non-fishing income (X6), which will be analyzed using multiple linear regression analysis. The data used as the dependent variable (welfare level) is FER data. Regression analysis was carried out to measure the influence of the independent variable on the dependent variable, i.e. the welfare level of hand-line fishermen in the Karimunjawa Islands. The results of the regression analysis illustrate the the relationship between the independent variables and the dependent variable either jointly/simultaneously or partially. Several stages in multiple linear regression analysis include classical assumption tests (multicollinearity test, normality test and heteroscedasticity test), coefficient of determination, model parameter estimation and hypothesis testing. Data analysis in this study used multiple linear regression analysis using SPSS 25.0.

Equation model: $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + e$
Hypotheses:
- H0: variable indicators of household expense (X1), fishing expense (X2), work experience as a fisherman (X3), number of family members (X4), capture fishing income (X5) and non-fishing income (X6) have no effect on the level of fishermen's welfare either jointly or partially;
- H1: variable indicators of household expense (X1), non-food expense (X2), work experience as a fisherman (X3), number of family members (X4), capture fishery income (X5) and non-fishery income (X6) influence the level of fishermen's welfare either jointly or partially.

There are criteria for determining the influence between the variables used, as follows:
a. If the sig value < 0.05, then H0 is rejected and H1 is accepted. It means that there is a significant influence between the independent variable and the dependent variable;
b. If the sig value is > 0.05 then H0 is accepted and H1 is rejected. It means that there is no significant influence between the independent variable and the dependent variable.

Results

Characteristics of hand-line fishermen. The characteristics of fishermen can be seen based on age, education level, work experience as a fisherman and number of family members. Productivity in working as a fisherman is greatly influenced by age. Age structure and experience as a fisherman highly influence the income earned. In addition, education for fishermen has an important role as efforts to innovate fishing technology and the number of family members is one of the determining factors for the average expense of fishermen's families (Firdaus et al 2014; Hapsari et al 2019; Primawati et al 2023).

Table 1 show that the majority of fishermen are in the productive age range (34 to 61 years). At this age, fishermen still have enough energy and physical strength to earn higher income by carrying out farther fishing operations, thereby influencing the catch they get. At the educational level, fishermen have an average education of elementary school graduates. The education level of fishermen is one factor which affects the empowerment of fishermen because of their limited productive skills. In terms of work experience characteristics, work experience as a fisherman is in the range of 26 to 33 years, which means that the average fisherman has half the experience of his age. In consequence, the influence on the income earned can be seen from the length of work

experience which is one of the determining factors for the success of a capture fisheries business. Meanwhile, the majority of family members dependent is between 4 and 6 people in one family. If the family has many dependents, the economic burden on the fishermen family is quite high, if only one person works to meet the economic needs of the fishermen family. The number of family members and their composition influence the amount of time spent on household work to earn a higher income to meet the family needs which keep increasing.

Table 1

Respondent characteristics based on age, education level, work experience, and number of family members

	Characteristics	Frequency (%)
Age	Under 26 years old	8.8
	27 to 33 years old	10.0
	34 to 40 years old	20.0
	41 to 47 years old	19.4
	48 to 54 years old	17.4
	55 to 61 years old	16.9
	62 to 69 years old	5.6
	Over 70 years old	1.9
Level of education	Not graduate from elementary school	10.6
	Elementary school	69.4
	Junior high school	10.6
	Senior high school	8.1
	University	1.3
Work experience as a fisherman	Under 8 years old	3.1
	10 to 17 years old	13.8
	18 to 25 years old	16.3
	26 to 33 years old	20.6
	34 to 41 years old	18.1
	42 to 49 years old	19.3
	50 to 58 years old	6.9
	Over 59 years old	1.9
Number of family members	1 to 3 people	40.0
	4 to 6 people	58.1
	7 to 9 people	1.9

A person's productive age for work ranges from 15 to 64 years. In general, the older the age, the higher the income, and it also depends on the type of work a person does. A person's physical strength to carry out activities is closely related to age because if a person's age has passed the productive period, their physical strength decreases and will lead to productivity decrease and their income also decreases (Ariska & Prayitno 2019). A person's education is a factor that determines the gap between the level of education achieved and the level of income earned (Putri & Setiawina 2013; Primawati et al 2023).

