



The prospective path of small-scale fishermen: From vulnerable to viable condition (A study in Tegal Regency-Central Java Province, Indonesia)

¹Hapsari A. Kusumawardhani, ¹Indah Susilowati, ²Hadiyanto

¹ Faculty of Economics and Business, Diponegoro University, Indonesia; ² School of Postgraduate Studies, Diponegoro University, Indonesia. Corresponding author: H. A. Kusumawardhani, hapsariak@gmail.com

Abstract. The current study identifies the resources of the Karang Jeruk Conservation area and the perception of small-scale fishermen on vulnerability, analyzes their adaptive capacity, and analyzes the strategy for the sustainability of small-scale fishermen in the Tegal Regency, by using primary and secondary data. The fishermen respondents were selected using a purposive sampling method and the analysis utilized a mixed method approach. The purpose of this study was to understand the perceptions of fishermen on vulnerability. Criteria were grouped into 5 aspects: natural, social, economic, institutional and technological. Their adaptive capacity has the potential to help them to grow resilience. An empowering plan was identified for improving the livelihood of the local small-scale fishermen.

Key Words: vulnerability, adaptive capacity, strategy, Tegal, Indonesia

Introduction. Tegal Regency is located in Central Java Province, being dominated by small-scale fishermen. The law number 45/2009 stipulates that a small-scale fisher is a person whose livelihood is fishing in order to meet their daily needs. Most fishermen in the region own from a Jukung, a small wooden Indonesian outrigger canoe, up to 3–5 GT vessels (Tegal Regency Marine Fisheries and Livestock Service 2020). Referring to the new Indonesian regulation (No. 7/2016 about Protection and Empowerment of Fishermen, Fish Raisers, and Salt Farmers), Indonesian small-scale fishermen catch fish for daily needs, without or with fishing vessels of less than 10 gross tons (GT), whereas only a few fishermen own vessels above 5GT. Therefore, from these data, we can see that most fishermen in Tegal Regency are small-scale fishermen.

Vulnerability emerges from the climate science and policy arena, and the concept has been widely discussed in previous studies (Cinner et al 2012; Belhabib et al 2015; Senapati & Gupta 2017; Nayak & Berkes 2019). In fisheries, vulnerability is due to a combination of natural disasters and technologies beyond human control. However, community livelihoods are also affected by many other issues besides climate-related factors. Consequently, specific vulnerability schemes inherently link this concept to society, moving beyond specific physical triggers (Khatabi & Jobbins 2011; Bennett et al 2016). From the perspective of social vulnerability, various economic, social, institutional, and technological factors can limit people's ability to have decent livelihoods. In small-scale fishing communities, people may be less able to decide. From the perspective of human geography collectively, the vulnerability knowledge domain comprises a long history, especially in the areas of disasters, global environmental change, hunger, and poverty (Cutter et al 2003; Adger 2006). Some studies suggest that fishermen may not always be the poorest of the poor (in terms of money), in small-scale fisheries. Still, they are the most vulnerable due to their high exposure to different natural, health, or economic shocks, and disasters (Bene 2003; Jentoft et al 2011). This latter perspective rests on the observation that vulnerability integrates additional dimensions related to various insecurities and exposures to risks, shocks, and stress (Salas et al 2011). Vulnerability assessments are often quantitative, mainly relying on quantifiable

characteristics or attributes, in order to assign a score or index representing the level of vulnerability of a system (Senapati & Gupta 2017). Expert-driven assessment can differentiate among communities, based on their level of vulnerability, and can provide valuable insights into policy interventions (Alwang et al 2001; Yohe & Tol 2002; Allison et al 2009).

Coastal communities around the world have relied on marine resources for their livelihoods for decades. These resources make many contributions to society, culture, and the economy, especially in terms of employment, food security, and income (Teh et al 2011; Belhabib et al 2015). In terms of conservation, small-scale fisheries could become the future of fisheries (Pauly 2011). As coastal communities are connected to their natural resources, they have a sense of ownership. Therefore, they must use less destructive fishing practices. Milan (2019) classified the domains related to the natural fishery resources: social, economic, institutional, and technology domains. Social domain includes kinship, association, and network within the fishing community. Meanwhile, economic domain denotes savings, access to credit, loans, and profits, whereas institutional domain refers to the role of community-based rules and state regulations that affect access to natural or financial resources. Lastly, technology domains concern on the critical assets needed to develop fishing activities. Meanwhile, Nayak & Berkes (2019) provided details about the vulnerability experienced by small-scale fishermen in material, relational, and subjective aspects. The material level includes natural, financial, and physical aspects, whereas the relational level includes human, physical, social, and financial aspects. Lastly, the subjective level includes human and social capital. Adaptive capacity can be defined as individuals, groups, and organizations' capacity to build resilience through collective actions in a social-ecological system during the ongoing change (Walker et al 2004; Folke 2006). Adaptive capacity depends on many factors, such as perceived change, available resources, and memory of previous adaptive responses (Kerner & Thomas 2014). The five proposed attributes of the adaptive capacity were: response diversity, collaborative capacity, connectivity, abundance/reserves, and learning capacity (Kerner & Thomas 2014). Even though fishermen are vulnerable, they have an adaptive capacity and resources which can be maximized. Therefore, the current study aimed to explore the resources in the Karang Jeruk waters, to identify the fishermen's perception of what makes them vulnerable, to identify the adaptive capacity they have, and to analyze strategies enabling fishermen to improve their conditions from vulnerable to viable.

Material and method

Description of the study sites. This research took place in the northern coastal area of Central Java. This research was conducted in Munjung Agung and Larangan fishermen villages in Tegal reGENCY (Figure 1).



