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Socio-economic study of mud crab (*Scylla serrata*) households in Bengkulu Province, Indonesia

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Abstract Results indicated that the food security of mud crab fishermen households in Bengkulu Province, Indonesia was generally secured. It was found that 92% of fishermen's households were very secure, 4% were quite secured, and 4% were less secure. Meanwhile, based on multidimensional poverty category of mud crab fishermen households was not impoverished. Overall, 67% of people were not poor, 22% were vulnerable poor, 3% were poor, and 7% were very poor. Furthermore, the welfare of mud crab fishermen households is found to be in the category of high welfare. Those included in high welfare was 53% and in moderate category is 47%. In addition, the feasibility of mud crab fishery business carried out by fishermen which was in the feasible category with a BC ratio of 3.04. The socio-economic status of fishermen households as indicated by the sufficient category were grouped into good, sufficient and bad were accounted for 27.9%, 70.8%, and 1.3%, respectively. Improving the socio-economic status of fishermen's households could be done through the expansion of the mud crab fishing industry. Then, increasing income would increase food security, reduce multidimensional poverty, enhance welfare and raise business feasibility. Increasing income could be completed by enlarging the volume mud crabs caught by fishermen as well as selectively selling bigger size to have higher revenue.

Keywords: Food security, Mud crab households, Multidimensional poverty, Socio-economic status, Welfare

Introduction

The mud crab (*Scylla serrata*) is an essential commodity in the capture fisheries sector in Bengkulu Province, with an annual production reaching 18,096 tons and an average production value of Rp 4.59 billion (Bengkulu Province Fisheries Department, 2021). This commodity holds significant economic potential for fishing households and contributes significantly to the region's economy. Mud crabs are primarily harvested from the mainland

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regions, such as in Seluma, Mukomuko, South Bengkulu, Kaur, Central Bengkulu, North Bengkulu, Bengkulu City, and outer islands of Enggano.

Previous studies have explored various aspects of mud crab fisheries in the mainland regions, including ecology, growth, fishing gear design, economic impact, and sustainability. These studies covered ecological factors (Putro *et al*., 2015; Sunarto *et al*., 2015; Tahmid *et al*., 2015; Ismail *et al*., 2018; Ulfa *et al*., 2018), crab growth (Suprapto *et al*., 2014; Hoek *et al*., 2015; Kaligis, 2016; Sen and Homechaudhuri, 2016; Dewantara *et al*., 2017; Waiho *et al*., 2018; Widigdo *et al*., 2017), fishing gear design (Tallo, 2015), and economic analysis (Apine *et al*., 2019). However, research on the socioeconomic status of mud crab fishing households remains scarce, particularly in the main and outermost island areas.

Study on the socioeconomic aspects of crab fisheries is limited to the blue swimming crab (BSC, *Portunus pelagicus*) in the archipelago by Lopulalan and Rahman (2024). So did, research on mud crab fisheries in the outermost small islands is also limited. Some existing studies investigated crab ecology (Suryani, 2007), population structure and parameters (Cahyadinata *et al*., 2021), resource utilization (Cahyadinata *et al*., 2020), and perceptions, participation, food security, and welfare of fishing communities (Cahyadinata *et al*., 2019a, 2019b, 2019c). Nevertheless, mud crab fishermen face challenges in optimizing resource utilization. Mud crabs' high market demand and economic value often motivate fishermen to maximize their catches. While this may generate short-term income, unsustainable practices could negatively impact fishing communities' long-term food security, welfare, and poverty alleviation (Allison and Horemans, 2006).

The socioeconomic conditions of fisher households reflect the interplay between food security, multidimensional poverty, welfare, and business feasibility (Weeratunge *et al*., 2014). Ensuring food security is crucial for fishermen households, guaranteeing access to sufficient and nutritious food. Multidimensional poverty evaluates household welfare based on access to education, healthcare, and living standards. The feasibility of the mud crab fishing business is assessed through cost-benefit analysis, which measures business efficiency and profitability. Considering the significant contributions of mud crab catches for fishermen households, it is very crucial to conduct thorough research on the socioeconomic status of mud crab fishermen in Bengkulu Province. The results could provide better understanding economic conditions, informed policy making, sustainable fisheries management, community development, gender and social equity, improved marketing and value chain development, impact of external factors, empowerment and capacity building. Such information will be very useful to strengthen the

prosperity of fishermen household in the Province of Bengkulu. However, there have been less researches addressed on the comprehensive socioeconomic status of mud crab fishermen in Bengkulu Province. The research aimed to comprehensively assess the socioeconomic status of mud crab fishermen in Bengkulu Province.

