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Perception and Participation of Fishermen in The Sustainable Management of Mud Crabs on The Outermost Small Island (Case Study : Enggano Island, Bengkulu Province, Indonesia)

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***Abstract*— Enggano Island is one of 111 small outermost islands in Indonesia and administratively belongs to the North Bengkulu Regency Bengkulu Province. Of 881 households, as many as 20.89% worked in the capture fisheries sub-sector. One species of capture fisheries which is the economic basis is mud crabs with an average production of 37.85 tons per year. In its life cycle, mud crabs are associated with mangrove ecosystems. This study aims to 1) examine the perception and participation of fishermen in the management of mud crabs and mangrove ecosystems on the small outer islands and 2) analyze factors that influence the participation of fishermen in the sustainable management of mud crabs and mangrove ecosystems in a sustainable manner. The analytical tool used is the Likert scale and multiple linear regression. The results showed that the perception of fishermen towards mud crabs was in a good category with a score of 3.46 and the perception of fishermen on mangrove ecosystems was in the very good category with a score of 4.23. The participation of fishermen in the sustainable management of mud crabs is categorized in the high category with the score of 3.81, and the participation of fishermen in the sustainable management of mangrove ecosystems is categorized in the very high participation category with the score of 4.35. Fishermen's participation in mud crab management is influenced by perception of mangrove ecosystems and income as fishermen. The participation of fishermen in the sustainable management of mangrove ecosystems is influenced by perceptions of the mangrove ecosystem and the income of fishermen from other sources.**

***Keywords*— perception; participation; mud crab; mangrove.**

I. INTRODUCTION

Enggano Island is one of 111 small outermost islands in Indonesia [1] and one of 19 sub-districts in North Bengkulu Regency [2]. Enggano Island is a base for mud crab production in Bengkulu Province with a total of 33.46 tons per year [3]. Mud crabs are strongly associated with mangrove forests so that the life cycle of crustaceans that have high economic value is highly dependent on mangrove forests [4]. Mangrove forests are a habitat for various types of organisms that can adapt to changes in ecosystems, one of which is mud crabs [5]. Thus, managing mud crabs means also managing the mangrove ecosystem.

The number of fishermen on Enggano Island is 184 households from 881 households [6]. Of 184 fisherman families, around 27.17% are fishermen of mud crabs (primary data). The use of mud crabs is expected to be sustainable as one of the livelihoods of fishermen on Enggano Island. Therefore, it is interesting to study the perception and participation of fishermen in the sustainable management of mud crabs, including the management of mangrove ecosystems. Perception is an experience of an object or a relationship obtained by concluding information and interpreting a message so that perception gives meaning to a sensory stimulus [7]. Participation is a voluntary contribution from the community to a program. Participation means participating, that is, following and accompanying a program [8].

Mud crabs as a whole of the mangrove ecosystem, require the existence and condition of a good mangrove ecosystem. The existence of mud crabs will be disturbed or disturbed if the environmental conditions in which they live do not support good breeding and the rate and method of utilization that are not suitable and exceed the number of catches, including in the form of size and amount. The problem formulated in this study are (1) How is the perception and participation of fishermen in the sustainable management of mud crabs and mangrove ecosystems on the small outermost islands?, and (2) What factors influence the participation of fishermen in the sustainable management of mud crabs on

the small outermost islands? This research aims to (1) Assess the perception and participation of fishermen in the sustainable management of mud crabs and mangrove ecosystems on the small outermost islands, (2) Analyze the factors that influence the participation of fishermen in the sustainable management of mud crabs on the small outermost islands.

II. MATERIAL AND METHOD

A. Location

The location of the research is villages in Enggano Subdistrict whose one of the livelihoods of the people is the mud crab fishermen. The community that captures mud crabs is the people who live in villages that have mangrove ecosystems. Of the six villages in Enggano District [6], there are three villages (50%) whose people work as fishermen of mud crabs, namely Desa Kahyapu, Desa Kaana, and Desa Banjarsari.

B. Raw Material and Data

The data in this study consisted of primary data and secondary data. Secondary data were obtained from the available literature (which was sourced from relevant agencies/institutions), and primary data was obtained directly in the field through interviews with questionnaire guidelines.