Performance of fisheries and non-fisheries income from hand-line fishermen. Karimunjawa fishermen are artisanal fishermen who carry out fishing operations using hand-line fishing gear targeting squid and mackerel species. The fisheries income of hand-line fishermen, besides being greatly influenced by the season (Anwar & Wahyuni 2019), also depends on the size of the catch obtained, the condition and type of fish caught and the selling price at the Karimunjawa market or middlemen. Table 2 explains the fisheries and non-fisheries income of hand-line fishermen.

The income of hand-line fishermen is greatly dependent on the utilization of potential fisheries resources found in the waters of the Karimunjawa Marine National Park. The results show that the average income from fishing activities has a higher value than non-fisheries income with an average annual income of IDR 471,803,366. The

majority of income (90.68%) is obtained from fishing activities. This shows the significance that the fishing income of Karimunjawa fishermen has an important role in the sustainability of the fishermen's econy. The income of fishing communities will directly or indirectly affect their quality of life (Rahmawati 2017), since fisheries income is the main source for Karimunjawa fishermen's income, while non-fisheries income is obtained from tourism activities in the Karimunjawa Islands.

Table 2

Fisheries and non-fisheries income of hand-line fishermen

| Description | Income (IDR year^{-1}) | |
	Fisheries	Non-fisheries
Minimal	Minimal	10,425,000
Maximal	Maximal	1,742,560,000
Average	Average	471,803,366
Standard deviation	Standard deviation	321,437,018

Fishing business income varies greatly and is strongly influenced by several important variables, including the type and amount of catch, selling price, number of fishing gears and season (Salakory 2016; Hapsari et al 2022). However, the most important factor which affects the amount of income is the fishing capacity of each vessel. In fishing activities, the increasingly distance reach of fishing areas, supported by fishing boat size, vessel engine power and other auxiliary technology (Sari & Rauf 2020; Zamdial et al 2020) is one of the factors determining the number of catches. The larger the size of the boat, the fishermen can fish farther. Small boats have a limited fishing area, while larger boats have larger and farther fishing area.

Performance of fishing at sea (seagoing) and household expenses. The ability to allocate expenses efficiently in a business is an important factor in the success of the business being done. The hand-line fishing business in Karimunjawa has different expense variations depending on the size of the vessel used, the number of fishing gears, and the range of the fishing area. The amount of fishing at sea (seagoing) expense and household expense can be seen in Table 3. This table explains the hand-line fishermen's fishing and non-fishing expenses.

Table 3

Fishing at sea (seagoing) and household expense

| Description | Expense (IDR year^{-1}) | |
	Fisheries	Non-fisheries
Minimal	14,862,857	11,384,000
Maximal	228,218,000	80,104,000
Average	76,622,893	26,031,588
Standard deviation	35,297,197	10,465,416

The research results show that expense on fisheries is greater than non-fisheries expense, with an average expense of IDR 76,622,893. The amount of expense is for maintenance costs and operational costs for going to sea for each trip. The number of fishing trips carried out in one year is averagely 275 trips. This shows that the frequency of fishing trips greatly influences the amount of fishermen's fishing expenses. Most non-fisheries expense is spent on daily necessities such as rice, vegetables and kitchen ingredients. Other large expenses are mostly spent for cigarettes and home maintenance for each year.

The size of expenses greatly affects the profits in a business that is run. Thus, it can be concluded that when the expense in the business being run is greater, the revenue will also increase and it may also exceed the expenditure incurred. Therefore,

the business being run can be profitable. Expenses for fisheries business are influenced by the number and length of fishing trips (Firdaus & Witomo 2014; Booth et al 2022; Siaila & Rumerung 2022).

Welfare of hand-line fishermen based on fishermen's exchange rates*.* The FER is used as one of the main performance indicators of the Ministry of Marine Affairs and Fisheries to measure the welfare level of a fishermen community (Koeshendrajana 2012; Hikmayani et al 2019; Soesilo 2021). FER is the ratio between total income and total expense of fishermen's households. This value is used to measure the welfare level of fishermen households. The use of this value is based on the understanding that each household has different levels of income and expenses, which really depends on the lifestyle patterns and financial management abilities of each household.