Materials and methods

Study sites

This research was conducted in seven coastal regions of Bengkulu Province, specifically Kaur Regency, South Bengkulu, Seluma, Central Bengkulu, North Bengkulu, Mukomuko, and Bengkulu City. The research sites were selected purposively, focusing on areas that serve as critical centers for mud crab production. Data were consisted of both primary and secondary sources. Primary data were collected through interviews and field surveys using structured questionnaires, while secondary data were obtained from relevant literature and statistical records provided by various institutions.

Data collection

Sampling was done using a random sampling method, with 89 fishermen respondents spreaded across seven research areas. Each region involved 12 – 15 randomly selected fisher respondents. Interviews and surveys collected food security, welfare, multidimensional poverty, and business feasibility data. The interview was conducted to obtain in-depth information about the socioeconomic conditions of mud crab fishermen households.

Data analysis

Food security

Food security was analyzed using the Food Security Index, which includes three main dimensions: food availability, food affordability, and food utilization (BPS and FEMA IPB, 2015). Measurement was carried out by giving a score to each indicator of each dimension to assess fisherman households' food security level.

Food security comprises three main components: availability, affordability, and utilization. Food security is successfully achieved if there are similarities between the three components. The food security index was measured by giving a score on each aspect of each dimension, as presented in Table 1.

Table 1. Food security index measurement

No	Dimensions	Aspects	Indicators	Score
1	Availability food	Adequacy food	Adequacy of food supplies	0-6
			No shortage of food	0-3
			Fear of food shortages	0-3
2	Affordability/ food access	Affordability physical, economic, social	Food is produced in sub-districts	0-1
			No difficulty reaching the purchase location	0-1
			The purchase price is not high	0-1
3	Utilization food	Adequacy intake	No toddler is malnourished	0-1
			No toddler died of illness	0-1
		Water quality	The primary source of drinking water	0-3
			The primary source of water for cooking	0-3

Source: BPS and FEMA IPB (2015)

Food security measured was based on the food security index and categorized into three categories; less secure (≤ 33.33), fair (33-34 – 66.66), and secure (≥ 66.67).

Multidimensional poverty

Multidimensional poverty is based on three main dimensions: education, health, and living standards. Each dimension has indicators that reflect household conditions, such as access to education, health quality of family members, housing conditions, and access to basic facilities (Table 2). Each dimension has the same weight, which is one-third or 33.33%.

Table 2. Multidimensional poverty measurement

No	Dimensions	Indicators
1	Education	• Do not have a family member who has completed nine years of education (junior high school) • Have at least one school-age child (up to grade 9) who has dropped out.
2	Health	• Have at least one malnourished family member • Have one or more children who have passed away
3	Standard of living	• No electricity • Not having access to clean drinking water • Not having access to adequate sanitation • Uses cooking fuels from charcoal, coal, or firewood • Have a house with a ground floor • Do not own a motor vehicle and only have one of the following items: bicycle, motorcycle, radio, refrigerator, telephone, or television.

Source: BPS and FEMA IPB (2015)

Multidimensional poverty score (KM) of households ranges from 0-100. The higher the KM score, the higher the poverty rate. From the multidimensional poverty score value, households can be grouped into four categories; (1) not poor, if the household has a multidimensional poverty score of less than 20, (2) vulnerable poor, if the household has a multidimensional poverty score of less than 20 to less than 33.33, (3) poor, if the household has a multidimensional poverty score between 33.34 and less than 50, and (4) extreme poor, if household has a multidimensional poverty score higher than 50.

Welfare

The level of welfare was measured using a scoring approach based on education level of the the household head, the proportion of working family members, home conditions, access to sanitation, and property ownership. The score was calculated to classify the level of household welfare into three categories: low, medium, and high welfare. Welfare indicators, categories, and scores for each category used in this study are presented in Table 3.