Questionnaires for perceptions of mud crabs consisted of 15 questions, perceptions of the mangrove ecosystem consisted of 11 questions, participation in mud crabs management consisted of 18 questions and participation in the mangrove ecosystem management consisted of 14 questions. Thus, the total number of questions for perception and participation in the questionnaire was 58 questions. The questionnaire was also supplemented with questions about the social and economic conditions of mud crab fisher's.

C. Sampling

The population of fishermen in mud crabs on Enggano Island is 50 people. Determination of the number of samples with the approach developed by Isaac and Michael [9], then the sample in this study was 42 people (84% of the total population). The sampling method used was a census, in which 8 fishermen were not selected as samples because they were not at Enggano at the time of the study.

D. Data Analysis

Perception and participation of coastal communities in utilizing good mangrove ecosystems can be alternative livelihoods [10]. Perception measurement is the concept of knowledge (cognitive) and attitude (affective) [11]. The data analysis of perception and participation usually use descriptive statistics [12].

The perception and participation of fishermen catching mud crabs were measured by compiling a set of questions in the form of questionnaires to the community, including mangrove ecosystems. Respondents' answers to questions about perception and participation use a Likert scale 1: (disagree), 2 (less agree), 3 (quite agree), 4 (agree), 5 (strongly agree) [13] with intervals of each class measured by criteria [14] :

TABLE I
PERCEPTION AND PARTICIPATION ASSESSMENT CRITERIA

No	Score	Category	
		Perception	**Participation**
1	1.00 – 1.80	Bad	Bad
2	1.81 – 2.60	Fairly enough	Fairly enough
3	2.61 – 3.40	Enough	Enough
4	3.41 – 4.20	Good	High
5	4.21 – 5.00	Very good	Very high

The score of perception and participation from likert scale categorized ordinal data. In the analysis of parametric statistics, it is necessary to measure at least intervals data. To conduct an analysis of the factors that influence fishermen's participation, the ordinal data (perceptions and participation) is necessary transformed into interval data by using the Successive Interval Method [15], with 8 stages :

- Focus to each question
- For each of these questions, determine how many people answered the scores 1, 2, 3, 4.5. which is called frequency.
- Each frequency is divided by the number of respondents and the results are called proportions.
- Determine cumulative proportions
- Using a normal distribution table, calculate the z value for each cumulative proportion obtained.
- Determine the density value for each z value obtained (using the density table)
- Determine the scale value
- Determine the value of transformation

Factors that influence the participation of fishermen are analyzed using multiple linear regression analysis [16], with the equation:

$$Y = bo + b_1X_1 + b_2X_2 + b_3X_3 + ... + b_{12}X_{12} \quad (1)$$

Information :

Y	:	Fishermen's participation (score)
X_1	:	Perception of mud crabs (score)
X_2	:	Perception of mangrove ecosystem (score)
X_3	:	The number of dependents (person)
X_4	:	Age (years)
X_5	:	Job Status (1 = main, 0 = side)
X_6	:	Experience as a fisherman (years)
X_7	:	Formal education (years)
X_8	:	Fishermen's income (IDR/Month)
X_9	:	Income from other sources (IDR/month)
X_{10}	:	Long domicile in Enggano (year)
X_{11}	:	Enggano exit frequency (times/year)
X_{12}	:	Land area owned (Ha)
bo	:	Constants
b_1 - b_{12}	:	Regression coefficient

III. RESULT AND DISCUSSION

A. Fishermen's Perception

Perception is the ability of a person to organize an observation, including the ability to distinguish, classify and focus on an object. Fishermen's perception consists of perceptions of mud crabs and perceptions of mangrove ecosystems. Distribution of answers to perceptions of fishermen on mud crabs are :

TABLE II
DISTRIBUTION OF ANSWER TO MUD CRABS PERCEPTION

No	Question	Answer (%)				
		1	2	3	4	5
1	Catching mud crabs is a potential business	0	2	5	71	21
2	Mud crabs according to environmental conditions	0	2	0	86	12
3	Catching mud crabs is in accordance with fisher's habits	2	21	5	60	12
4	Fishermen can catch the mud crab well	0	0	5	71	24
5	The community can easily catch mud crabs	10	19	24	43	5
6	Catching mud crabs is more profitable	2	17	24	52	5
7	Trends of fisher's number was increase	2	12	17	48	21
8	Government officials support to catch mud crabs	14	21	36	21	7
9	Catching mud crabs is better done in groups than individuals	19	33	12	26	10
10	Fisher's have no difficulty in marketing	2	14	14	52	17
11	The price to be relatively stable	0	7	10	74	10
12	Handling after catching is relatively easier	2	7	10	74	7
13	Income can meet the household needs of fisher's	5	7	24	62	2
14	Fishermen obtain information on government regulations	31	33	21	12	2
15	Fishermen never focus on to the sex of caught mud crabs	10	50	12	17	12