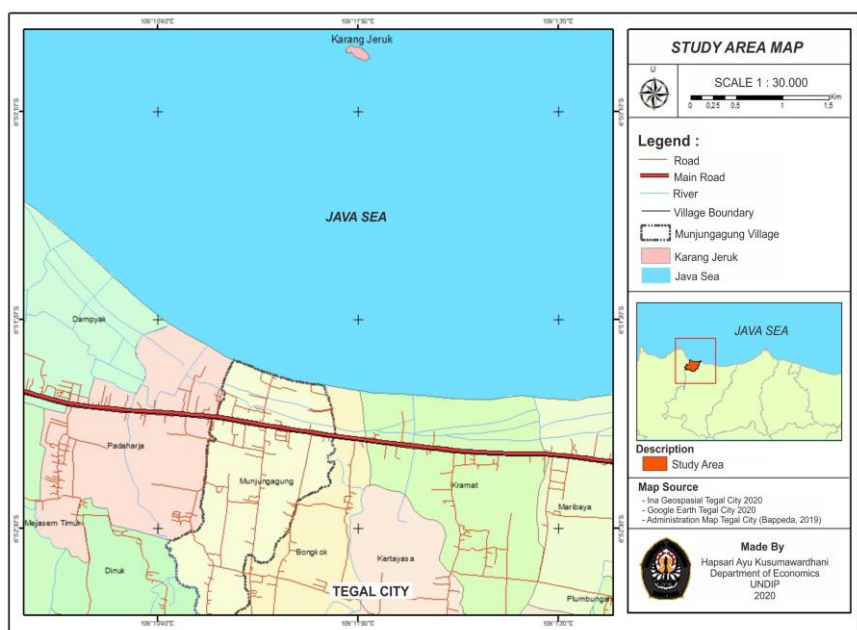


Figure 1. Study sites in Munjung Agung Village, Tegal Regency, Central Java Province, Indonesia.

The study area was chosen because the majority of fisheries are small-scale businesses (Tegal Regency Marine Fisheries and Livestock Service 2020). The Karang Jeruk coral reef conservation area is parallel to the fishing village of Larangan and contains a marine zone of 3.00 nautical miles. Karang Jeruk is also a potential fishing ground rich in anchovies, with a high biodiversity of the marine life. The anchovies and Javanese rice anchovies is the main pillar of the economy of the coastal community of Tegal, as a supplier of raw materials for the anchovy processing industry in Pemalang and Kendal. (Tegal Regency Marine Fisheries and Livestock Service 2020). The research was conducted between 2020 and 2021.

Material and Method. The method used in this study was a combination of quantitative and qualitative analysis, according to similar studies (Ardiansyah et al 2019; Prastyadewia et al 2020). The quantitative approach was carried out through descriptive statistics to answer the first, second, and third research objectives. The first objective was to explore the resources in the Karang Jeruk waters, the second to identify the fishermen’s perception of what makes them vulnerable, and the third to identify the adaptive capacity of fishermen. The qualitative approach through simple triangulation with the help of the ATLAS.ti program was conducted to answer the fourth research objective, which was to analyze strategies enabling fishermen to improve their conditions from vulnerable to viable. The study was based on primary and secondary data. Respondents in this study consisted of 70 fishermen who were selected by purposive sampling. The number of samples was twice the requirement, which is of minimum 30 respondents (Perneger et al 2015). It was suggested that this sample size will produce an approximately normal sampling distribution for the sample mean, from a non-normal parent distribution (Islam 2018). Fishermen respondents were interviewed using a semi-structured questionnaire and in-depth interviews for key persons, in order to obtain a clearer picture for the qualitative analysis (Guion et al 2011; Kaur 2020). Sampling of the key persons was carried out by using the purposive sampling method. Key persons in this study included academics, business people, the representatives of Fisheries and Marine Service of Central Java Province West Region and the Fisheries and Marine Service of Tegal Regency, all these people being able to contribute to analyze the sustainability strategy of small-scale fishermen in Tegal District. Also, representatives of fishermen groups were included as key persons.

Results

Characteristics of resource. Karang Jeruk waters are an area of marine waters in Tegal Regency which has a coral reef ecosystem. Geographically, the Karang Jeruk conservation area is located at the ordinates of 109° 11' 85"-109° 12' 15" east longitude and 06° 48' 75" - 06° 48' 80" south latitude. Karang Jeruk is in the administrative area of the Kramat District, Tegal Regency. The distance to Karang Jeruk (perpendicular to the coastline) is of 3.0 nautical miles, parallel to the fishing village of Larangan, Munjungagung Village, Kramat District. Based on the Regent's Decree No. 523/448/2010, the coral reefs in Karang Jeruk are a protected area. Following the regulation of the Minister of Marine Affairs and Fisheries number 31 of 2020, the realisation of the Karangjeruk Aquatic Tourism Park is still waiting to be approved in the Conservation Area in Karang Jeruk.