Table 3. Welfare level measurement

No	Indicators	Scores	
1	The level of education of the head of the household	College	5
		Senior high school	4
		Junior high school	3
		Elementary school	2
		Unfinish elementary school	1
		Not in school	0
2	Proportion of working family members	1	3
		x<1, x>0.49	2
		x<0.5, x>0.25	1
		x<0.25	0
3	Have adequate house walls	Permanent	3
		Semi permanent	2
		Non permanen (Bamboo)	1
		Other	0
4	Floor area per capita	≥ 8 m2	3
		< 8 m2	0
5	Have access to adequate sanitation	There are toilets	1
		None	0
6	Source of lighting	Electricity	1
		Other	0
7	Ownership of goods	• Bicycle, fishing boat, Radio, Motorcycle, Television, refrigerator	0.5 each
		• Cars/Motorboats	1

Source: BPS and FEMA IPB (2015)

The classification of welfare levels was determined using the scoring method. The score was calculated by subtracting the highest score from the lowest number of the eleven predetermined welfare indicators, and the result of the reduction was divided by the number of welfare level classifications to be used, namely, three classifications. The obtained score was then used as an index (0-100). Based on the index obtained, households were grouped into three categories, namely: (1) low, with an index ≤ 33.33, (2) fair , with an index of 33.34 – 66.66, and (3) high, with an index ≥ 66.67.

Business feasibility

Mud crab fishing directly benefits mangrove ecosystems (Massiseng 2013). The feasibility assessment process can be carried out using cash flow. Decisions with a certain efficiency level were evaluated to analyze the cost of benefits with the decision criteria is B-C ratio (Wibowo *et al*., 2016). The cost-benefit analysis measurement for evaluation, in simple terms, is illustrated in the following formulation:

$$\frac{B}{C} = \sum_{t=1}^{n} \frac{\frac{Bt}{(1+r)^t}}{\frac{Ct}{(1+r)^t}} \qquad \text{.....(2)}$$

with criteria of Gross B/C > 1: feasible and Gross B/C ≤ 1: not feasible

Notes:

B / C	:	Ratio Benefit – Cost	t	:	time *t*
r	:	Interest Rate	n	:	Project period
B	:	Benefit			
C	:	Cost			

Cost (C) is the total expenses spent by fishermen in carrying out mud crab catching activities. Benefit (B) is the catch multiplied by the selling price of mud crabs. The catch is classified into 5 categories with different prices for each category.

Socioeconomic status of fishermen households

The socioeconomic status of mud crab fishermen is based on four main variables: food security, multidimensional poverty, welfare, and business feasibility. The assessment of variables used a score with a value of 1-5 (Table 4). All these components were the basis for recommendations to improve fishermen's welfare.

Table 4. The score for each variable

No	Variables	Categories	Score
1	Food security	Less secure	1
		Fair	3
		Secure	5
2	Multidimensional poverty	Extreme poor	1
		Poor	2
		Vulnerable poor	3
		Not poor	4
3	Welfare	Low	1
		Fair	3
		High	5
4	Business feasibility	Not feasible	1
		Feasible	3

Each variable was the same weight based on the score, an index of the household's socioeconomic status was obtained and categorized into four categories (Table 5).

Table 5. Socioeconomic status of fishermen households

Index Value (%)	Category
0.00 – 25.00	Bad
25.01 – 50.00	Less
50.01 – 75.00	Fair
75.01 – 100.00	Good

Results

Food security

The results of the food security index (FSI) assessment can be seen in the following Table 6. Result showed that the food security index of mud crab Fisherman Households in Bengkulu Province had an average of 88.4 and is found in the food security category because the FSI is >66.6, meaning that Mud crab fishermen households had achieved a level of food security which included various dimensions ranging from food availability, food affordability/access, and food utilization. It reflected a commitment to ensure that mud crab fishing households can access and enjoy sufficient, safe, nutritious, and quality food to support their well-being.

Table 6. Food security index of mud crab fishermen households in Bengkulu Province

Food Security Index	N	Percentage (%)	Average
Less secure (≤33,33)	4	4	
Fair (33.34-66.66)	4	4	88.40
Secure (≥66.67)	81	92	
Total	**89**	**100**	**88.40**

Food availability for mud crab fishermen in Bengkulu Province is included in the insufficient category. Households had food supplies at home, but they were not enough to meet their needs for one year and meet their shortcomings in buying (Table 7). Various factors, including natural factors, technology, government policies, and social factors, can cause food shortages experienced by fishermen. Because as many as 97% of fishermen had experienced food shortages in the past, as many as 98% of fishermen feel afraid or worried about food shortages in the future. This means fishing households currently included in the category that have never experienced food shortages are still worried about food shortages. Job loss is related to additional cause of concern, in addition to several causes of households experiencing food shortages in the past.