Fishermen's perception of mud crabs has a score of 2.47 - 4.27 with an average of 3.46. This finding means, on average, fishermen's perception of mud crabs is in a good category. A good perception will behave positively towards conservation efforts. In general, fishing communities are aware of the importance of the existence of mangroves as a place of care for various types of marine life. The better the mangrove ecosystem, so the better the catches, such as shrimp, crabs and other fishery products [17]

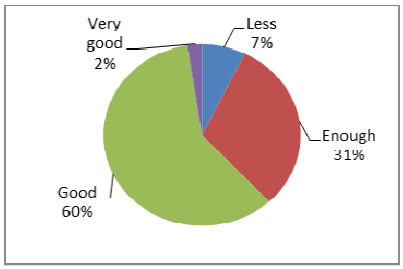

Fig 1 Fishermen's Perception in Mud Crabs

Distribution of answers to perceptions of fishermen on mangrove ecosystem are :

TABLE III
DISTRIBUTION OF ANSWER TO MANGROVE ECOSYSTEM PERCEPTION

No	Question	Answer (%)				
		1	2	3	4	5
1	Mangrove is very necessary to protect island	2	2	0	45	50
2	Mangrove is currently in good condition and maintained	0	0	0	60	40
3	The existence of a mangrove is beneficial to community	0	0	0	67	33
4	Mangrove has direct and indirect benefits for fisher's and resident's	0	0	0	76	24
5	Mangrove is beneficial for mud crab fisher's	0	0	0	74	26
6	Mangrove ecosystem supports the breeding of mud crabs	0	0	0	63	36
7	Mangrove ecosystems can be developed as one of the natural tourist destinations	12	5	0	67	17
8	Mangrove have positive benefits for coastal ecosystems	0	0	2	86	12
9	The better mangrove will increase the catch of mud crabs	0	2	5	60	33
10	A good mangrove ecosystem will maintain the quality of coastal	0	0	0	71	29
11	The community has a high awareness to maintain the mangrove ecosystem	0	7	14	60	19

Fishermen's perception of the mangrove ecosystem has a score of 3.55 - 4.91 with an average of 4.23. This means, on average, the perception of fishermen on mangrove ecosystems is in a very good category. The value of fishermen's perception of the mangrove ecosystem is higher than the value of fishermen's perception of mud crabs. With more protected habitat conditions, the sustainability of the mud crab life cycle can be maintained.

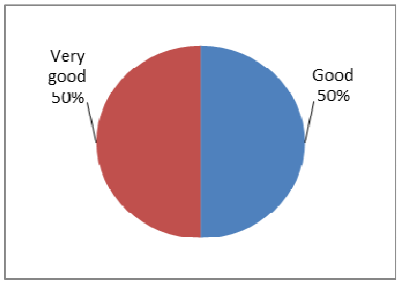

Fig 2 Fishermen's Perception in Mangrove Ecosystem

Perception can be influenced by the socio-cultural character of the community, such as Such understanding and close relationship with mangroves leads, intentionally or unintentionally, to their environmental protection, as has been shown in other traditional communities. However, fisher's understanding and perceptions of mangroves have not been in past and current government management policies of the coastal area [18]. In consumer behavior, perceptions relate to people's knowledge of a product. Good perception has a positive impact on awareness to preserve the environment [19].

Mangrove ecosystems have socio-economic functions that are useful in sustaining the economic life of the community. A good perception of fishermen is characterized by a good understanding that life depends on the biological resources of the mangrove ecosystem. Community perceptions are strongly influenced by factors of residence, education and community participation in mangrove rehabilitation activities [20].

