Comparative social vulnerability of fishermen in the coastal area of Bengkulu and Central Java, Indonesia

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Abstract. This study examines and compares the social vulnerability of fishing communities involving various indicators and their determining factors. The fishing community is a group of poor people with limited economic resources and high dependence on marine resources. The coastal areas of Central Java and Bengkulu, Indonesia, have different coastal characteristics that influence the differences in the social vulnerability of fishermen in the two regions. This study involved 210 fishermen selected by purposive sampling with the criteria of one-day fishing fishermen and boat owners. The social vulnerability of fishermen in the coastal area of Bengkulu is higher than that on the coast of Central Java. This difference is due to a lower level of education and income. In addition, Bengkulu province is the second poorest region on the Indonesian island of Sumatra. The social vulnerability of fishermen in the coastal area of Central Java is influenced by their participation in groups and by fishing distance. Meanwhile, the social vulnerability of fishermen in the coastal regions of Bengkulu is influenced by fishermen poverty.
Key Words: capture fishery, marine resources, one-day fishing, poverty, Sumatera.

Introduction. Vulnerability refers to a condition affected by physical, social, economic, and environmental factors increasing a risk (Herawaty & Santoso 2007). Vulnerability is a condition where the system cannot adapt to the impact of a change (Olmos 2001; Fussel 2007). The vulnerability has been defined differently in areas of scholarship (Fussel 2010; Vincent-Akpu & Annor-Frempong 2017). Vulnerability is generally defined as the degree to which a system is susceptible and unable to cope with adverse effects or disturbances (Adger 2006; Cinner et al 2013). Observation on the status of poor households (usually defined only by whether or not the level of the household consumption expenditure is above or below a predetermined poverty line) is an ex-post realization of an ex-ante probability state that can determine the level of vulnerability (Isiyana et al 2018). Thus, predicting the probability of poverty for a household with various sets of characteristics indicates its vulnerability (Abustan 2010).

According to Chambers (1995), vulnerability has two sides. Namely, the outer side of the risks, shocks, and pressures faced by each individual, and the inner side is the inability to survive, meaning the inability to cope with anxiety without losing something. Losing impacts a person's physical abilities, economic and social dependence and induces psychological stress. Therefore, Moser (1998) draws on Chambers' conception, stating that analyzing vulnerability must involve identifying threats and resilience or adaptive responses in using the opportunity side of this vulnerability and reducing the negative effects of environmental changes. So, according to Moser (1998), vulnerability is closely related to asset ownership. Thus, individuals and households who have more assets than others tend to be more able to survive, and vice versa.

One of the vulnerable communities experiencing the vulnerability of falling below the poverty line is the coastal community. Those who live on the coast must face the pressures of climate change and pressures that disrupt their subsistence capacity (Islam et al 2014). According to Kristiyanti (2016), people who live in coastal areas are

characterized by their dependence on marine resources, the environment, climate, markets and human resources. The provinces of Central Java and Bengkulu are part of the coastal areas in Indonesia with a high poverty index, namely 11.84% and 15.30%, respectively. Bengkulu Province ranks seventh of the poorest provinces in Indonesia in 2020 (BPS 2021). Coastal communities use many coastal resources to meet their daily needs, and they carry out their daily activities in the area. The reality of fishermen poverty is an irony because of the enormous potential of natural resources of the marine and fisheries sector in Indonesia (Wijaya & Fauzie 2020). This study aims to measure social vulnerability and its determinants in Central Java and Bengkulu's coastal areas and compare them in the two regions.