Table 7. Results of food security index measurement

No	Indicators	Sum (person)	Percentage (%)
1	Adequacy of food supplies		
	• There is supply and enough for one year	5	5.61
	• There are supplies and sufficient shortages from buying	50	56.17
	• There are supplies and sufficient shortages of aid	4	4.49
	• There is supply and sufficient for the shortage from other sources	3	3.37
	• Not having enough supplies and enough from buying	24	26.96
	• Not having enough supplies and sufficient aid	2	2.24
	• Not having supplies and sufficient supplies from other sources	1	1.12
2	No shortage of food		
	• Households do not lack food	29	32.5
	• Households are short of food for one reason	14	15.7
	• Households lack food for two reasons	23	25.8
	• Households are undernourished for three or more reasons	23	25.8
3	Fear of food shortages		
	• Not afraid of food shortages	30	33.7

	• Fear of food shortages for one reason	25	28.0
	• Fear of food shortages for two reasons	20	22.4
	• Fear of food shortages for three or more reasons	14	15.7
4	Food production locations		
	• Most of them are produced in the sub-district	55	61.7
	• Most of them are produced outside the sub-district	39	43.8
5	Where to buy		
	• The location to buy food is easy to reach	83	93.2
	• The location of buying food is quite difficult to reach	7	7.86
6	Purchase price		
	• Quite affordable	77	86.5
	• Relatively expensive	18	20.2
7	Malnourished toddlers		
	• Available	31	34.8
	• Inavailable	58	65.1
8	Toddlers who died of illness		
	• Available	14	15.7
	• Inavailable	75	84.2
9	The primary source of drinking water		
	• Bottled/refilled/plumbing water	29	32.5
	• Pump	2	2.2
	• Wells/springs	50	56.1
	• River	1	1.1
10	The primary source of cooking water		
	• Bottled/refilled/plumbing water	29	32.5
	• Pump	2	2.2
	• Wells/springs	50	56.1
	• River	1	1.1

Food-secure mud crab fishermen were households that had food supplies and meet their shortcomings by buying, not lacking food, not being afraid of food shortages, and the purchase price of food being relatively affordable. The existence of food supplies characterized fisherman households that were food secure and meeting their shortage needs by buying, having experienced food shortages for two reasons: the fear of food shortages for two reasons and the relatively expensive purchase price of food (Table 8).

Multidimensional poverty

Multidimensional poverty index (MPI) is a condition of household poverty. MPI covers education, health, and living standards. The results of the multidimensional poverty measurement are categorized into four categories, namely not poor (less than 20), vulnerable poor (20-33.34), poor (33.4-50), and extreme poor (more than 50) can be seen in Table 9.

Table 8. Category of fishermen food security

No	Indicators	Secure	Fair	Less Secure
1	Inventory adequacy food	Have supplies and meet the shortcomings of buying	Have supplies and meet the shortcomings of buying	Not having supplies and fulfilling them from other sources
2	Adequacy food	No shortage of food	Food shortages for two reasons	Food shortages for three or more reasons
3	Fear deficiency food	Not afraid of food shortages	Fear of food shortages for two reasons	Fear of food shortages for three or more reasons
4	Production location food	Most of them are produced in sub-districts	Most of them are produced in sub-districts	Most of them are produced outside the sub-district
5	Where to buy	Easy to reach	Easy to reach	Easy to reach
6	Purchase price	Quite affordable	Relatively expensive	Relatively expensive
7	Malnourished toddlers	Exist	Exist	Exist
8	Toddlers who died because of illness	Exist	Exist	Exist
9	The primary source of drinking water	Wells/springs	Wells/springs	Wells/springs
10	The primary source of cooking water	Wells/springs	Wells/springs	Wells/springs

Table 9. Multidimensional food poverty of mud crab fishermen households in Bengkulu Province

Multidimensional Poverty Index	N	Percentage (%)	Average
Not poor (<20)	60	67	
Vulnerable poor (20-33.4)	20	22	11.74
Poor (33.4-50)	3	3	
Extreme poor (>50)	6	7	
Total	**89**	**100**	**11.74**

The education dimension is relatively low because the education level of fisherman household members is dominated by elementary school graduates, which was 47.19%. The health dimension is in the relatively good category because there were no malnourished family members, and only about 4.76% of households experienced child death. In terms of living standards, in general, fishing households had already electricity, accessed to clean drinking water, adequate sanitation, fuel for cooking from wood, houses with floors instead of

soil, and some adequate household appliances, including motorcycles, telephones, refrigerators and televisions (Table 10).