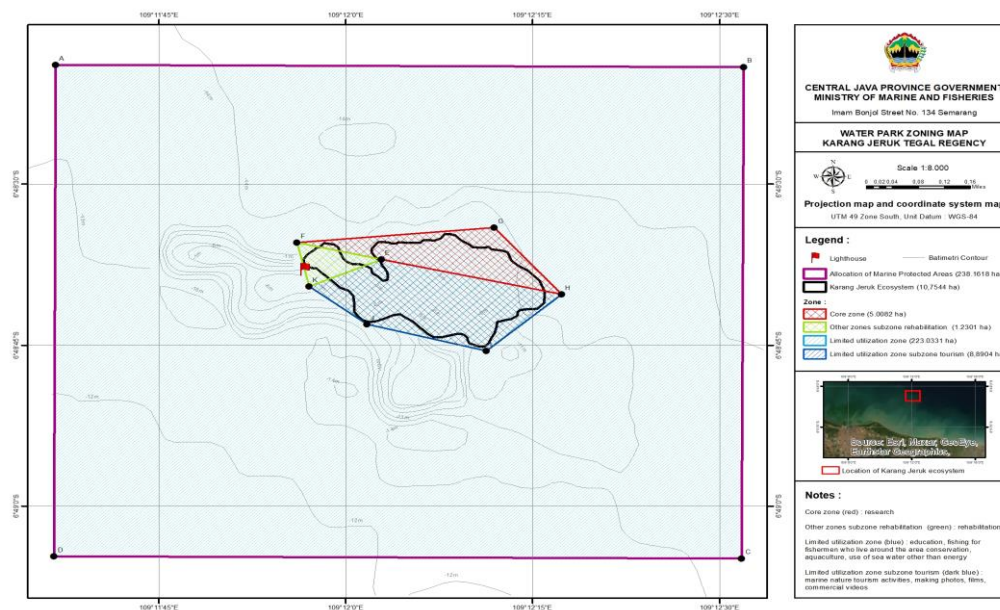


Figure 2. Map of the conservation area plan for the Karangjeruk Aquatic Tourism Park.

The Karang Jeruk waters are used as fishing area. According to local fishermen, Karang Jeruk waters are very productive. The anchovy dominate the catch in Karang Jeruk waters, as shown in Figure 3.

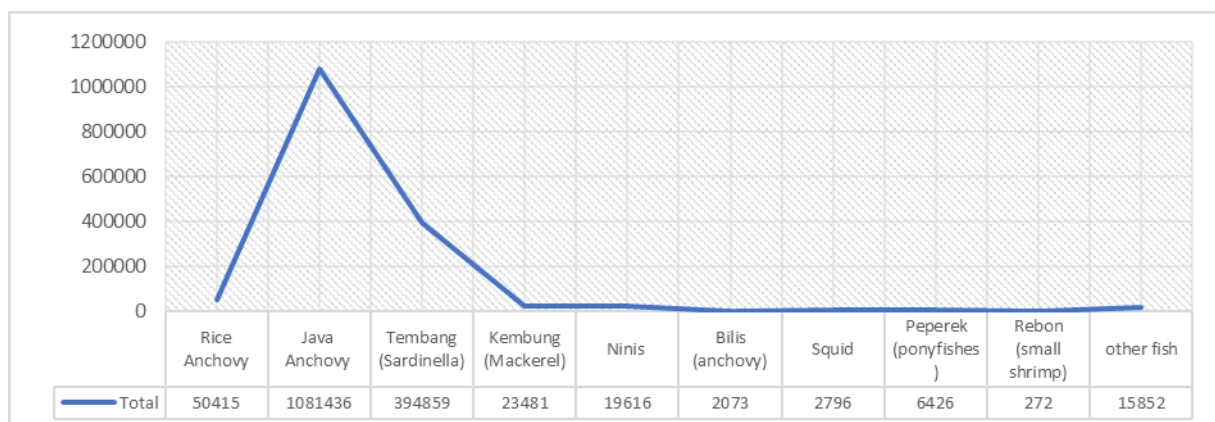


Figure 3. Types of fish caught by fishermen in the Karang Jeruk waters (secondary data from DKKP Tegal Regency 2021, processed).

Characteristics of fishermen. As shown in Table 1, the socio-demographic profile of the respondents is: gender, age, education level, marital status, number of dependents, fishing gear and low-income side jobs.

Table 1

Fishermen characteristics

<i>Variable</i>		<i>% of respondents</i>	<i>Notes</i>
Age (years)	<30	11	
	30-40	16	Min=23
	41-50	34	Max=67
	>50	39	Mean=47
Level of education	0		
	1-6	62	Min=0
	7-9	23	Max=12
	10-12	9	
	>12	0	
Income per fishing trip (USD)	Fishing gear: Pursin		Min=13
	<50 USD	79	Max=77
	>50 USD	21	Mean=44
	Fishing gear: Payang		Min=25
	<50 USD	33	Max=73
	>50 USD	67	Mean=46

Fishermen had an average operational trip duration 1 of 3 days. The locations for fishing had a range less than 12 miles. Table 1 shows a summary of the characteristics of fishermen in the waters around Karang Jeruk waters, Tegal Regency. The age range of respondents was mostly in the range of 30-50 years, with an average of 40 years old, the productive age. The level of education of fishermen was: 62% of fishermen had 1-6 years of studies (elementary school). The survey showed that the highest income of fishermen (purse seine) was 77 USD trip⁻¹ and the lowest was 13 USD trip⁻¹; the highest income of fishermen with Payang fishing gear was 73 USD trip⁻¹ and the lowest was 25 USD trip⁻¹, when the season was good. If there were big waves and storms, they could not even go to sea.

Vulnerability based on the perception of small-scale fishermen. This study was conducted to determine the fishermen's perceptions related to vulnerability. The vulnerabilities experienced by fishermen were identified by Prateep & Berkes (2019) from natural, social, economic, institutional and technological factors. Fishermen' perceptions of these vulnerability factors were standardized through adjustments, in order to obtain objective results. The perception of small-scale fishermen on vulnerability factors is summarized in Table 2.

Respondent 18 explained that the current season was no longer certain. Determining when the dry or rainy season came was difficult because the seasons were always changing (unlike in the past). Thus, they would only go to the sea when the weather was favorable. The social factors, according to fishermen's perceptions of vulnerability, were the less supportive regulations, the lack of health and employment insurance and the high migration. Respondent 17 also mentioned that the problem with small-scale fishermen in terms of health insurance was the difficulty in managing it, due to the distance to the insurance office. They did not have a strong motivation to visit the insurance office from the fishing community villages. Meanwhile, regarding the economic factors, the fishermen's perception of vulnerability focused on the insufficient income, seasonal sales, fuel shortages, lack of money to go to the sea and the expansion of large companies. The majority of respondents incriminated their income fluctuations.