Material and Method

Description of the study sites. The study was conducted in the coastal area of Bengkulu, covering Bengkulu City, North Bengkulu Regency, South Bengkulu Regency, and Central Java Province, covering Kendal Regency, Batang Regency, Pekalongan Regency, and Pemalang Regency. The coastal areas of Bengkulu Province are located on the west coast of Sumatera Island, with a coastline of more than 525 km. These coastal areas are parallel with the Bukit Barisan Mountains and face the Indonesian Ocean (BPS Bengkulu Province 2017). Meanwhile, the coastal regions of Central Java Province have a coastline of 971 km, consisting of 645 km of the northern coast and 326 km of the southern coast. The study areas were selected purposively based on the number of fishermen (more than 200 people) and their high dependence on marine capture businesses (Figure 1).
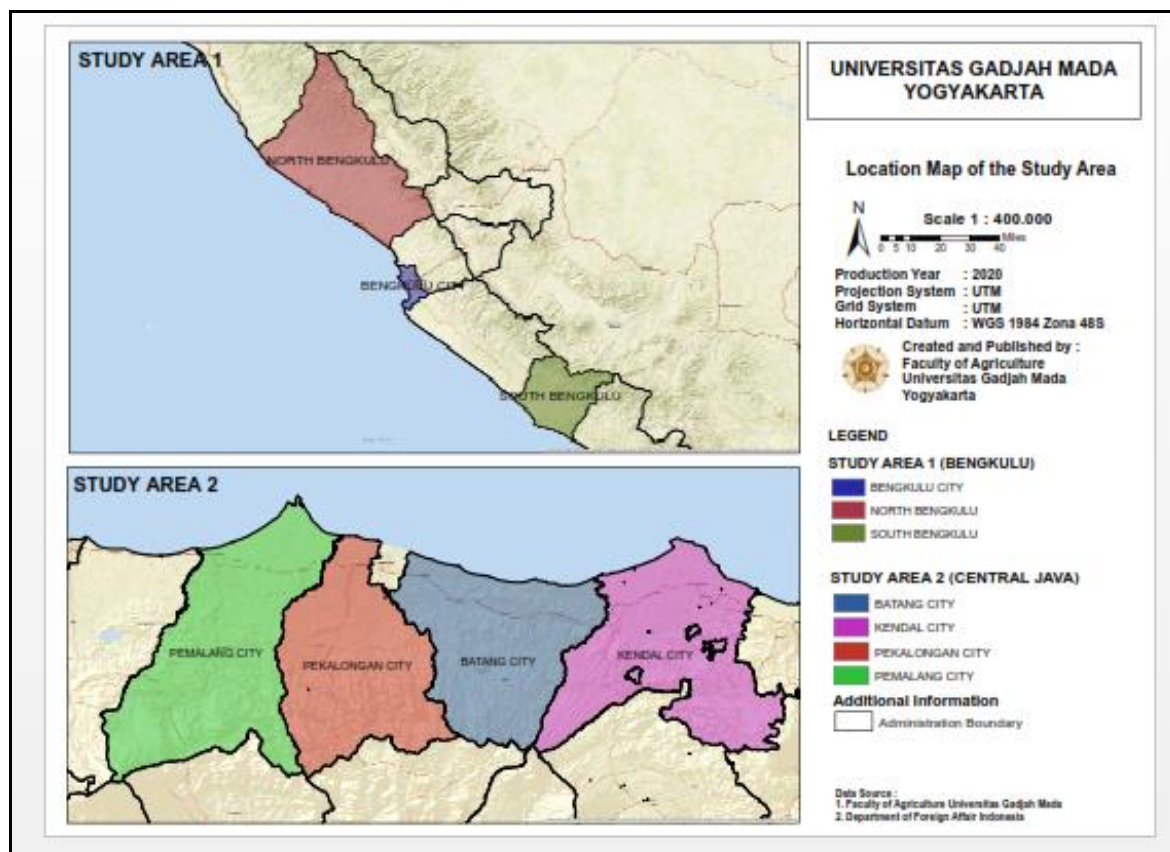

Figure 1. Study area.

Sampling and questionnaire. Respondents in this study are 210 marine fishermen (90 fishermen in Bengkulu and 120 fishermen in Central Java) who were interviewed using structured questionnaires. The first part of the questionnaire regarded fishermen profile

information: age, years of schooling, experience, household size, income, ship weight, fishing distance, fishing time, and catch capacity. The second part regarded information related to the social vulnerability of fishermen and determinants of social vulnerability. All data were collected from July to September 2019.

Method of analysis. This study uses the measurement of social vulnerability according to Setyaningrum & Giyarsih (2012), which consists of indicators of income, education, occupation, population status, ownership of buildings, a distance of facilities, number of family members, children, the elderly, gender, and time of domicile. Vulnerability measurements are based on the weight assigned to each indicator (Table 1).

