Strategy to Handling The Challenges of Small-Scale Fisheries Vulnerability: Case Study Roban Coastal, Batang Regency

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ABSTRACT: This study aims to identify the vulnerability of small-scale fishermen in the Roban Coastal Area through fast variables and slow variables, identify the adaptive capacity of fishermen to social-ecological changes, and analyze the resilience strategy of fishermen in facing rapid social-ecological changes due to national strategy projects. The method used was a mixed method with descriptive statistical analysis and 100 small-scale fishermen were taken as samples through purposive sampling. The results obtained show that the level of vulnerability of small-scale fishermen is in the high vulnerability category with a score of 7.89, the most vulnerable indicator is dependence on nature. The Roban Coastal small-scale fishermen resilience strategy is carried out through interdependence between stakeholders (academics, business people, government, and community) by obtaining the results that need to pay attention to several aspects (social, environmental, economic) in facing changes so that fishermen have a resilient level of resilience.

Keywords: Vulnerability, Fishers, Adaptive Capacity, Viability

ABSTRAK: *Penelitian ini bertujuan untuk mengidentifikasi kerentanan nelayan kecil di Pesisir Roban melalui telusur variabel cepat dan variabel lambat, mengidentifikasi kapasitas adaptif nelayan terhadap perubahan sosial-ekologis serta menganalisis strategi ketahanan nelayan dalam menghadapi perubahan cepat sosial ekologis akibat proyek strategi nasional. Metode yang digunakan adalah mix method dengan analisis statistif deskriptif dan sebanyak 100 orang nelayan skala kecil diambil sebagai sampel melalui purposive sampling. Hasil yang diperoleh menunjukkan tingkat kerentanan nelayan kecil berada di kategori kerentanan tinggi dengan skor 7,89, indikator paling rentan ialah ketergantungan terhadap alam. Strategi ketahanan nelayan kecil Pesisir Roban dilakukan melalui interdependensi antar pemangku kepentingan (akademisi, pebisnis, pemerintah dan komunitas) dengan memperoleh hasil bahwa perlu memperhatikan beberapa aspek (sosial, lingkungan, ekonomi) dalam menghadapi perubahan sehingga nelayan mempunyai tingkat ketahanan yang tangguh.*

Kata Kunci: *Kerentanan, Nelayan, Kapasitas Adaptif, Ketahanan*

INTRODUCTION

Indonesia is known as a mega-biodiversity country in terms of biodiversity and also has coastal areas that have great potential for various development options (Rahmawaty, 2006). Coastal areas cover a large area and have abundant resources, so most of Indonesia's population chooses to live in coastal areas. The high population has caused the impact of climate change to be increasingly felt, including by fishermen (Diposaptono et al., 2009). One of the coastal areas with abundant fishing resources is Batang Regency. The geographical location on the north coast of Java is considered to have tremendous potential in the capture fisheries sector (Andhian et al., 2014). The potential of marine and fisheries resources is quite large, including capture fisheries and aquaculture, the fishery product industry, conservation, and, of course, marine and beach tourism (DPRD, 2021). Fisheries production in Batang Regency is ranked 5th largest in Central Java, with a total production of 14,159 tons and a production value of Rp. 203,452,275.00 (BPS, 2022).

Batang Regency is also the location of the Steam Power Plant (PLTU) megaproject development. The existence of the Batang PLTU has an impact that tends to be contradictory for each individual. The affected hamlets are West Roban and East Roban, where the hamlet is the research location. With the majority of residents whose livelihoods are fishermen, they consider that the construction of the PLTU threatens their activities (Apriando, 2015). The operational costs of small fishermen have also increased due to the farther fishing location due to the construction of the PLTU (Wibby, 2021).

Due to various forms of change, coastal communities are often forced to adapt to socio-ecological changes when the continuity of their natural resource-dependent livelihoods is deemed unsustainable. Adaptation can certainly be done when other factors such as individual skills, allocation of available resources, and individual preferences are met (Kaur, 2020).