The results of calculating the FER of Karimunjawa hand-line fishermen show that the average FER value is 4.98, with a minimum value of 0.46 and a maximum value of 18.20. The majority of fishermen (97.5%) are categorized into the FER > 1, indicating that the families of hand-line fishermen have a level of good enough welfare to meet their subsistence needs and have the potential to consume their secondary or tertiary needs, or save in the form of investment goods. There are 0.6% of fishermen families whose FER value is around number one, meaning that fishermen families are only able to meet their subsistence needs. Moreover, there are 2.5% of fishermen families in the FER < 1 category, which indicated that these fishermen families have lower purchasing power to meet their daily needs and have the potential to experience a household budget deficit. The FER is obtained through a calculation between the comparison of fishermen's income and expenses. The income and expenses included in this calculation are income and expenses which have been calculated based on the average value between three seasons, i.e. peak season, medium season and lean season (Geni et al 2021).

Analysis of factors that influence the level of hand-line fishermen welfare in the Karimunjawa Islands using multiple linear regression analysis*.* Predictive linear regression analysis was carried out to measure the influence of the independent variable on the dependent variable, i.e. the level of handline fishermen welfare in the Karimunjawa Islands. The results of the regression analysis illustrate the close relationship between the independent variables and the dependent variable jointly/ simultaneously or partially. Several stages in multiple linear regression analysis are checking cases of multicollinearity, normality test, heteroscedasticity test, coefficient of determination, estimating model parameters and hypotheses testing.

Multicollinearity test. Multicollinearity test is used to check the existence of a perfect linear relationship between several independent variables in the regression model for the welfare level of handline fishermen. Cases of multicollinearity occur when the variance inflation factor (VIF) value is > 10 or when the tolerance value is < 0.1. If the VIF value is high, it indicates that there is a high correlation between the independent variables. On the other hand, if the tolerance value is low, this also indicates a high correlation between the independent variables. The results of the multicollinearity test using SPSS can be seen in Table 4.

Table 4
Results of multicollinearity test

Variable	Description	VIF
X_1	Household expense	1.122
X_2	Fishing expense	1.213
X_3	Work experience	1.161
X_4	Number of family members	1.018
X_5	Capture fisheries income	1.244
X_6	Non-capture fisheries income	1.115

Source: Results of SPSS data processing, 2023.

Table 4 shows that all independent variables have a VIF value < 10, so they have fulfilled the assumption of multicollinearity or the absence of cases of perfect linear relationships between independent variables in the regression model for the welfare level of handline fishermen and can be continued for multiple linear regression analysis.

Normality test. Normality test was carried out using the Kolmogorov-Smirnov test. The normality test produces an asymptotic sig value of 0.324. This value is greater than the real level used in the model of 5%. This shows that the data is distributed normally, which means > 0.05. Thus, it meets the normality requirements.

Heteroscedasticity test. The heteroscedasticity test is applied to investigate whether there is an inequality of variance from the residuals of one observation to another observation in the regression model. If the residuals have the same variance, it is called homoscedasticity and if the variance is not the same/different, it is called heteroscedasticity (Sugiyono 2022). The heteroscedasticity test in this study was conducted by looking at the Scatter Plot graph (Figure 2). If the points are spread randomly and evenly distributed over both the X and Y axes, it can be concluded that heteroscedasticity occurs. Furthermore, random distribution shows a good regression model; therefore, it can be stated that there is no heteroscedasticity.
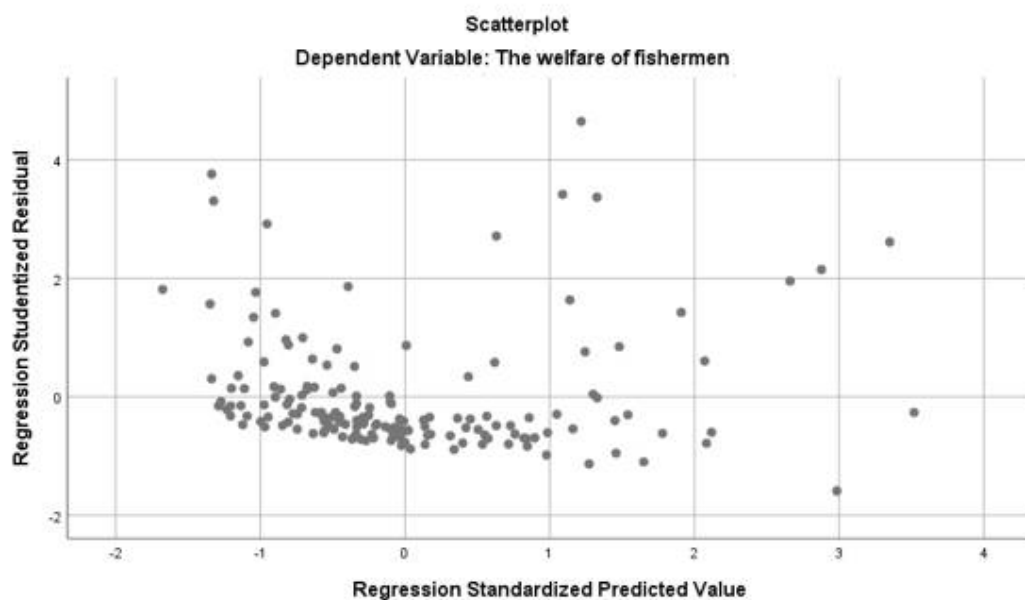