Table 2

Vulnerability perceptions of small-scale fishermen

<i>Likert scale</i>	<i>Vulnerability</i>	1	2	3	4	5
<i>Domain</i>		(%)	(%)	(%)	(%)	(%)
Natural	Floods and rob floods	16	79	6	0	0
	Fish in season are getting harder to predict	0	0	4	63	33
	The current season is hard to predict	0	4	7	40	49
	Unpredictable waves around fishing grounds	0	10	4	51	34
	Damaged natural resources	0	26	31	33	10
Social	Regulations from the government are currently considered less supportive for the fishermen	0	16	21	46	17
	Most fishermen still do not have a health insurance	0	0	0	81	19
Economy	Fishermen's perception of migration	17	49	11	23	0
	Income from fishing is still not enough	0	17	11	41	30
	Seasonal fish sale	0	30	6	44	20
	Getting fuel to go to the sea is still difficult	0	51	1	31	16
Institutional	Expansion of large fishing companies	17	59	3	21	0
	Lack of fishermen empowerment activities	0	17	13	44	26
	There is a conservation area	3	61	10	26	0
Technology	The fishing equipment used by fishermen is old	0	17	0	50	33
	Fishermen do not have modern technology	0	10	1	54	34
	The difficulty of understanding modern technology	0	17	9	44	30

Likert scale: (1) Strongly disagree; (2) Disagree; (3) I do not know; (4) In agreement; (5) Strongly agree.

Regarding the technology factor, the fishermen perceived vulnerability through the indicators of old fishing equipment, lack of modern technology and difficulty in understanding technology. In addition, fishermen's perception of vulnerability related to the institutional factor was reflected by the indicators of lack of empowerment and the existence of conservation areas. Respondent 41 had a positive perception on the existence of the Karang Jeruk conservation area. He said that it did not interfere with fishing activities but instead it helped. Most fishermen felt that they benefited from the existence of a conservation area, especially those living around the coral conservation area. Due to the existence of conservation, the government paid attention to their sustainability, particularly protecting their fishing grounds from damage caused by big fishermen from other areas. However, local fishermen also had to pay more attention to their fishing gear and to the period allowed to use a fishing ground.

Assessing adaptive response. In the resilience literature, community adaptability is the capacity to build social-economic resilience through collective action (Walker et al 2004; Folke 2006). One way to analyze trends forming local adaptive responses is to use various attributes of adaptive capacity. Each attribute expresses information that supports closing the gap between the goals and actions of human actors who participate in the attribute system of adaptive capacity. These attributes control the extent to which a community may exercise resilience and adapt or change in response to change. The following are the aspects of this adaptive capacity: response diversity, collaborative capacity, connectivity, abundance/reserves and learning capacity (Tompkins & Adger 2004; Kerner & Thomas 2014; Kaur 2020).

Response diversity. Responses to changes in socio-ecological systems can involve aspects of social and ecological subsystems (Figure 4). Components, such as human and

organically constructed infrastructure, workforce and expertise, multilevel and institutional actors, formal and casual actors play essential roles in responding to change. Moreover, livelihood and income diversity are common indicators used to determine the diversity of responses within social subsystems, alongside economic opportunity, degree of dependence on natural resources, migration patterns and willingness to change (McLeman & Hunter 2010; Whitney et al 2017). Identifying the diversity of livelihoods within a system allows understanding the possible social inequalities and unequal distribution of opportunities despite change (Leslie & McCabe 2013). The response was shown from the results of semi-structured interviews.

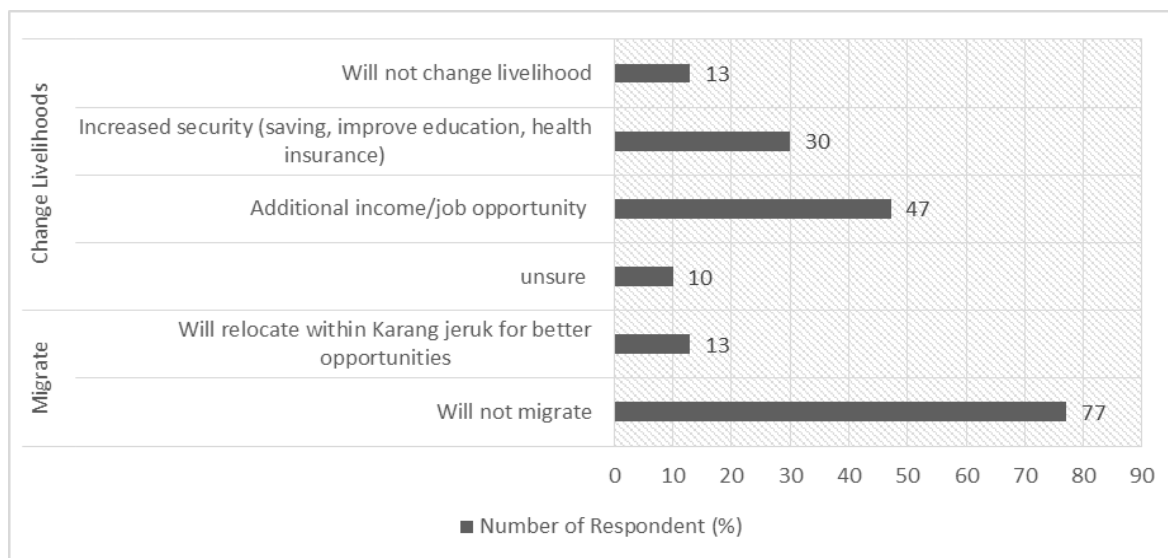


Figure 4. Fishermen's information regarding hypothetical adaptive responsive in % (Semi-structure n=70).