Table 1

Indicators of social vulnerability

Indicators	Low	Medium	High
Income	>USD 106.01	USD 49.47–106.01	<USD 49.47
Years of schooling	>9 years	6–9 years	<6 years
Job position	government official	entrepreneur	labor/farmer/ fisherman
Resident status	native	settler	temporary
Building ownership	private	official	rented
Building distance	2–35 m	36–68 m	69–100 m
Household member	1-3	4-6	>6
Children	<33%	33-66%	>66%
Elderly people	<33%	33-66%	>66%
Gender	<33%	33-66%	>66%
Length of domicile	>7 years	7–4 years	<4 years

Note: 1 - low; 2 - medium; 3 - high.

A linear regression was selected based on variables of a previous study to determine social vulnerability factors (Table 2). The variables consisted of age, fishing experience (Nguyen et al 2012), poverty (Deressa et al 2009), fishing distance (Senapati & Gupta 2017), and fishermen group membership (Wibowo & Satria 2015). The coefficient of determination was calculated to reveal the effect of each variable on social vulnerability. T and F tests were performed to identify whether those independent variables affect the social vulnerability variable at 1%, 5%, and 10% significance levels.

Table 2

Description of variables

Variable	Description of variables
Age	Fishermen age (years)
Fishing experience	Fishermen experience in fishing (years)
Poverty	Poverty measured based on BPS Indonesia
Fishermen group membership	1 = join the fishermen group, 0 = do not join
Fishing distance	Fishing ship mileage (miles)

Capture fisheries potential. Central Java Province has a long coastline of 791.76 km, consisting of the north coast of 502.69 km, the south coast of 289.07 km, and 34 small islands. The condition of the north coast of Central Java is sloping and the waters are relatively calm. Thus, the northern coast of Central Java is an area that has many fishing centers, especially on a small and medium scale. Capture fisheries of Central Java Province consist of sea capture fisheries and general developed water capture fisheries. Capture fisheries potential in the waters of Central Java is approximately 1873530 tons per year, in the Java Sea around 796640 tons per year and in the Indonesian Ocean around 1076890 tons per year (Department of Ocean and Fisheries of Central Java 2018). Nowadays, the fish production in this area decreases because of overfishing, and

fishermen fish farther. Climate change also affects marine capture fishermen in Indonesia, especially Central Java and Bengkulu (Mulyasari et al 2019).

In the coastal areas of Bengkulu, there is significant potential in the subsector of fisheries, especially marine fisheries, due to facing the Indian Ocean, with a beach length of 525 km. Bengkulu Province has a territorial sea area of 53000 km^2 and an area of the Exclusive Economic Zone (EEZ distance 12-200 nautical miles from the coast), reaching 685000 km^2 (Department of Ocean and Fisheries of Bengkulu 2014). Data published by BPS Bengkulu Province (2017) shows that the catch in 2016 reached 62213.90 tons with 7583 marine fishermen households spread across six districts and cities of Bengkulu. The results of marine fishery production in Bengkulu Province fluctuate yearly because of climate change, among other factors.

Results and Discussion

Profile of fishermen. The profile of fishermen included age, years of schooling, household size, fishing experience, poverty, ship weight, fishing time, fishing distance, and ship crew (Table 3).

Table 3
Profile of fishermen

Profile	Bengkulu	Central Java
Age (years)	41.77	43.09
Years of schooling (years)	7.84	5.48
Household size (person)	3	3
Fishing experience (years)	17.44	26.47
Income (USD per month)	198.08	408.35
Ship weight (GT)	6.51	4.59
Fishing time (hours)	7.17	8.48
Fishing distance (miles)	6.44	7.08
Catch capacity (kg per trip)	39.41	230.03

The average age of fishermen in the coastal areas of Central Java is higher than the average age of fishermen in Bengkulu (Table 3). Age is an important variable related to physical strength, an essential requirement in working as a fisherman, especially in productivity. In the coastal areas of Central Java and Bengkulu, almost all fishermen have a productive age that supports work.

The years of schooling of fishermen in the coastal areas of Bengkulu is higher than that of fishermen in Central Java (Table 3). The average years of schooling of fishermen in the coastal regions of Central Java are 5.84, and 7.48 in Bengkulu. Overall, the average years of schooling of fishermen have not reached the nine-year education target set by the Government of Indonesia. The education level of fishermen is deficient and reflects the poverty of fishermen households in Indonesia. The household size is generally related to household expenses. Family dependents increase these expenses. The results showed that the average household size of fishermen families in the coastal areas of Central Java and Bengkulu was three people (Table 3).