Figure 2. Scatterplot graph of heteroscedasticity test.

Based on Figure 2, the scatterplot graph can be used to conclude the conditions where heteroscedasticity does not occur, due to the fact that the points on the graph are distributed randomly and do not create a particular pattern or group. Accordingly, it can be stated that there are no symptoms of heteroscedasticity in the regression model used.

Coefficient of determination. The coefficient of determination (R^2) represents the percentage value of the variability in the strength of the relationship between fishing expense and capture fisheries income in explaining the level of hand-line fishermen welfare in the Karimunjawa Islands. The coefficient of determination value is always between zero and one. The closer the value is to 1, it will result in the better coefficient of determination. The coefficient of determination value from the regression model for the level of welfare of hand-line fishermen is 0.902, which means that the variables of fishing expenses and fishing income are able to explain the level of welfare of hand-line fishermen amounted to 90.2% and the remaining 9.8% was explained by other variables outside of this study.

Estimation of model parameter. The results of parameter estimation analysis of the regression model on the level of hand-line fishermen welfare in the Karimunjawa Islands in this study are as follows:

$$Y = 0.287 - 0.00000003705\ X_1 - 0.00000004244\ X_2 - 0.002\ X_3 - 0.042\ X_4 - 0.000000009193\ X_5 - 0.000000008919\ X_6 + e$$

where: Y = fishermen's exchange rate (FER) in the Karimunjawa Islands;
   X_1 = household expense;
   X_2 = fishing expense;
   X_3 = work experience;
   X_4 = number of family members;
   X_5 = capture fisheries income;
   X_6 = non-capture fisheries income;
   e = error or mistake rate.

The Table 5 show that household expense ($\beta = 0.00000003705$; $p < 0.05$), fishing expense ($\beta = 0.00000004244$; $p < 0.05$), capture fisheries income ($\beta = 0.000000009193$; $p < 0.05$) and non-capture fisheries income ($\beta = 0.000000008919$; $p < 0.05$) have a significant effect on the welfare level of handline fishermen. Household expense has a negative effect, meaning that every 1 unit increase in household expense will reduce the level of welfare by 0.00000003705 units. Expense on fishing at sea (seagoing) has a negative effect, indicating that every 1 percent increase in household expense will reduce the level of welfare by 0.00000004244 units. Furthermore, the positive influence of capture fisheries income can be interpreted as every 1 percent increase in capture fisheries income will increase welfare by 0.000000009193 units and non-capture fisheries income (tourism) has a positive effect meaning that every 1 unit increase in non-capture fisheries income (tourism) will increase the level of welfare by 0.000000008919 units.

Table 5

Estimation of regression model parameter

Variable	B	Significance value
Household expense (X_1)	-3.705E-8	0.000
Fishing expense (X_2)	-4.244E-8	0.000
Work experience (X_3)	-0.002	0.763
Number of family members (X_4)	-0.042	0.477
Capture fisheries income (X_5)	9.193E-9	0.000
Non-capture fisheries income (X_6)	8.919E-9	0.000

Dependent variable: fishermen's exchange rate.

Hypotheses testing. Hypotheses testing was carried out to determine the influence of household expense, fishing expense, work experience, number of family members, capture fisheries income and non-capture fisheries income simultaneously or partially on the level of handline fishermen welfare in the Karimunjawa Islands. Hypotheses testing was conducted simultaneously (concurrently) or partially (individually).