The vulnerability experienced by coastal communities due to various social-ecological changes needs to be addressed effectively so as not to threaten long-term survival. Therefore, this research was conducted to identify the vulnerability of small-scale fishermen in the Roban Coastal Area by examining fast and slow variables, the adaptive capacity of fishermen to social-ecological changes, and fishermen's resilience strategies in facing rapid social-ecological changes due to national strategic projects.

The study focuses on the vulnerability of coastal communities, especially small-scale fishermen, caused by social and ecological changes, with the aim to help them achieve a more decent or sustainable life. This study uses the Vulnerability to Viability (V2V) Framework to understand vulnerability factors and find solutions that support the social, economic, and environmental sustainability of coastal communities. The framework not only aims to reduce the risks and vulnerabilities faced by coastal communities but also strengthen their capacity to adapt and achieve long-term sustainability (Nayak et al., 2023). The implications of this research are very important for better understanding the responses of small-scale coastal communities to environmental disturbances, both prolonged and sudden, as well as the environmental and social characteristics that may make communities locally more or less resilient. (Rocker et al., 2022).

METHODS

Mixed-methods research was used in this study, combining qualitative and quantitative methods to provide a more complete picture of the research focus (Heigham & A. Croker, 2020). The integration of qualitative and quantitative data yields a more detailed understanding than using either one (Creswell, 2014). The research location was Roban Coast, and 100 small-scale fishermen were sampled through purposive sampling, as well as six key informants from academia, business, government, and the community

Quantitative methods were used to answer the first and second objectives related to the identification of the level of vulnerability of small-scale fishermen in the Roban Coastal Area by tracking fast variables and slow variables and the adaptive capacity of fishermen to social-ecological changes through data collection techniques of observation, surveys, semi-structured interviews, literature studies, and then analyzed descriptive statistics. The qualitative method was used to answer the third objective related to fishermen's resilience strategy in facing rapid social-ecological changes due to national strategic projects through in-depth interviews which were then simply triangulated with Atlas. ti software. Primary and secondary data collection for this research was conducted in March and May 2023.

RESULTS AND DISCUSSIONS

Respondent Characteristics

The vulnerability of small-scale fishers can refer to various aspects that make them susceptible to various changes, risks, and challenges related to social and ecological aspects. Analyzing the level of vulnerability of small-scale fishers can be done through the identification of slow variables and fast variables in social and ecological systems. The two variables then interact with each other and cause feedback, so to respond to vulnerability, it is necessary to manage slow variables that will help overcome the impact of social and ecological changes (Kaur, 2020). Based on the results of surveys and interviews conducted with small-scale fishermen on the Roban coast, a list of changes in slow and fast variables in the social and ecological system is obtained as follows:

Table 1. Identification of Slow Variables by Fishermen (n: 100)

	Variables	Percentage
Social	Norms, local values, and culture	79%
	Infrastructure and wealth	63%
	Fishermen skills	66%
Ecological	Fish biomass	75%
	Coral reefs	75%
	Ecological function of the coast	57%

Source: Primary data

Based on the table, it can be seen that there are three slow variables in the social subsystem, namely norms, local values, and culture with a percentage of 79%, infrastructure and wealth with a percentage of 63%, and fishermen skills with a percentage of 66%. There are also three slow variables in the ecological subsystem, namely fish biomass with a percentage of 75%, coral reefs with a percentage of 75%, and coastal ecological functions with a percentage of 57%.

Table 2. Identification of Slow Variables by Fishermen (n: 100)

	Variables	Percentage
Social	Fishermen's income	87%
	Fishermen's expenses	80%
	Employment opportunities	55%
	Total population	65%
	Information technology	59%
	Fishing method	56%
Ecological	Capture fisheries production	81%
	Daily weather changes	100%

Source: Primary data, 2023

The table above shows that there are six fast variables in the social subsystem, namely; 1) fishermen's income with a percentage of 87%; 2) fishermen's expenses with a percentage of 80%; 3) employment opportunities with a percentage of 55%; 4) population with a percentage of 65%; 5) Information technology, with a percentage of 59%; 6) fishing methods with a percentage of 56%. There are also two fast variables in the ecological subsystem, namely 1) capture fisheries production with a percentage of 81% and 2) weather changes with a percentage of 100%.