Fishing experience is an essential factor in working as a fisherman and is the basic capital for fishermen to develop a business in fishing. A longer fishing experience brings a better ability better know the fishing techniques, fishing grounds, the use of more skilled fishing gear and others. Fishermen in the coastal areas of Central Java and Bengkulu have a relatively high average experience (Table 3). This shows that fishermen rarely switch jobs. The low level of education means that fishermen do not have the opportunity to get other jobs.

Season-dependent conditions greatly affect welfare when fishermen do not go to sea, sometimes for several weeks. Low human resources and the equipment used by fishermen affect catch quantity and quality, limitations in understanding technology, and access to capital and marketing. Table 3 shows that the average household income of

fishermen in the coastal areas of Central Java is much higher than the average household income of fishermen in Bengkulu. This is because fishermen in the coastal regions of Central Java still use cantrang fishing gear, which can provide a better income for fishermen.

The average weight of fishing boats on the coast of Bengkulu is higher than the average weight of fishing boats on the coast of Central Java. Bengkulu coast waters are directly facing the Indian Ocean, so it requires ships with high capacities. In addition, in the coastal areas of Central Java, many fishermen choose to use boats with a weight less than 10 GT because processing permits are relatively easy to obtain and inexpensive. Most fishermen in the coastal areas of Central Java and Bengkulu are environmentally friendly fishermen because they have ships with a weight of 10 GT. The Minister of Marine Affairs and Fisheries (2014) stated that 10 GT vessels no longer need permits but must be registered. The catch must also enter the Fish Auction Place (TPI) so that the local government receives information on the number of catches and on the market actors. This is because ships weighing less than 10 GT are not allowed to sell their catch to foreign vessels.

Fishing time is the amount of time allocated by fishermen to carry out fishing activities at sea. Fishermen on the coast of Central Java have an outpouring of fishing time ranging from 3 to 20 hours with an average of 8.5 hours. Meanwhile, outpouring fishing time in Bengkulu ranges from 2 to 12 hours per day, with an average of 7 hours per trip. The fishing distance is the distance required for fishermen to reach the fishing ground. It is influenced by how long it will take for fishermen to find the ideal fishing ground. Fishermen usually reduce the fishing distance if there is a high tide so that fishermen cannot catch fish from afar. The majority of fishermen in the coastal areas of Central Java have an average fishing distance of 7 miles (Table 3).

Meanwhile, the average fishing distance of fishermen in Bengkulu is about 6 miles. This is due to the different coastal characteristics between Central Java and Bengkulu. Catch capacity is the amount of catch obtained by fishermen from fishing activities. The amount and the number of catches are related to the level of income earned by fishermen. The average catch capacity in the coastal areas of Central Java is higher than in Bengkulu. Different coastal characteristics determine the catch capacity. In addition, climatic factors also affect catch capacity.

Comparative social vulnerability of fishermen. The study results (Table 4) show that fishermen in the coastal areas of Central Java have the highest percentage of vulnerability to the indicators of job position and gender. Meanwhile, fishermen in the coastal area of Bengkulu have the highest percentage of indicators of social vulnerability for job positions and years of schooling. Being a fisherman is a job with a variable level of income. Fishermen are a group of people classified as poor (Mubyarto 1984; Kusnadi 2002; Imron 2003). According to Mubyarto (1993), fishermen (especially fisherman laborers and traditional fishermen) can be classified as the poorest social strata compared to other community groups in the agricultural sector.

The coastal area of Bengkulu and the West coast of Sumatra, in general, facing the Indian Ocean, is characterized by continuous rough waves, wild currents, and steep coastline topography. This is different from the coastal condition in the North coast of Java, facing the shallow sea of Java, characterized by a calm tide, slow current, and gentle coastline topography.

Based on the social vulnerability index calculation, fishermen in the coastal areas of Bengkulu have a higher social vulnerability than those in the coastal regions of Central Java (Figure 2).

