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Adaptive Co-Management Strategy in forming Social-Ecological Resilience as a Basis for Achieving Blue Economy Development in Coastal Regions. Case Study of Tambakbulusan, Demak

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ABSTRACT

Coastal areas represent a dynamic and productive intersection between land and sea, characterized by unique ecosystems such as estuaries, mangroves, seagrass beds, and coral reefs. However, these areas face significant environmental challenges, including silting, climate change, land subsidence, and pollution, exacerbated by human activities like resource extraction and industrial development. Despite the abundant natural resources, many fishers struggle with low income due to factors such as poor fishing technology, environmental degradation, and climate variability. The research aims to analyzing the Socio-Economic Ethnography of Tambakbulusan, 2). Investigating coastal vulnerability in Tambak Bulusan, 3). Explore the adaptation and mitigation in dealing with the vulnerability of resources and communities in coastal areas, 4). Formulate adaptive strategies through a co-management approach.. This study location in Tambakbulusan Village, Demak Regency. Using a mixed-method approach, both quantitative and qualitative data were collected from 57 small-scale fishers through field surveys and interviews. The findings highlight that sensitivity is the highest indicator that causes vulnerability. Its needed for sustainable coastal management practices and co-management strategies to improve the adaptive capacity of fishers and enhance their livelihoods in the face of environmental and economic uncertainties.

Keywords: Adaptive capacity, Co-management, Indonesia, Small-scale-fishers, Vulnerability.

INTRODUCTION

Indonesia has vast marine resources, the coast is not only vulnerable to natural processes such as erosion, silting, and disasters, but also experiences strong pressure from human processes such as economic growth, resource development, and pollution discharge [1]. Coastal areas are a very dynamic and productive transition between land and sea, where the habitat and types of biota are specially adapted to the unique environment. In coastal areas, various typical ecosystems develop, including estuaries, forests, mangroves, seagrass beds, coral reefs and interdal beaches [2, 3]. In line with the increase in population, humans utilize natural resources in coastal areas. Some uses of natural resources that are generally carried out include fishing activities, including capture fisheries,

aquaculture and mariculture; tourism activities both on land and underwater; sea transportation activities; industrial activities, mining activities; even agricultural and plantation activities. [4, 5]

Utilization of marine resources is used to meet economic needs, namely increasing welfare by placing high dependence on natural and environmental conditions [6, 7]. The use of coastal resources often gives rise to negative reciprocal interactions because human exploitation tends to be destructive (Nayak & Berkes, 2019). Communities living in rural coastal areas are vulnerable communities, which are unable to face the ecological threats resulting from destructive economic activities. Apart from that, threats to coastal communities also arise from the threat of climate change and severe land subsidence phenomena [8]. In this case, the decline in green belt land worsens the socio-ecological conditions in coastal areas.

Fisheries should be the most superior sector in Indonesia because Indonesia's geographical condition, which is an archipelagic country, has a very large abundance of capture fisheries resources. The abundant natural wealth in the marine resources sector usually has a positive impact on seaside communities, especially those who work as fishers . Fisheries resources can potentially be utilized to improve the standard of living and welfare of fishers , but in reality there are still quite a lot of fishers who are in poor economic conditions. well because they cannot increase their catch, so their income does not increase [9, 10]

Fishers carry out their work with the aim of earning income for living needs. However, the catch is greatly influenced by many factors, including: fishing gear, technology, human resource skills, climate change, the status of maximum resource production capacity to meet the needs of his family. In its activities, there are many factors to support the success of the activity [11]. People who have a livelihood and income as fishers are one of the people who carry out business activities by earning income from fishing activities themselves. Fishers are people who actively work in fishing operations and other aquatic animals [12] The level of welfare of fishers is largely determined by their catch. The amount of catch is also reflected in the amount of income they receive and most of this income is for family consumption needs. [13, 14]. Figure 1 shows the position Demak Regency based on comparion of Indonesian Coastal Households and Central Java Province