B. Fishermen's Participation

Participation is the involvement of someone in an activity. High community participation will contribute to sustainable mangrove management [21], categorized in mud crab management. Distribution of answers to participation of fishermen on mud crabs management are :

TABLE IV
DISTRIBUTION OF PARTICIPATION ANSWER ON MUD CRABS MANAGEMENT

No	Question	Answer (%)				
		1	2	3	4	5
1	I used a fishing gear that matched the size of the mud crab	2	2	7	71	17
2	I used environmentally friendly fishing gear	0	0	2	67	31
3	I caught crabs with weight more than 200 grams	2	24	0	52	21
4	I caught crabs with a carapace width more than 15 cm	0	14	14	64	7
5	I released the crabs if their weight less than 200 grams	5	5	2	76	12
6	I released the crabs if carapace less than 15 cm	2	21	29	43	5
7	I learned regulations about rules for catching crabs both in carapace and weight	17	19	24	36	5
8	I release the crabs if they are laying eggs	5	38	5	36	17
9	I always sold crabs even though they were laying eggs	19	17	5	24	36
10	In the future (ITF), I will always use fishing gear that matches the size of crabs	2	7	5	50	36
11	ITF, I will use environmentally friendly fishing gear	2	0	5	64	29
12	ITF, I will always catch crabs with weight more than 200 grams	2	19	5	55	19
13	ITF, I will always catch crabs with carapace more than 15 cm	5	10	14	57	14
14	ITF, I will always release the crabs if less than 200 grams	2	2	10	76	10
15	ITF, I will always release the crabs if carapace less than 15 cm	0	10	21	57	12
16	ITF, I will always find out crabs government regulations	2	2	0	81	14
17	ITF, I will always release the crabs if laying eggs	7	5	2	62	24
18	ITF, I will always sell crabs even though they are laying eggs	2	12	7	29	50

The score of participation of fishermen in mud crab management is 3.00 - 4.94 with an average of 3.81, categorized in the high participation category. High participation can also be stated as very active. The relationship between perception and the level of participation is quite strong. A good perception will encourage high participation in the management of regional marine conservation areas [22].

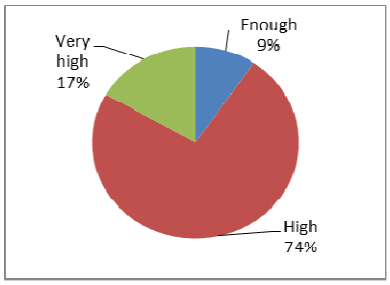

Fig 3 Participation of Fishermen's Perception in Mud Crabs Management

Distribution of answers to participation of fishermen on mangrove ecosystem management are :

TABLE V
DISTRIBUTION OF PARTICIPATION ANSWER ON MANGROVE ECOSYSTEM MANAGEMENT

No	Question	Answer (%)				
		1	2	3	4	5
1	I have used firewood from mangrove trees	7	2	2	19	69
2	I have used mangrove trees to make stakes / fences	5	5	0	21	69
3	I have cut down mangrove trees when I caught crabs	5	10	2	17	67
4	I have cut down mangrove trees to clear land	5	10	0	17	69
5	I participated in maintaining the mangrove both as individuals and groups	0	12	10	67	12
6	I look and report if there are other people cutting down mangrove	0	10	2	69	19
7	I have participated in planting mangroves	26	21	21	21	10
8	In the future (ITF), I will never use firewood from mangrove trees	0	0	2	38	60
9	ITF, I will never use mangrove trees to make stakes / fences	0	0	0	36	64
10	ITF, I will never cut mangrove trees when I catch crabs	0	0	0	33	67
11	ITF, I will never cut down mangrove trees to clear land	0	0	0	33	67
12	ITF, I will always participate in maintaining the mangrove both as individuals and groups	0	0	2	48	50
13	ITF, I will always look up and report if there are other people cutting down mangrove trees	0	0	0	67	33
14	ITF, I will participate in planting mangroves	0	0	2	52	45

The score of the participation of fishermen in the sustainable management of mangrove ecosystems is 3.57 - 5.00 with an average of 4.35, classifying in the very high participation category. Participation scores generally have a higher value than perception scores. The high score of participation of fishermen is expected to be able to maintain the presence of mangrove ecosystems in Enggano Island for the sustainability of fisher's business in capturing mud crabs. Mangrove ecosystem management builds community awareness to maintain the coastal environment [23].