Table 10. Multidimensional poverty measurement

No	Dimensions	Indicators	Number (Person)	Percentage (%)
1	Education	• Do not have a family member who has completed nine years of education (junior high school)	42	47.19
		• Have at least one school-age child (up to grade 9) who has dropped out of school	12	13.48
2	Health	• Have at least one malnourished family member	4	4.49
		• Have one or more children who have passed away	9	10.11
3	Standard of living	• No Electricity	3	3.37
		• Not having access to clean drinking water	4	4.49
		• Not having access to adequate sanitation	4	4.49
		• Uses cooking fuels from charcoal, coal, or firewood	16	17.97
		• Have a house with a ground floor	12	13.48
		• Do not own a motor vehicle and only have one of the following items: bicycle, motorcycle, radio, refrigerator, telephone, or television	15	16.85

Welfare

The level of welfare was measured by an educational approach based on the education level of the household head, the number of household members based on the proportion of the number, the condition of the house based on the type of wall, the floor area of the house per capita, access to sanitation, main lighting and property ownership. The measurement results per welfare indicator are presented in Table 11.

The education level of mud crab fishermen as heads of families was generally elementary school (48.31%). For each fisherman's household, the number of household members who work is more than 25%, but less than 50% of the total household members. This implied that there were around 1-2 people out of 4-5 family members who actively work. The mud crab fishermen's house was in the permanent house category as much as 82.02%. The floor area of the house per capita which was more than 8 m2 is as much as 95.5%. Household sanitation access was in the good category which was indicated by as much as

94.38% of households having toilets and as much as 96.62% already having electricity. In addition, as many as 92.13% of fisherman's household possed their own boats.

Table 11. Measurement of mud crab fishermen welfare indicators

No	Indicators	Categories	Number (person)	Percentage (%)
1	The level of education of the head of the household	College	1	1.12
		Senior high school	20	22.47
		Junior high school	21	23.59
		Elementary school	43	48.31
		Unfinish elementary school	4	4.49
		Not in school	0	0
2	Proportion of working family members	1	8	8.98
		x<1, x>0.5	24	26.96
		x<0.49, x>0.25	36	40.44
		x<0.25	11	12.35
3	Have adequate house walls	Permanent	73	82.02
		Semi Permanent	14	15.73
		Non Permanent (Bamboo)	2	2.24
		Other	0	0
4	Floor area per capita	≥ 8 m2	85	95.50
		< 8 m2	4	4.49
5	Have access to adequate sanitation	Toilets	84	94.38
		None	5	5.61
6	Source of lighting	Electricity	86	96.62
		Other	3	3.37
7	Ownership of goods	Bicycle	21	23.59
		Fishing boat	82	92.13
		Radio	8	8.98
		Motorcycle	76	85.39
		Television	73	82.02
		Refrigerator	70	78.65
		Car	13	14.60
		Motorboat	22	24.71

Results also indicated that the level of welfare has three categories, namely low welfare (≤33.33), fair (33.34-66.66), and high welfare (≥66.67). The level of welfare of mud crab fishermen's households is presented in Table 12.

Table 12. Mud crab fishermen household welfare index in Bengkulu Province

Welfare Index	N	Percentage (%)	Average
Low (≤33.33)	0	0	
Fair (33.34-66.66)	42	47	70,00
High (≥66.67)	47	53	
Total	**89**	**100**	**70,00**

The welfare index of mud crab fishermen households is on average 70%, which means that in general fishermen households are in the high welfare category. Based on the category, households with moderate welfare and high welfare were 47% and 53%, respectively

Business feasibility

The peak fishing season for mud crab fishermen occured in March and December, with the lowest catches in July and November. The average monthly catch was approximately 46.72 kg per fisherman. A1 (over 1 kg per crab), priced at 80,000 IDR per kg; A2 (0.8–1 kg per crab) priced at 70,000 IDR per kg; B (0.4–0.7 kg per crab) priced at 40,000 IDR per kg, C (less than 0.4 kg per crab) priced at 20,000 IDR per kg, and BS (crabs with eggs, molting, or incomplete body parts) priced at 25,000 IDR per kg. The proportion of each grade was 13.1%, 14.2%, 42.8%, 19.5%, and 10.4%, respectively. This resulted in an annual revenue of 24,677,095 IDR per fisherman, or 2,056,425 IDR per month.