Figure 4 showed that only a tiny proportion of fishermen, 47% of the respondents, chose to adapt by having a side job. Respondents added that people started to think about having another job besides, being a fisherman, by getting involved with tourism development in this area. According to Respondent 26, a plan was launched for tourism development in the port, like in Tegal City.

Connectivity. With the development of activities around Karang Jeruk waters, the community could adapt by increasing connectivity. This was identified by increasing the number of local-level associations, raising awareness and increasing the frequency of community gatherings during ongoing changes or when facing unfavourable situations.

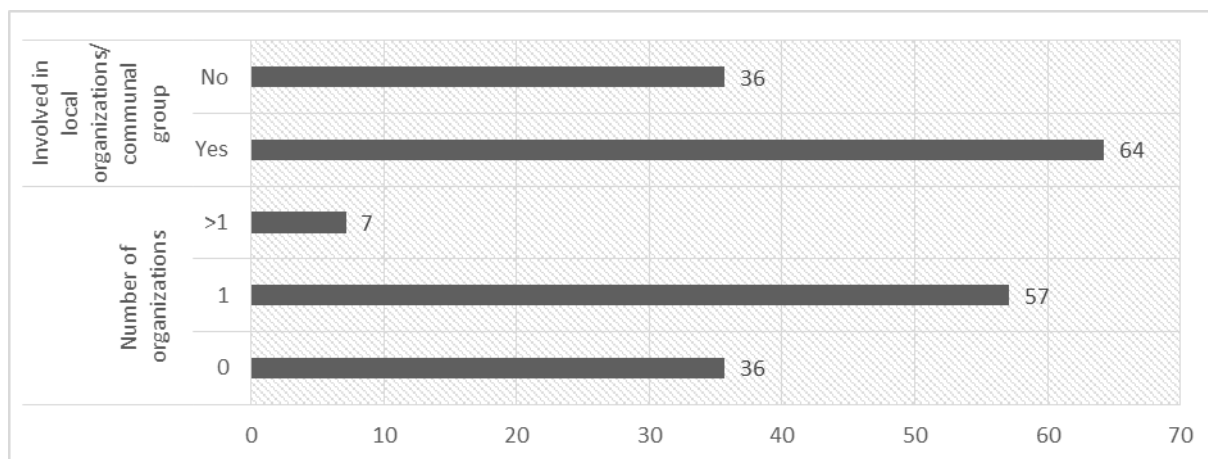


Figure 5. Fishermen's information related to the local connectivity in % (Semi-structure n=70).

Based on social relations in Figure 5, 64% of the fishermen respondents admitted joining the organizations, whereas the remaining 36% did not join the organizations. Most of the people joined only 1 organization and just 7% of the respondents joined more than 1 organization. This showed the necessity for improving awareness of the importance of organizing their connectivity with the environment and society. The associations they participated in were also more informal community associations/organizations than the fishermen’s organizations/associations.

Collaborative capacity. Collaboration in communities often depends on the human systems and their level of involvement in the socio-ecological system (Leslie & McCabe 2013).

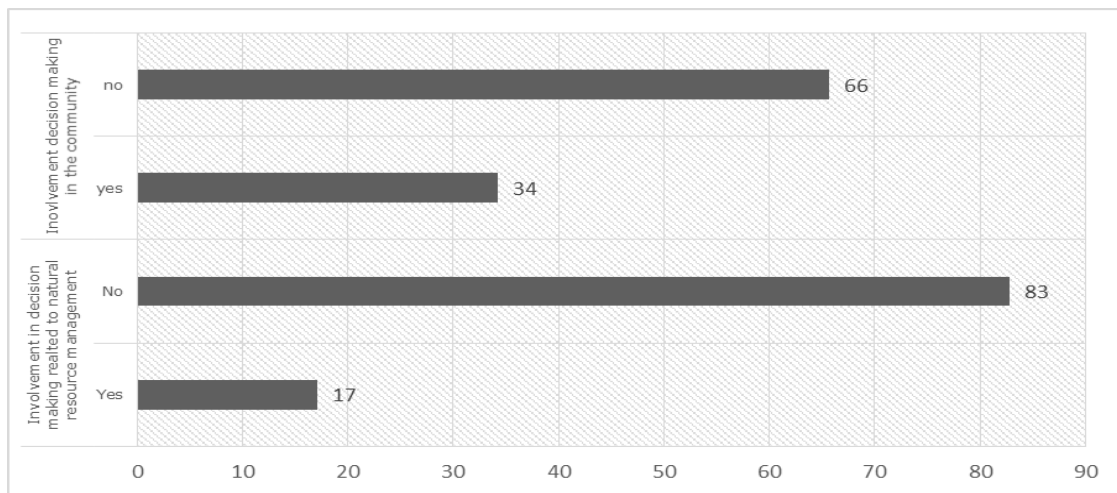


Figure 6. Answers related to the collaborative capacity (Semi-structure n=70).

Respondents were asked about their involvement in making decisions in community and natural resource management (Figure 6). Out of the 70 fishermen respondents, 34% stated that they participated to the community decision-making whereas the remaining 66% respondents said that they did not. Related to the natural resource management, only 17% of the respondents indicated that they participated in making decisions, whereas the other 83% did not. Thus, we can interpret that their role in the decision-making in the community was still small and that they were less involved in natural resource management decisions.

Reserves. Diversifying assets as reserves can play an essential role in local growth (Kaur 2020). Figure 7 describes the reserves owned by individuals or households of coastal communities.