<u>*a. F test*</u>. Hypotheses testing was carried out simultaneously (concurrently) using the F test to determine the influence of household expense, fishing expense, work experience, number of family members, capture fisheries income, and non-capture fisheries income simultaneously on the level of handline fishermen welfare in the Karimunjawa Islands. The results of simultaneous statistics test results using F test are shown in Table 6.

Table 6 shows that the results of the F Test have a P-value (0.000) < 0.05. Therefore, H0 is accepted, i.e. meaning that the variables household expense, fishing expense, work experience, number of family members, capture fisheries income and non-capture fisheries income have a simultaneous effect on the level of handline fishermen welfare.

Table 6
Results of F test

Model	Sum of squares	df	Mean square	F	P-value
Regression	1013.628	6	168.938	50.522	0.000
Residual	511.611	153	3.344		
Total	1525.240	159			

Source: Result of SPSS data processing, 2023.

b. T test. Partial (individual) hypothesis testing result will be analyzed using the T test with 95% confidence interval. Furthermore, the result of partial (individual) test at 5% significance level using the T test is illustrated in Table 7.

Table 7

Result of T test

Variables	Description	T	P-value
X_1	Household expense	-5.778	0.000
X_2	Fishing expense	-19.602	0.000
X_3	Work experience	-0.302	0.763
X_4	Number of family members	-0.712	0.477
X_5	Capture fisheries income	34.060	0.000
X_6	Non-capture fisheries income	4.238	0.000

Source: Result of SPSS data processing, 2023.

Table 7 shows the results of the T test on variables that have a P-value < 0.05, i.e. household expense, fishing expense, capture fisheries income and non-capture fisheries income. Therefore, H0 is accepted which means that these four variables have a partial effect on the welfare level of hand-line fishermen in the Karimunjawa Islands.

Discussion. The FER still becomes the benchmark for all provinces in Indonesia to measure the welfare level of marine fisheries communities. Moreover, it is used to measure the ability of fishermen's catch/production to exchange for goods and services needed for the fishing business and food and non-food consumption of fishermen's households (Hapsari et al 2022). Government programs should also be focused on increasing the fishermen's exchange rate so that fishermen are able to meet their needs and families' need for both consumption and non-consumption needs. This is also related to the cost structure of fishing businesses which are still very pricey. Periodic measurements of the welfare of marine and fisheries communities need to be carried out to see the developments.

One of the indicators in measuring family welfare is through calculating the amount of household expense. The average family expense of handline fishermen in the Karimunjawa Islands is IDR 8,554,540 per month. The largest proportion of family expense is for food expense, i.e. 67% and the remainder, at 33%, is for non-food expense. This expense allocation is almost the same as Salam's (2022) research on the welfare of fishermen in Torosiaje Laut village with a family expense allocation for food at 64% and non-food at 36%, as well as Widyaningsih & Muflikhati's (2015) study on the welfare of fishermen in Sarang Tiung village, South Kalimantan with family expense allocation for food of 61.06% and non-food of 38.94%.

Engel's theory states that a large allocation on food expense rather than on non-food expenditure indicates that the family is not yet prosperous (Korir et al 2020; Nsabimana et al 2020; Rasyid et al 2020; Junaedi 2021). Cigarettes are the second largest expense after food expense. Results of previous studies also show that cigarettes contributed a large percentage of family food expenditure (Agustina & Usman 2019; Suwandi 2020; Welker 2021; Nurhasana et al 2022). There are 3 families who have a financial deficit. The results of previous research also found that 28% - 40.4% of fishing families had a financial deficit (Muflikhati et al 2010; Riantini et al 2019; McWilliam et al

2021; Warren & Steenbergen 2021). The location of their village which is far from the daily market means that respondents buy their food needs at stalls that are commonly more expensive compared to market prices. Snacks are a complementary need often purchased because it is easy to access, delicious on the tongue and affordable. The types of snacks available on the market can be purchased cheaply, attractive and delicious, but many contain ingredients that can eventually harm for the health when being consumed over time. In addition, cigarettes are one of the expenses that take relatively high cost. The average fisherman can consume two packs of cigarettes a day, if multiplied over a month the expense on cigarettes can be higher than the food expense. Poverty in coastal communities is often not only limited to low-income levels but is also caused by the inability to manage household expenses (Thomson et al 2017; Simcock et al 2021).