The vulnerability of Roban small fishermen is influenced by several factors both internally and externally, including the low level of education and skills of fishermen, high dependence on the fisheries sector, the condition of fishermen's health, which is easily declining, the influence of PLTU development, climate change, the threat of Rob flooding, and abrasion. The assessment carried out on Roban fishermen is based on three aspects, namely exposure, sensitivity, and adaptive capacity (Wibowo et al., 2012; Cinner et al., 2012).

Table 3. Vulnerability Scoring Scale

Scoring Scale	Interpretation
1-2	Very Low
3-4	Low
5-6	Medium
7-8	High
9-10	Very High

Source: (Rahayu, 2018; Wardhani & Susilowati, 2021)

Table 4. Vulnerability Level of Roban Small Fishermen (N=100)

	EXPOSURE				
	Category	Description	Value	Mean	Level
Internal Factors	Low level of education and skills of fishermen	Low level of knowledge and skills of fishermen in dealing with threats	7,88		
	High level of dependence on nature	The level of dependence of fishermen on nature, especially in the fisheries sector, is high.	8,9		
	Health condition of fishermen	Low health conditions affect the level of productivity or activities of fishermen.	4,7		
External Factors	PLTU development	Fishermen's fishing activities are disrupted due to the construction of PLTU.	8,62	7,32	High Exposure
	Climate Change		7,6		

EXPOSURE				
Category	Description	Value	Mean	Level
	Unstable weather causes fishermen to face difficulties going to the sea and catching fish.			
Rob	Community living comfort and socio-economic activities are disrupted due to frequent tidal surges.	7,2		
Abrasion	Abrasion that causes land to erode	6,31		

SENSITIVITY				
Category	Description	Value	Mean	Level
Social Subsystem	Income and catch instability due to dependence on the fishing sector	7,6		
	Restrictions on fishing locations because PLTU increases the cost of supplies	7,9		
	Infrastructure damage due to continuous tidal flooding	5,8		
	Damage to fishing facilities, both nets and boats, due to PLTU construction	5,2		
	Limited access to resources such as diesel fuel	4,7		
	The social conflict between fishermen	6,1		
	Decreased regeneration of fishermen	2,3		
Ecological Subsystem	PLTU development activities cause damage to the coral reef ecosystem.	7,89	5,85	Medium Sensitivity
	Fish biomass is affected due to PLTU activities.	8,02		
	Rob flooding disrupts fish farmers.	2,33		
	Environmental degradation due to rob and abrasion	6,27		

ADAPTIVE CAPACITY				
Category	Description	Value	Mean	Level
Response Diversity	Diversity of fishermen's responses to facing the threat of work-related vulnerability	3,96		
	Able to do other jobs or have alternative jobs	3,35		
	Taking an active role and joining local organizations and groups	7,55		
Connectivity	Lines of communication and information exchange within the community	6,75		
	Involved in group decision-making	6,5	5,28	Medium
Collaborative capacity	A member of the community who can collaborate with internal and external stakeholders.	5,02		
Abundances/reserves	Assets and resources owned	7,32		
Learning capacity	Knowledge and skill capacity of fishermen	3,39		
	Access to adequate skill enhancement	3,66		
Vulnerability			**7,89**	**High**

Source: Primary Data, 2023

The vulnerability of small-scale fishermen in West Roban and East Roban has a high level of vulnerability, with an average value of 7.89 out of 10. The interval score used is 1–10; 1 means a low level of vulnerability, while 10 means a high level of vulnerability. Based on the three indicators above, it shows that exposure has a high level of vulnerability, sensitivity has a medium level of vulnerability, and adaptive capacity has a medium level of vulnerability.

Adaptive Capacity of Small Fishermen to Socio-Ecological Change:
Response Diversity
Fishermen are very dependent on natural factors, so most small-scale fishermen in Roban do not have other alternative jobs, which results in 80% of them choosing to become farmers and 5% choosing to become laborers as alternative livelihoods. Respondents who do not have other livelihoods do so due to the low skills they have, so they only depend on their main job as a source of livelihood. This is in line with what was conveyed by Mr. Iswandi, who is one of the fishermen, "Here the main thing is fishermen at most there are some who have rice fields or not, farm laborers, some are construction workers, whatever they do when they are not leaving."