Comparative distribution of respondent (%) based on social vulnerability indicators

Indicators	Central Java			Bengkulu		
	1	2	3	1	2	3
Income	96.67	3.33	0.00	70.00	30.00	0.00
Years of schooling	7.50	70.00	22.50	21.11	51.11	27.78
Job position	0.00	0.00	100.00	0.00	0.00	100.00
Resident status	94.17	5.83	0.00	54.44	40.00	5.56
Building ownership	97.50	0.00	2.50	92.22	1.11	6.67
Building distance	86.67	9.17	4.16	100.00	0.00	0.00
Household member	55.00	43.33	1.67	38.89	58.89	2.22
Children	60.83	35.00	4.17	54.44	38.89	6.67
Elderly people	97.50	1.67	0.83	100.00	0.00	0.00
Gender	17.50	46.67	35.83	51.11	31.11	17.78
Length of domicile	98.33	1.67	0.00	77.78	11.11	11.11

Note: 1 - low vulnerability; 2 - medium vulnerability; 3 – high vulnerability.
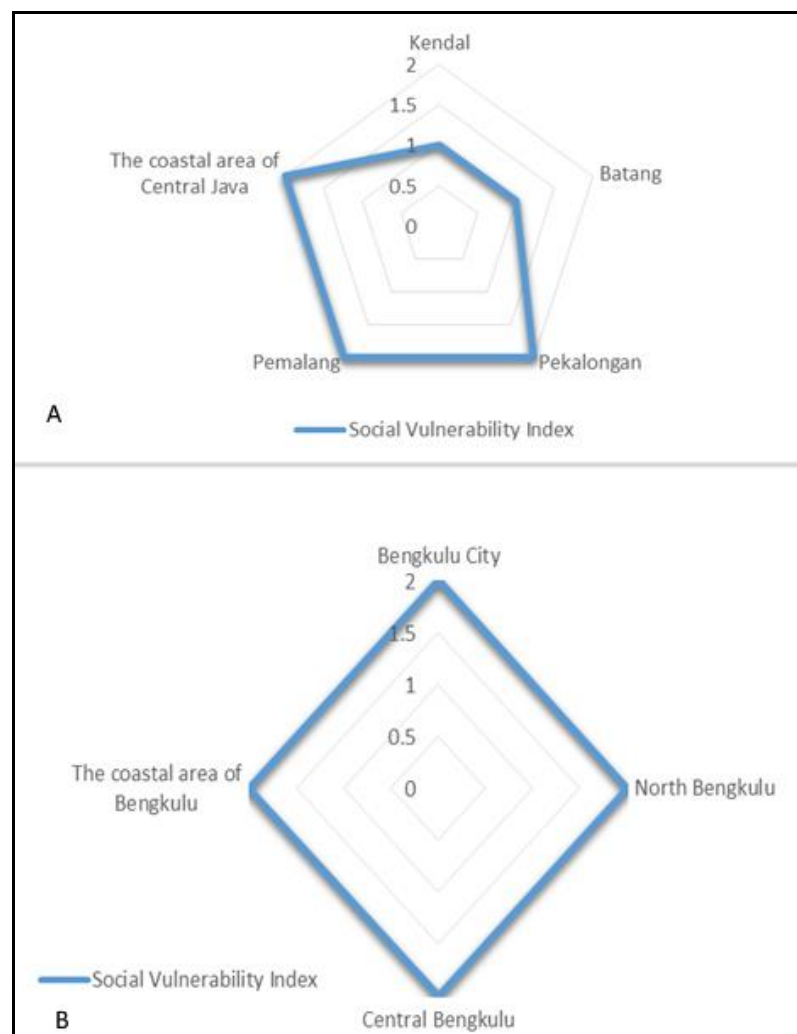

Figure 2. Social vulnerability in (A) Central Java and (B) Bengkulu.

The characteristics of the coastal areas are different, causing the income earned by fishermen to be different. Fishermen in the coastal area of Bengkulu have a lower income compared to fishermen in the coastal regions of Central Java. The risk of going to sea is that higher waves make it difficult for fishermen in the Bengkulu coast to find potential

fishing areas. In addition, the coast directly facing the Indonesian Ocean makes fishermen endure extreme weather events and high waves, with a higher frequency than in the north coast of Central Java.

Determinants of social vulnerability. The results showed differences in the determinants of social vulnerability of fishermen in the coastal areas of Central Java and Bengkulu (Table 5). The participation of fishermen influences their social vulnerability in the coastal regions of Central Java in organizations and fishing distance. Meanwhile, the social vulnerability of fishermen in the coastal areas of Bengkulu is determined by poverty. The results also show that based on the results of the F test (Table 5), the overall variables of age, fishing experience, poverty, fishing distance and fishermen group membership together affect the social vulnerability of fishermen both in the coastal areas of Central Java and Bengkulu.