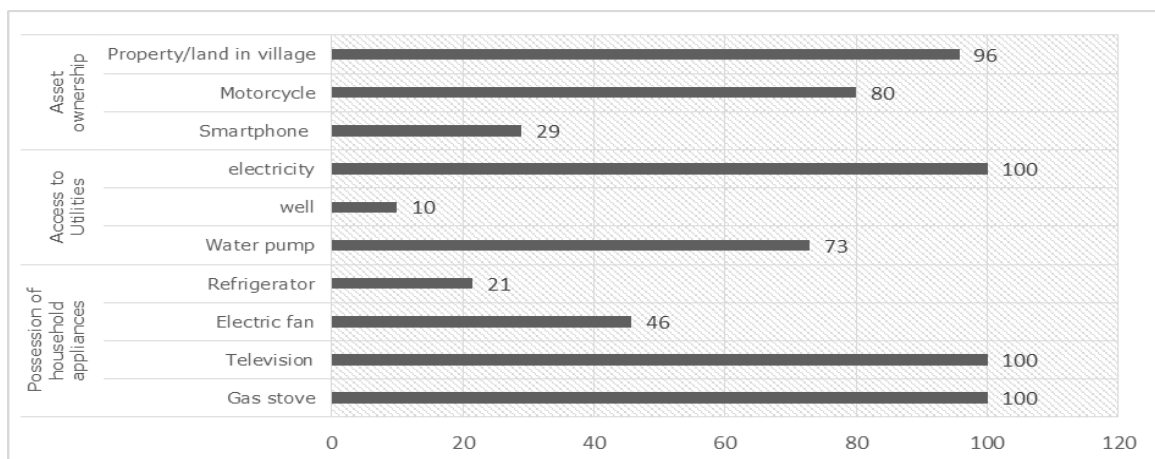


Figure 7. Reserves held by individuals or households (Semi-structure n=70).

Fisher respondents were asked about their ownership of assets, around the Munjung Agung village. They indicated household appliances and access to water and electricity. Based on the asset ownership, most of the fisher respondents had motorbikes (i.e., 80% fishermen respondents). Meanwhile, 96% respondents owned houses or land around the Karang Jeruk waters, and 29% owned communication devices of a smartphone type. Based on the ownership of household appliances, all fisherman respondents stated that they had gas stoves, televisions and access to electricity. For the water access, as many as 73% of fisherman respondents had clean water sources from PDAM (local water supply utility), and the remaining 10% people used wells to obtain clean water.

Learning capacity. To make optimal use of the natural reserves, we must understand the local community's learning capacity, which considers several aspects, such as education level, access to resources and cultural memory (Kaur 2020). The following question arises: How and where do they communicate?

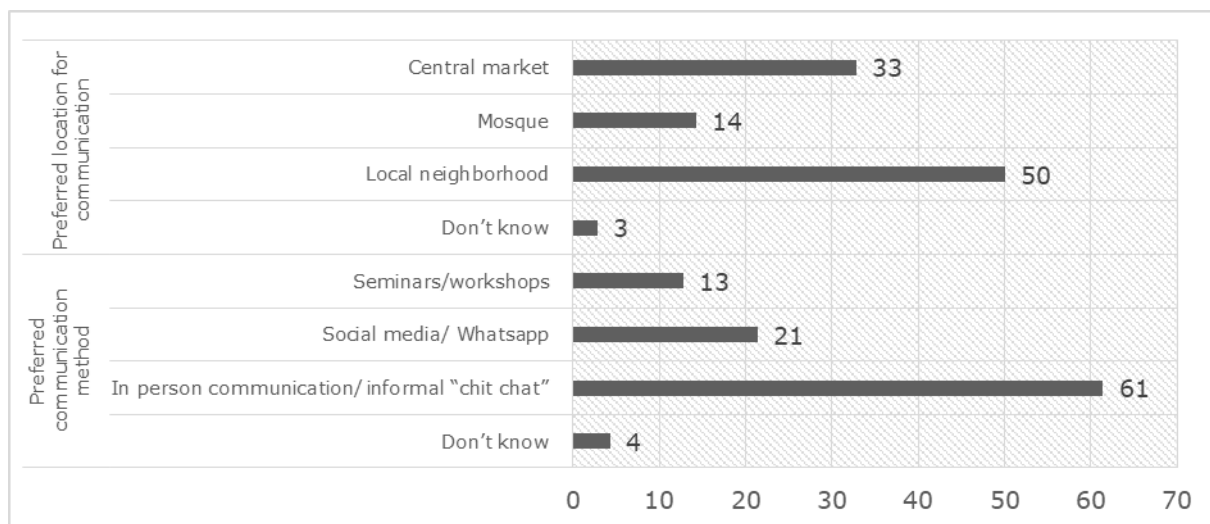


Figure 8. Preferences in communication efforts (Semi-structure n=70).

As shown in Figure 8, respondents tended to choose the communication method by chatting directly. A total of 61% respondents decided to talk directly whereas 21% of the respondents communicated through social media or WhatsApp. Moreover, only 13% of the fishermen communicated during the seminars or workshops. Meanwhile, the remaining three people answered that they did not know. When choosing a reference based on location to communicate, half of fisherman respondents decided to chat in the local neighborhood, 14% communicated in the mosque, and 33% respondents chose to talk at the TPI (fish auction), the central market, or in harbor. In contrast, three people answered that they did not know.

Strategy to empowerment fishermen. Once having performed a complete profile of a place, with the characteristics of its socio-ecological context, after having identified its strengths and problems, it is necessary to define the best way to address the challenges and to set the path for viability. It is important to set a collective vision with the best strategies and goals with innovative ideas that can foster job growth, environmental preservation, community well-being and to maintain this "stability" for the upcoming years. We analyzed the results of the interviews using the "ATLAS.ti in-depth interview" with the roles of A-B-G-C (academician, business, government and community) for the key persons, in order to obtain a factorial structure for the strategy to support small-scale fishermen, as shown in Figure 9.