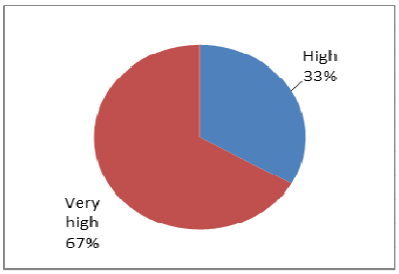

Fig 4 Participation of Fishermen's in Mangrove Management

C. *Factors Affecting Fishermen's Participation*

Factors that influence the participation of fishermen are factors that influence the participation of fishermen in the sustainable management of mud crabs and mangrove ecosystems. Of the 12 independent variables significantly influence the participation of fishermen in the sustainable management of mud crabs at 95% confidence level, with a coefficient of determination of 60.80%. Two independent variables have a significant effect, namely the perception of fishermen on the mangrove ecosystem and the income obtained by respondents from their work as fishermen. Research [24] stated the number of household members had a significant effect on mangrove ecosystem restoration. Community participation in maintaining traditional use of mangrove forests such as only for firewood can help maintain the rate of degradation of mangrove ecosystems.

TABLE VI
RESULTS OF ANALYSIS OF FACTORS AFFECTING FISHERMEN'S PARTICIPATION IN MUD CRABS MANAGEMENT

No	Variables	Coeff	t stat	F
1	Perception of mud crabs	(0.297)	(1.318)	3.479
2	Perception of mangrove ecosystem	0.627	2.834	
3	The number of dependents	0.280	0.309	
4	Age	(0.165)	(1.292)	
5	Job Status	(1.915)	(0.649)	
6	Experience as a fisherman	0.073	0.352	
7	Formal education	(0.697)	(1.734)	
8	Fishermen's Income	0.0000031	2.904	
9	Income from other sources	0.0000016	1.202	
10	Long domicile in Enggano	0.040	0.395	
11	Enggano exit frequency	0.298	1.118	
12	Land area	0.123	0.247	
13	Intercept	58.620	5.015	
t table : 2.020 F table : 2.104 R square : 60.80%				

Fishermen's perception of the mangrove ecosystem has a coefficient of 0.627, which means that every increase in perception scores on mangroves by 10% will increase the participation score of 6.27%. Perception and community participation can be used as a basis for determining adaptive management strategies. Sustainable management of mangrove ecosystems can be achieved while still taking into account its economic potential and being taken into account in developing its protection strategy [25].

Fishermen's income variable has a coefficient of 0.0000031, which means that every increase in fishermen's income increases by IDR 100,000 per month, it will increase the participation score by 0.31 points. The income obtained by respondents from their work as fishermen ranged from IDR 200,000 - IDR 5,000,000 per month with an average of IDR 1,380,952 per month.

The income of mud crab fisher's who are included in the low category with ranges from IDR 200,000 - IDR 1,800,000 per month is 74%. The income of fisher's who are included in the medium category with ranges from IDR 1,800.001 - IDR 3,400,000 per month is 21% and income in high categories with ranges from IDR 3,400,001 - IDR 5,000,000 per month is 5%.

Mangrove ecosystems receive a lot of waste from various types of fishermen, industrial and household activities, but there are still very few of the people who know the ecological impact of these wastes. The work of fishermen who will generate income can lead to vulnerability in participation [26].

TABLE VII
RESULTS OF ANALYSIS OF FACTORS AFFECTING FISHERMEN'S PARTICIPATION IN MANGROVE ECOSYSTEM MANAGEMENT

No	Variables	Coeff	t stat	F
1	Perception of mangroves crabs	(0.448)	(1.996)	2.413
2	Perception of mangrove ecosystem	0.540	2.441	
3	The number of dependents	(0.215)	(0.238)	
4	Age	(0.234)	(1.842)	
5	Job Status	0.774	0.263	
6	Experience as a fisherman	0.407	1.967	
7	Formal education	(0.121)	(0.301)	
8	Fishermen's Income	0.0000014	1.327	
9	Income from other sources	0.0000028	2.153	
10	Long domicile in Enggano	(0.001)	(0.006)	
11	Enggano exit frequency	0.385	1.446	
12	Land area owned	0.472	0.945	
13	Intercept	43.104	3.639	
t table : 2.020 F table : 2.104 R square : 49.97%				

Twelve independent variables together also have a significant effect on the participation of fishermen in the sustainable management of mangrove ecosystems in the 95% confidence level with a coefficient of determination of 49.97%. Partially, the perception of fishermen on the mangrove ecosystem has a coefficient of 0.540, which means that every increase in perception scores on mangroves by 10% will increase participation scores by 5.40%. Other

income also has a significant effect on participation with a 0.0000028 equivalent coefficient, which means that every increase in other income increases by IDR 100,000 per month, it will increase the participation score by 0.28 points.