The total annual cost of running a mud crab fishing business was 8,105,671 IDR or 675,473 IDR per month. This included investment depreciation and operational costs, with 25.2% allocated to investment and 74.8% to operations. Operational costs covered equipment maintenance and expenses related to going to sea and catching crabs. After accounting for business costs, the fishermen's net annual income was 16,571,424 IDR or 1,380,952 IDR per month. The Benefit-Cost (BC) ratio was 3.04, indicating that the mud crab fishing business was efficient, as the BC ratio exceeds 1 with an 8% discount rate. For every rupiah spent, fishermen earned a revenue of 3.04 rupiah.

Socioeconomic status of the household

Overall, the socioeconomic status of mud crab fishing households was generally adequated with 70.8% classified as fair, 27.9% as good, and 1,3% as less. This indicated that while many households had sufficient socioeconomic

conditions, with an index value of 50.01–75.00 (Table 13), some still required improvements in food security, welfare, and business viability. Addressing these households' socioeconomic challenges did not necessarily required focusing solely on income increases. Instead, business diversification and enhancing market access should be prioritized.

Table 13. The Socioeconomic status of fishermen households

Index Value (%)	Category	Percentage (%)
0.00 – 25.00	Bad	0
25.01 – 50.00	Less	1.3
50.01 – 75.00	Fair	70.8
75.01 – 100.00	Good	27.9

Discussion

BPS and FEMA IPB (2015) stated that the Food Security Index (FSI) is based on the food security index, which is categorized into three categories, included less resistant, moderately resistant, and food resistant and consists of three dimensions (food availability, food affordability/access, food utilization), four aspects (food adequacy, physical, economic and social affordability, intake adequacy, and water quality) and ten indicators (food supply adequacy, no shortage of food, fear of food shortages, food produced in sub-districts, no difficulties, reaching the location of purchase, purchase prices are not high, no toddlers who are undernourished, no toddlers who die from illness, primary source of drinking water, main source of water for cooking). Those categories, dimensions, and indicators provided an overview of the level of food security achievements in Bengkulu Province, especailly for mud crab catches for fishermen households.

The study showed that most fishing households had good food security, as indicated by the high percentage of households in the food security category (index value = 88.40). Strong food security is crucial in ensuring households can sustainably meet their basic needs (Allison and Horemans, 2006; Bene and Friend, 2011). However, a few households remain food insecure, reflecting challenges related to food access that must be addressed. These challenges may arise from fluctuations in catch yields, high food prices, and limited market access and supporting infrastructure (Kawarazuka and Bene, 2010; Johnson, 2012).

Multidimensional poverty, measured through education, health, and living standards indicators, revealed that most fishing households were not considered multidimensionally poor. However, the significant percentage of households that are vulnerable to poverty or currently experiencing poverty

highlights a gap in access to essential services (FAO, 2015). Low levels of education and limited access to healthcare facilities are key factors that exacerbate poverty among fishermen. This situation underscores the importance of policy interventions and collaboration between the government and local communities (Pomeroy and Berkes, 1997), mainly focused on economic empowerment, education improvement, and healthcare access to address the root causes of multidimensional poverty (Jentoft and Eide, 2011). The findings by Butt (2024) suggested that socioeconomic adversity, beyond just financial poverty, plays a crucial role in health outcomes. Future research is encouraged to refine poverty's role in disease risk prediction and promote interventions to reduce health disparities through a more comprehensive understanding of poverty.