The variable of expense on fishing (seagoing) has a significant effect on the level of welfare with a negative value. Therefore, the greater the expenditure on fishing, the welfare of handline fishermen will decrease because the higher the level of expenditure on fishing, the higher the income allocation will be if there is no increase in business capacity. If production capacity can be increased, income will also increase (Di Franco et al 2020; Uddin et al 2021). Expenses used in the hand-line fishing business include the following: operational costs for fishermen's needs when going to sea including food and drink consumption, diesel, ice, salt, petrol, bait, cigarettes and expenses for repair and maintenance of boats, engines, fishing gear as well as fishing aids equipment. Financial calculation predictions need to be carried out so that fishermen do not spend a lot of capital, but the income obtained cannot cover the capital spent or even only reaches the break event point (Tan et al 2015). Capital issue causes fishermen to look for fish around the shoreline since the farther the fishing distance, the greater the capital spent. The large number of fishermen taking fishing distances close to the coast results in negative externalities in the form of a high density of fishermen fishing in a fishing area (Falk-Andersson et al 2020; Hailu et al 2023).

The variable of capture fisheries income has a significant effect on the level of welfare with a positive value. Thus, it can be interpreted that every 1% increase in capture fisheries income will increase the welfare of the fishermen, seen from the increase in the FER value of 0.000000009193 units. The income of hand-line fishermen depends highly on several factors such as weather and season. In consequence, it leads to uncertain income. Natural factors are related to fluctuations in fishing seasons and the natural structure of village economic resources. Non-natural factors are attributed to the limited reachability of fishing technology and weak marketing networks. Economic inefficiencies often occur due to large efforts and lower production volumes, which will result in not making a profit. Income can be influenced by the size, type and quality of fish caught (Kruijssen et al 2020). This can affect the selling price of the fish. Income between seasons also varies, where one year is divided into harvest season, normal season and lean season. As an adaptation strategy because of this variability which affects the income, many fishermen in the Karimunjawa Islands implement a coping strategy by diversifying their sources of income from the tourism sector (Sugio 2020; Setiawan et al 2021).

The existence of tourism activities in the Karimunjawa Islands is an opportunity for fishermen to increase their family income. Construction of hand-line fishing vessels in Karimunjawa Island covers an average size of 1-7 GT. The size of the boats varies because the boats owned by Karimunjawa fishermen are not only used for fishing activities, but also for tourism activities. The development of tourism sector is expected to provide benefits in economic sectors for the surrounding community and the development of tourist areas will increasingly empower communities involved in tourism activities. Therefore, the communities become motivated to increase their potential and utilize this tourist attraction potential which will eventually benefit the community through their income levels. Based on the results of the analysis, 1% increase in income from tourism activities will increase the welfare of hand-line fishermen by 0.000000008919 units; thus, good tourism management planning is significantly required as integration and synergy in the use of space between capture fisheries activities and the business of tourism activities which can increase fishermen's income in harmonizing

the management of the Karimunjawa Marine National Park area as a conservation area to realize sustainable ecotourism.

Conclusions. Based on the results of the fisherman exchange rate analysis, there were 97.5% of respondents who had a fairly good level of welfare (156 handline fishing families). These fishermen can fulfill their subsistence needs and have the potential to meet their secondary or tertiary needs, or save in the form of investment in goods. There are 4 variables which partially influence the level of welfare of hand line fishermen in the Karimunjawa Islands, i.e. household expense, fishing expense, capture fisheries income and non-capture fisheries income (tourism). Changes in income experienced by fishermen due to climate variability and fishing seasons influence fishing activities, causing fishermen's households become very vulnerable in their livelihoods. The government through related agencies and offices needs to make efforts to stabilize fishermen's income, particularly during the lean season, including through a fishing equipment diversification assistance program which can support tourism activities and knowledge transfer of various types of skills to encourage side jobs that can be carried out by fishermen in the tourism sector. Furthermore, it is necessary to introduce some innovations in the field of ecotourism and to identify alternative side livelihoods which may be carried out by fishermen, as well as empowerment assistance in the field of ecotourism to increase the capacity of fishermen as an effort to equalize fishermen's welfare and to maintain the sustainability of the social and ecological system in utilizing resources in the Karimunjawa Marine National Park area.

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