Other income is income obtained by respondents from other sources, other than as fishermen. Of the 42 respondents, as many as 66.67% had jobs other than fishermen, such as farmers, port officers, motorcycle repair mechanics and entrepreneurs (store). Fishermen's income from other jobs ranges from IDR 0 - IDR 4,000,000 per month with an average of IDR 639,048 per month.

The income of fishermen from other sources is categorized as low with a range of IDR 0 - IDR 1,333,333 per month is 85.7%. Other income of fishers included in the medium category with a range of IDR 1,333,334 - IDR 2,666,666 per month is 9.5% and high category with a range of IDR 2,666,667 - IDR 4,000,000 per month is 4.8%.

The total income of fishing households is IDR 2,020,000 per month, which comes from income as fishermen is as 68.4% and other jobs is 31.6%. On average, the income of mud crab fishermen is above the minimum wage of Bengkulu Province in 2018, which is IDR 1,888,741 per month [27].

Fishermen households with low income categories, will meet household needs by devoting work time to making a living from various economic activities such as agriculture and side jobs [28]. ncome will determine the consumption patterns of fishermen households. Income has a positive effect on household consumption of fishermen and if income increases by IDR 1,000,000 it will increase household consumption by IDR 556,000 [29]. Fishermen's income can be influenced by work frequency, business experience, age, education, number of family dependents and the number of catches or value of production [30].

The results of the analysis show that of 12 independent variables, there are 3 variables that influence fishermen's participation in managing mud crabs and mangrove ecosystems. This means, there are 9 independent variables that have no significant effect. The number of dependents of fishing families ranges from 0-6 person with an average is 3 people. This means, in one household consists of 1-7 people with an average is 4 people. In one family, it means there are parents and 2 children. This data also indicates that there are fishermen who have status as widowers, so they do not have a burden, except himselves.

The age of fishermen ranges are 19-61 years with an average is 35 years, which is still included in the productive age category. The profession of crabs fisher’s are the main occupation for 83 respondents and as a side job for 17% of respondents. Range of experience as a mud crab fisherman is 1 - 25 years with an average is 11 years. Data shows that there were 4.76% of respondents who just started the profession as mud crab fishermen last year.

Formal education of fishermen are 4-12 years with an average is 8 years. The lowest education is not graduating from elementary school and the highest education is graduating from high school. The average education of fishermen are level 2 in junior high school. The length of domicile of fishermen in Enggano are 2-50 years with an average is 20 years. As many as 28.6% of respondents have the same domicile with their age. This means that there are around 71.4% of respondents who do not always live in Enggano or they are immigrants.

The frequency of leaving the island is not carried out by all fishermen because there is limited transportation to get out of the island. In one year, the frequency of fishermen leaving the island are 0-24 times with an average is 2 times per year. There is only one fisherman whose frequency is out of the island is 2 times per month. The agricultural land owned by fishermen are 0-7 hectares with an average is 2 hectares. There is only one fisherman who does not have agricultural land. In general, ownership of agricultural land can be used to a source of additional or alternative income if the results of fishing do not meet household needs. The results of farming can also be used as self-consumption and not sold. The cultivation of land for agricultural activities for fishermen and the Enggano community needs to be a special consideration because Enggano is a small island that has limitations in land resources.

IV. Conclusions

Fishermen's perception of mud crabs is in the good category with an average score of 3.46 and the perception of fishermen on mangrove ecosystems is in a very good category with an average score of 4.23. The participation of fishermen in mud crab management is categorized in the high category with an average score of 3.81, and the participation of fishermen in the sustainable management of mangrove ecosystems is classified in the very high participation category with an average score of 4.35. The participation of fishermen in mud crab management is influenced by perception of the mangrove ecosystem and income as being fishermen with regression coefficients of 0.627 and 0.0000031, respectively, and the coefficient of determination of 60.80%. The participation of fishermen in the sustainable management of mangrove ecosystems is influenced by perception of the mangrove ecosystem and fishermen's income from other sources with regression coefficients of 0.540 and 0.0000028, respectively, and the determination coefficient of 49.97%.

Sustainable management of muud crabs requires the positive perception of fishermen on the mangrove ecosystem to increase income. Therefore, fishermen need to get up-to-date information related to regulations on the use of mud crabs. In addition, there needs to be alternative livelihoods when fishermen are not able going fishing.

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