Connectivity
The participation of a small fisherman in an organization can have a variety of benefits, both for the fishermen themselves and others. 64% of Roban's small fishermen are actively involved in local organizations such as fishing groups and local neighborhood groups. These organizations can help the

fisherman's progress in particular in economic terms because with the existence of organizations, they can know the necessary needs of the fishers as well as help their activities in the face of changes in both their social and ecological systems.

Collaboration Capacity

Fishermen's involvement in decision-making within an organization can help fishermen face change. 79% of respondents said they were not involved in decision-making in their neighborhood of residence, while only 21% had active involvement in decision-making. This leads them to be potentially resistant to all forms of change due to the poor role of fishermen in decision-making that influences their livelihoods.

Abundance/Reserves

The higher the level of asset ownership among the fishermen, the better their rate of adaptive capacity in the face of change. The table below shows fishermen's responses to reserves or ownership of household assets in favor of economic improvement:

Table 5. Abundance/reserves Fishermen's (n:100)

Abundance	Category	Percentage
Assets	Houses	100%
	Land	100%
	Fields	23%
	Boats	100%
	Motorcycles	100%
Household Appliances	Television	100%
	Gas stove	100%
	Fan	100%
	Fridge	87%
Roof Material	Clay bras	90%
	Cement Asbestos	7%
	Spandex	3%
Home Well Material	Brick	100%
	Wood	0%
	Bamboo	0%
Flooring Material	Cement	3%
	Tiles	10%
	Ceramics	87%
Access to Other Resources	Electricity	100%
	Water Pumps	77%
	Water Tanks	43%

Source: Primary data, 2023

Learning Capacity

Most respondents consist of fishermen who rely on their ability to learn and adapt when faced with changes such as fluctuating fish species and fish availability, as well as unpredictable weather and wave patterns. Overall, respondents assessed that face-to-face communication is the most preferred method of communication and learning for fishermen. A total of 47% of respondents estimated that the use of local environments was preferred as a communication media location, while 40% of fishermen estimated they preferred the local environment as a communications media location. One fisherman mentioned that: "There's rarely any training here, especially if there's information about fishermen passed to the TPI or through the HP."

Based on the results of the data analysis listed in Table 3, it can be explained that all indicators contained in each variable construct have met the criteria for data validity and reliability. This can be seen from the Pearson correlation value which is approximated by the calculated r which is greater

than the r table, as well as the Cronbach's alpha value which exceeds 0.60 at an alpha significance level of 0.05. This situation shows that the instruments used in this research can be considered valid and reliable for measuring the variables studied. Therefore, research can proceed to the next stage of analysis with the confidence that the data obtained can provide accurate and reliable results.

Small fishermen's resilience strategy in dealing with ecological and social change is identified in several aspects:

The strategy of resilience for small fishermen on the coast of Roban is carried out through interdependence between stakeholders (academic, business, government, and community). Cooperation among stakeholders will help to create a more holistic and sustainable solution to the challenges facing fishermen and the fishing sector as a whole. Three aspects can be done to increase fishermen's resilience to change, ranging from the ecological/environmental, social, and economic aspects:
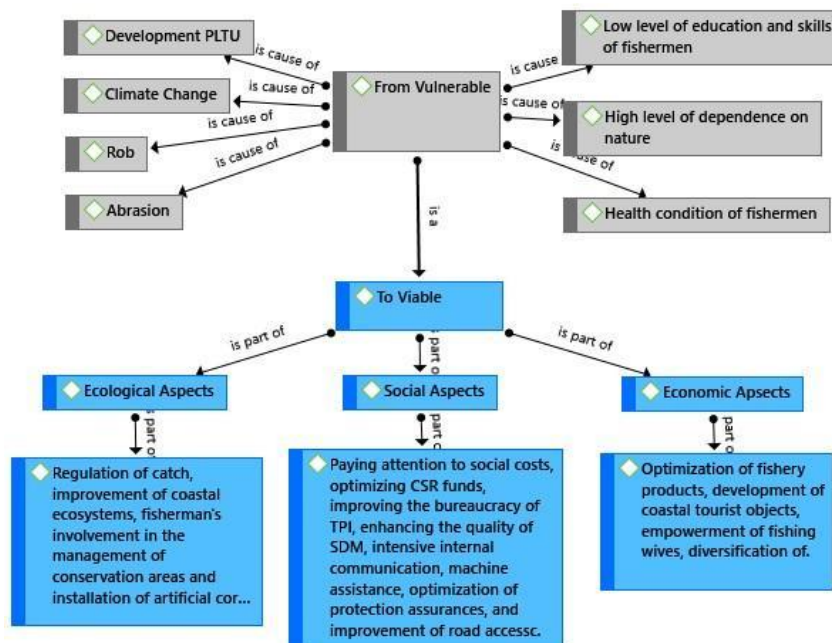