The welfare of fishing households is generally good, with more than half demonstrating a high level of well-being. Welfare indicators encompass various factors, such as housing conditions, access to sanitation, and ownership of goods that contribute to a decent standard of living (Pollnac and Poggie, 2008; Weeratunge *et al*., 2014). However, households with moderate levels of welfare require improvements through better access to education and public services. Such efforts will enhance the quality of life for fishermen and help them reduce their dependence on external factors that could hinder their well-being (Cinner *et al*., 2009; Bene *et al*., 2010).

The business feasibility analysis indicated that the mud crab fishery business is profitable and has the potential for further development. The high B/C ratio reflects that mud crab fishing activities generate positive economic benefits for fishing households. Nevertheless, it is essential to ensure the sustainability of this business so that it continues to provide long-term economic benefits while preserving natural resources (Kittinger *et al*., 2013). Implementing more environmentally friendly fishing practices, such as allowing small crabs to grow before being sold, could enhance economic value while supporting the sustainability of mud crab populations (Primavera, 2006; Khan *et al*., 2020).

The relationship between food security, multidimensional poverty, welfare, and business feasibility is interconnected. Strong food security improves welfare and reduces the risk of multidimensional poverty (Barrett, 2010). In turn, economically viable ventures provide stable incomes that improve household access to education, healthcare, and better living standards (Bene *et al*., 2010). The connectivity between these indicators creates a positive cycle with the potential to enhance the overall well-being of fishing households (Alkire and Foster, 2011; Allison and Ellis, 2001).

Despite the considerable potential, challenges remain, particularly for fishing households in the vulnerable category. Factors such as fluctuating market prices, environmental changes, and limited infrastructure can destabilize the economic conditions of these households (Bene and Friend, 2011). Therefore, a holistic and integrative policy approach is required one that not only focuses on economic improvements but also addresses social dimensions, such as education (Allison and Horemans, 2006; Bukhari *et al.,* 2024) and healthcare (Osei and Owoo, 2024), which is expected to have an impact on income diversification (Koiry *et al.,* 2024). Expanding access to sustainable skills training and economic empowerment programs will significantly contribute to reducing the vulnerability of fishing households (Kawarazuka and Bene, 2010).

Collaboration among the government, fishing communities, and other stakeholders is critical to achieve these goals. Strengthening the capacity of fishing communities through education and improved access to technology can enhance fishermen's competitiveness in both local and national markets (Allison and Horemans, 2006). This strengthening can be done with a holistic policy approach, including by considering gender sensitivity (Jerumeh, 2024; Maket, 2024; Suich *et al.,* 2024) and prioritizing empowerment, education, and income enhancement (Zanbak and Soycan, 2023). Economic and social empowerment, combined with the active participation of fishermen in decision-making processes regarding fisheries resource management, will have a significant positive impact (Pomeroy and Berkes, 1997). This study emphasizes that responsive policies and sustainable empowerment initiatives can foster a more prosperous and resilient fisheries ecosystem, particularly in Bengkulu Province, while improving the welfare of fishermen for future generations (Primavera, 2006).

This study highlighted that the socioeconomic status of mud crab fishermen households in Bengkulu Province was generally positive, with strong food security, relatively good welfare, and financially viable fishery business. However, challenges remain in addressing multidimensional poverty, impacting some fishing households. Limited access to education, healthcare, and basic facilities is found to be a crucial issue that must be addressed to improve fishermen's and their families overall quality of life.

This study confirmed there was a strong relationship between food security, welfare, multidimensional poverty, and entrepreneurship. Adequate food security and economically viable fisheries are found to be a critical in enhancing household welfare and reducing poverty risks. Therefore, efforts to improve the socioeconomic status of fishermen should be holistic, addressing both economic and social aspects, including education and healthcare.

Based on these findings, several recommendations are proposed. Firstly, enhancing access to education and training for fishermen is crucial, with a particular focus on business management and sustainable fishing practices. Secondly, the government should prioritize improving basic infrastructure, such as road access, healthcare services, and market facilities, to better support the economic activities of fishermen. Thirdly, promoting income diversification policies, including developing alternative livelihoods or initiatives like cultivating small mud crabs for higher market value, should be encouraged to boost fishermen's socioeconomic well-being further. Finally, empowering fishing communities through capacity-building programs and participation in local resource management. The collaboration between the government, the community, and other stakeholders is essential in creating a prosperous and sustainable fisheries ecosystem. With this integrated approach, it is hoped that mud crab fishermen in Bengkulu Province are able to achieve better and more sustainable welfare in the future.

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