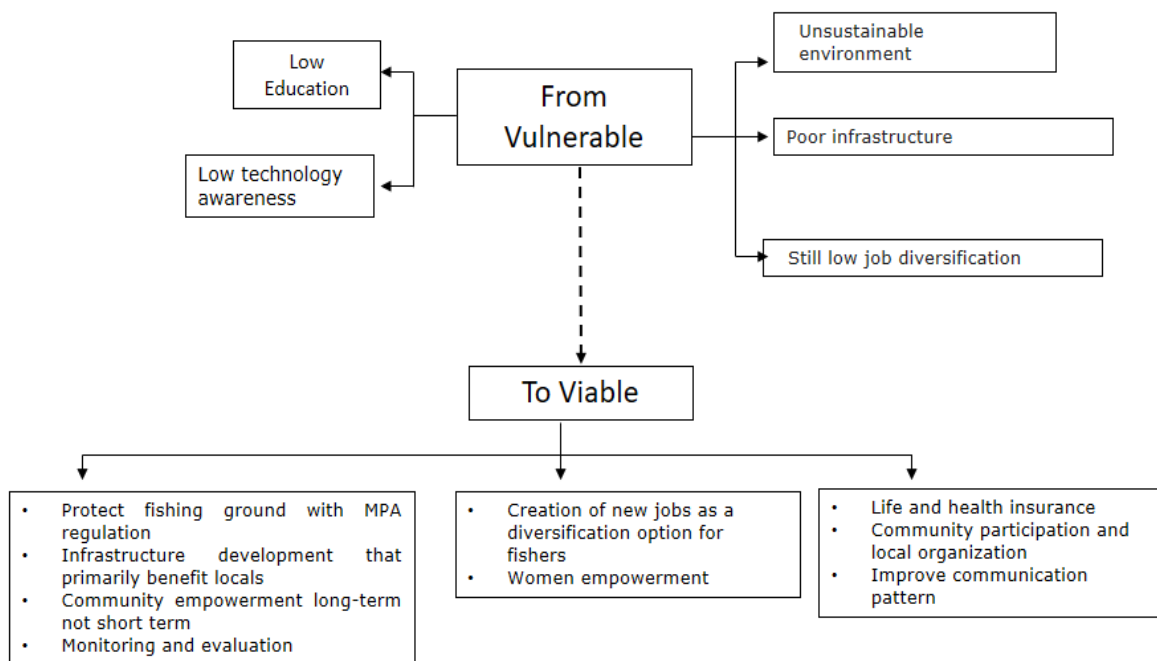


Figure 9. Factors supporting fishermen's vulnerability to be changed into viability.

One of the factors that supported the fishermen's livelihood was the fishing ground protection. For many years, small-scale fishermen have been using the fishing ground in the Karang Jeruk area as an area rich in fish resources, especially anchovies. Fishing grounds need to be protected for maintaining the sustainability of small scale fisheries (Horta e Costa et al 2013; Ardiansyah et al 2019; Krueck et al 2019). After the issue of the Ministerial Regulation KP No. 31 of 2020 concerning the Management of Aquatic Conservation Areas, the local government submitted a proposal for the Karang Jeruk Aquatic Tourism Park related to the coral reef within the Karang Jeruk conservation area. Infrastructure development contributed to the support of the small-scale fishermen livelihood (Stacey et al 2021). Small-scale fisherman in the area were concerned about the silting of their harbor making difficult entering and exiting the port. To ensure a long-term community empowerment, it was necessary to monitor and evaluate the policies that have been implemented, in order to determine whether they needed to be continued or stopped. Furthermore, the key persons emphasized the need for the creation of new jobs to diversify the professional opportunities for fishermen and to secure a stable income in various seasons or conditions (González & Antelo 2020; Luz 2021). Aquaculture and tourist development were two of the government's priorities. Afterwards, it was necessary to empower women in order to provide more security for their families livelihoods, so that they can help their husbands not only as pre-harvest, but also post-harvest to bring additional income for the family (Harper et al 2013; Febri et al 2017; Kusumawardhani & Susilowati 2021). Acknowledging and including women in the fisheries management is essential for a sustainable and equitable fishing industry. Furthermore, fishing is a very risky job so it is important for fishermen to have life insurance as well as health insurance to compensate for the work risks that they receive. With a high level of occupational risk, the fishing profession also requires special protection. It is important for fishermen and their families to have life insurance that can reduce the burden on families in case of hazards (Rani 2016). Besides that, it is also important for locals to have a sense of belonging and inclusion, by improving the communication patterns of fishermen with policy makers, to discuss if policies are in accordance with their needs and other potential developments (Zaremohzza et al 2014; Nugroho et al 2021).

Discussion. Although fishermen are not part of the poorest society, they are a society that is vulnerable to changes. Thus, vulnerability categorization should be based on

issues relevant to a particular incident or type of emergency. Furthermore, we know that all groups of people, men and women, young and old, rich and poor alike, may be vulnerable in different ways. We are all prone to some disadvantages. Thus, we needed a method to assess better and prioritize vulnerabilities (Buckle 1998; Paul 2014; Havrilla 2017). We identified the vulnerability factors based on the work of Milan (2019) which is divided into natural, social, economic, technological and institutional. These factors developed the concept of Nayak & Berkes (2019), dividing it into the material, relational and subjective aspects.