Figure 1. Factors supporting fishermen's vulnerability to be changed into viability

The ecological aspects in the context of fishing include the relationship of fishermen with the marine environment and fishery resources. There are several aspects relevant to fishing activities, including regulation of catch, improvement of coastal ecosystems, fishermen's involvement in the management of conservation areas, and installation of artificial coral reefs

The social aspect of fishermen's resilience involves a variety of factors that affect the well-being and resiliency of the fisherman community. Here are some relevant social aspects of fishermen's resilience: paying attention to social costs, optimizing CSR funds, improving the bureaucracy of TPI, enhancing the quality of SDM, intensive internal communication, machine assistance, optimization of protection assurances, and improvement of road access.

Improving fishermen's economic resilience to change requires understanding and implementation of various economic aspects. Here are some economic issues that can be considered to increase fishermen's resiliency to change: optimization of fishery products, development of coastal tourist objects, empowerment of fishing wives, and diversification.

The adaptation strategies applied by fishermen are certainly different and not only limited to one type of adaptation (Helmi & Satria, 2012). The livelihood strategies employed by these fishers are certainly to reduce vulnerability by means of job mobility, strengthening elements of social capital, and reducing dependence on fisheries resources (Kusumawardhani et al., 2022; Selvaraj et al., 2022). Developing strategies to reduce the impact of these events on fishers and fishing communities will help increase resilience and reduce vulnerability in small-scale fisheries (White & Scheld, 2024). There are many alternatives that fishermen can pursue, such as diverse livelihood approaches to reduce vulnerability (Danquah et al., 2021) as well as the development of family resources to achieve well-being (Kusumawardhani & Susilowati, 2021; Scoones, 2009).

Self-sustaining and dynamic livelihood systems, along with flexible governance systems and healthy local environments, are the first and main steps towards resilience from rapidly changing circumstances (De la Cruz-Modino et al., 2022 & Nicolosi et al., 2021). As such, the strategy should seek to generate income sources that allow households to be less dependent on natural resources and indirectly give them access to more markets and better infrastructure (Choden et al., 2020 & Yomo et al., 2020).

CONCLUSION AND SUGGESTION

The socio-ecological change that happens on the coast makes fishermen vulnerable. The level of vulnerability of fishermen can be determined by identifying slow and fast variables. The vulnerability assessment in this survey is based on three aspects: exposure, sensitivity, and adaptability. Factors that cause Roban's vulnerability to small fishermen are known as dependence on high nature, poor education and skills, the development of climate change, PLTU, Rob, abrasion, and fisherman's health. The capacity of small fishermen to adapt to ecological and social changes can be seen in the diversity of responses, collaboration, collaborative capacity, abundance, and learning capacity. The strategies that can be taken to improve the resilience of small fishermen are divided into three aspects: the ecological, social, and economic aspects so that the little fisherman has a strong level of resiliency.

This research has time constraints, so only small field samples are used, which means that few lists of variables are found. Moreover, interpreting respondent answers requires more knowledge to make recommendations for in-depth research in the future that will quickly identify additional significant variables.

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