Table 5

Comparative determinants of social vulnerability of fishermen

Variable	Central Java			Bengkulu		
	B	t	Sig	B	t	Sig
Constant	1.548	21.335	0.000	1.313	14.659	0.000
Age	-0.002	-1.183	0.239	0.002	0.841	0.403
Fishing experience	0.002	1.107	0.271	-0.005	-1.436	0.155
Poverty	0.005	0.596	0.552	0.028	3.127	0.002***
Fishing distance	0.002	1.796	0.075*	0.006	1.515	0.133
Fishermen group membership	-0.074	-2.727	0.007***	-0.011	-0.213	0.832
Results for model summary and ANOVA						
R square	0.089			0.187		
Adjusted R Square	0.049			0.138		
F – test Sig	0.057*			0.003***		
Standard error of the estimate	0.13425			0.16852		

Note: *** - significant at 1%; ** - significant at 5%; * - significant at 10%.

Age. Age does not affect the social vulnerability of fishermen in either coastal areas. This is because most fishermen have a productive age, so they can socialize in the community. In the social environment, fishing communities are also known for their high spirit of togetherness and unique characteristics (Duradin 2017).

Fishing experience. Experience as a fisherman has no effect on social vulnerability in the coastal areas of Central Java and Bengkulu. In both regions, the average fishermen experience is more than 15 years. This means that fishermen can find strategies to reduce their vulnerability to the social environment. The fishing profession is a legacy from generations before and has formed a fishing community in Indonesia known to be tough and strong. This is not in line with the results of Mulyasari et al (2020), where experience affects the vulnerability of fishermen's livelihoods to climate change in the coastal areas of Bengkulu.

Poverty. The results showed that poverty affects the social vulnerability of fishermen in the coastal areas of Bengkulu. Bengkulu Province is the second poorest region on the island of Sumatra, with poverty reaching 15.09% (BPS 2020). One of the causes of poverty is the low level of education, especially in fishing communities classified as poor communities in Indonesia. The average level of education of fishermen on the coasts of Central Java and Bengkulu does not reach the 9-year education program launched by the Government of Indonesia. The poor tend not to have economic diversification, so they cannot develop strategies to reduce vulnerability (Morrow 1999; H. John Heinz III Center

for Science, Economics, and the Environment 2000; Cutter et al 2000; Cutter et al 2003; Adger et al 2005).

Fishing distance. The results show that fishing distance affects the social vulnerability of fishermen in the coastal area of Central Java. This means that a farther distance from the sea will inflict a higher social vulnerability of fishermen. Fishermen in the coastal regions of Central Java and Bengkulu are one-day fishing fishermen with an average fishing distance of about 7 miles. They have a strong interaction with their social environment. If fishermen have further fishing distances, the social interaction of fishermen in their community will decrease, increasing social vulnerability.

Fishermen group membership. The participation of fishermen in organizations affects the social vulnerability in the coastal area of Central Java. This means that a lower participation of fishermen in organizations will increase social vulnerability. Fishermen organizations strengthen relationships between fishermen and help provide solutions to problems faced by fishermen. In Indonesia, various government-owned strategic programs are provided to the community through farmer/fishermen organizations or groups. Only group members can access the various facilities and assistance provided by the government for business development, especially in the capture fisheries sector.

Conclusions. The fishing community is classified as a poor group and vulnerable to economic, social, and natural disturbances. The coastal areas of Central Java and Bengkulu have different coastal characteristics that affect the social vulnerability of fishermen in the two regions. The results showed that the social vulnerability of fishermen in the coastal area of Bengkulu was higher than that of the coast of Central Java. Fishermen in the coastal area ofBengkulu have a lower income compared to fishermen in the coastal regions of Central Java, because the fishing risk is higher and it is more difficult to find new potential fishing areas in Bengkulu coastal area. In addition, the characteristics of directly facing the Indonesian Ocean makes fishermen of Bengkulu to deal with more extreme weather events than in the north coast of Central Java. The results also show differences in the determinants of social vulnerability of fishermen in the coastal areas of Central Java and Bengkulu. The social vulnerability of fishermen in the coastal regions of Central Java is influenced by the fishermen group membership and fishing distance. Meanwhile, the social vulnerability of fishermen in the coastal regions of Bengkulu is determined by poverty.

Conflict of Interest. The authors declare that there is no conflict of interest.

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