The perception of vulnerability is variable for every community. For example, in one coastal area, they can be vulnerable to the climate change, as in the research of Salik (2015) on the coastal communities involved with fisheries or agriculture sectors and therefore exposed or sensitive to this topic. Abu et al (2019) concluded that experienced people are more prone to adaptation practices, but this is not in line with previous claims by D'Silva et al (2012) and Islam et al (2014), who found that, although experienced, small-scale fishermen do not cope as well as expected with the climate change adaptation and do not take advantage from their broad skills and knowledge. By contrast, in line with Mohamed et al (2015), we determined that the most experienced small-scale fishermen preferred to maintain their traditional fishing techniques and refused to innovate in their adaptation practices by utilizing fishing technology, diversifying their catch and trying new fishing gear or other methods. Also, years of experience in deep-sea fishing led small-scale fishermen to live in comfort zones and were reluctant to adopt method improvements. The convenience of using existing technology is also manifest in fishermen around the Karang Jeruk area, who suggested that switching to modern technology was not urgent and interfered with their daily lives.

Meanwhile, Andrews et al (2021) explained that small-scale fishermen are also vulnerable to the expansion of large companies. The infrastructure and pipelines of the oil industry can also displace small-scale fishermen from the areas they need for fishing. This did not happen to small-scale fishermen on the coast of Karang Jeruk because no significant company expansion existed there. The fishermen's perception of vulnerability, as recorded in this study, considered the natural aspects as the most disturbing factor. Difficult seasons make small-scale fishermen most vulnerable to the unexpected impact of climate change (Hidalgo et al 2018). The adaptive response capacity is critical for the establishment of appropriate policies. Migration is just one of the possible adaptive responses of the fishing communities. Simar (2020) found that fishermen chose not to migrate, which is in line with this present study. By contrast, Islam stated that migration is one of their preferred ways of adapting, suggesting that migration is a viable strategy to respond to climate variability and change. Migration has produced some positive outcomes for resettled households. The issues at the original place influence the different strategies. Interestingly, small-scale fishermen in Karang Jeruk were still lacking of health insurance awareness. However, health insurance was beneficial for them to improve the welfare of life. They also had an average education level of primary school graduates, similarly to the farm communities in Indonesia, with a low average level of education (Central Bureau of Statistics 2016).

Building adaptive capacity to respond to vulnerabilities in small-scale fishermen in Karang Jeruk required a complex adaptive response; for example, managing the climate change impacts by increasing the access to resources and alternative livelihoods can require adaptive responses in other systems, such as the local culture, values and institutions. The interconnected feedback in the adaptive capacity of the social system in this research area indicates the need for a continuous review and response process. Understanding the vulnerability, response and adaptive capacity can be used as an initial basis for setting strategic policies to support transitions.

In an attempt to build the resilience of fishermen from the vulnerabilities they face, it is necessary to empower them and to consider their adaptive capacity (Wahyono et al 2016; Kaur 2020). The key persons considered that protecting fishermen's fishing ground was an urgent action. In order to protect the fishing ground and create a sustainable environment, the local government has proposed that the coral reefs in Karang Jeruk would be used as a conservation park, which would restore the marine

habitats and rebuild fish stocks. MPAs can benefit both conservation and fisheries in areas experiencing overfishing, which is common in many coastal areas (Cabral et al 2020). The key persons highlighted that the port's infrastructure is still in bad condition. Fishermen empowering policies with a long-term sustainability goal are a good option (Courtney et al 2017), but it is also necessary to evaluate and monitor whether the policy is still relevant.

Face to the uncertainty due to weather and government policies, fishermen take a side or backup job. The key persons suggested starting to encourage job diversification for fishermen and women's empowerment, to support the family economy. Also, insurance is essential, since fishermen's work was extremely risky and they were prone to accidents and disaster. Fishing is inextricably linked to workplace accidents, loss of life, loss of boats and equipment, personal health and safety, and ship crew safety. (Mustikasari & Relawati 2021). Law No. 7/2016 Article 30 Paragraph 2 and 3 states the risks faced by fishermen, together with other types of risk regulated by a Ministerial Regulation. These accidents are commonly due to natural disasters, fish disease outbreaks, the impact of climate change, and/ or pollution (Zekri et al 2008; Rani 2016). In the event of an accident, fisher folk families are automatically damaged because the breadwinner can no longer catch fish. Weather and natural conditions can also cause fishing equipment, such as a boat or nets, to become damaged and unable to catch fish, being one of the factors that cause fishermen and their families to lose their livelihood (Safitri 2018). Fishermen had not been actively involved in the local management thus far. Key persons encouraged to change the communication patterns so that fishermen could be more effective in the decisional process.

Conclusions. The analysis results revealed that the vulnerability, based on the perceptions of fishermen around the Karang Jeruk conservation area, was dominated by natural and social factors. Adaptive capacity was a way to measure vulnerability and it could also be considered an essential attribute of resilience. Moreover, adaptive responses to change were primarily limited to the livelihoods. Alternative sources of revenue, such as the jobs available in the tourism sector, although strongly dependent on the natural resources, may be a viable solution for these professional communities. Adaptive response is characterized by diversity, collaborative capacity, connectivity, abundance/reserves and learning capacity. The respondent adaptive strategy was essentially: migration rejection, job opportunities acceptance, local organizations for communication and information, and willingness to improve their participation to the decision-making in their local community, in particular regarding the environmental management. Determining the vulnerability and adaptive capacity can improve strategies to achieve survival during uncertain conditions. Future research is necessary on the specific vulnerability perception and adaptive capacity in different regions and communities, in order to inform and customize the policy.

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Conflict of interest. The authors declare no conflict of interest.

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Authors:

Hapsari Ayu Kusumawardhani, Diponegoro University, Faculty of Economics and Business, Indonesia, e-mail: hapsariak@gmail.com

Indah Susilowati, Diponegoro University, Faculty of Economics and Business, Indonesia, e-mail: prof.indah@gmail.com

Hadiyanto, Diponegoro University, School of Postgraduate Studies, Indonesia, e-mail: hadiyanto@live.undip.ac.id

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