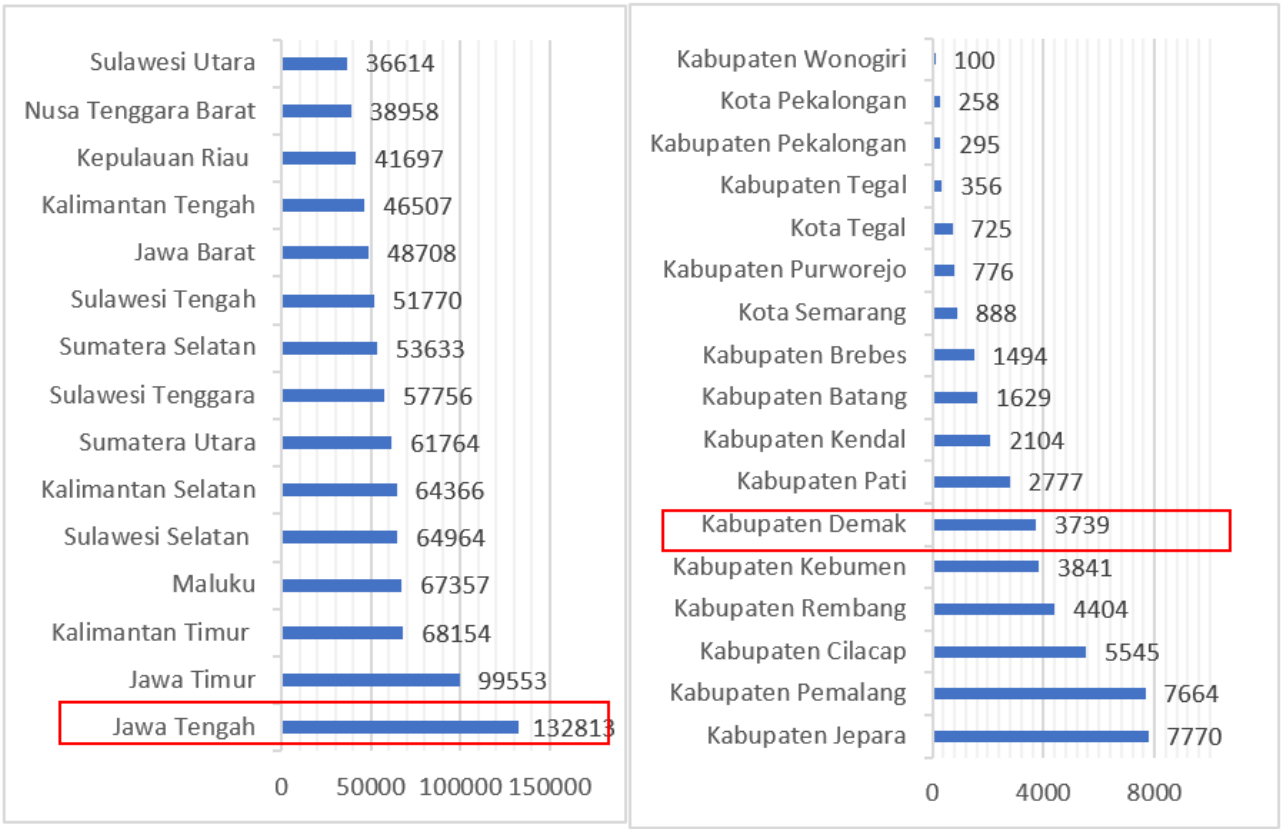

Figure 1. Comparison of Indonesian Coastal Households and Central Java Province in 2022.
Source: (KKP, 2023).

The Central Java Provincial Government has 7,809 poor villages spread across 537 sub-districts in 29 regencies in Central Java. Demak Regency is one of the regencies on the north coast of Central Java. Demak Regency has a coastline of 34.1 km, consisting of 14 sub-districts, around 11% of poor households out of a total of 1,273 households are fishers [15]. The marine potential of Demak Regency, especially capture fisheries, has a north coast

area of 57 km [16]. Demak Regency has a geographical area that is a combination of agricultural and coastal areas which has quite large marine and fisheries potential including marine fisheries and land fisheries. Fishery commodities in Demak Regency are diverse [17]. The negative impact of the welfare level of marginalized fishers, if left unchecked, will widen disparities and widespread poverty, becoming a barrier to sustainable resource optimization. The fisheries sector in Betahwalang Village is still dominated by small-scale commercial fishers (artisanal fisheries), especially in coastal waters using traps, arad and nets. [18]

The vulnerability of coastal communities is based on individual vulnerability and group vulnerability. The dimension of vulnerability can basically be measured into 3 sub-discussions: exposure, social sensitivity and adaptive capacity (Adu et al., 2018; G et al., 2016; Hoque et al., 2021; Ruiz-Díaz et al., 2020). Basically, the vulnerability of coastal communities is influenced by unfavorable natural conditions, starting from climate change, environmental damage, tidal disasters and ecological damage [19, 20]. Ecological damage is the basis that occurs most often due to the massive development of community cultivation without paying attention to the impact on the environment. Ecological damage has an impact on the occurrence of abrasion and tidal floods, apart from that, the development of coastal communities' efforts to manage marine resources is also limited, which ultimately results in one of the indicators causing the vulnerability of coastal communities. [21, 22]. Therefore, it is necessary to carry out environmentally sound coastal management, in order to restore previous conditions [23]

Appropriate coastal management to protect people and community resources from potential damage due to ecological damage requires systematic vulnerability assessments (Rahadiati et al., 2019). Measuring the vulnerability of a target area or population has been explored during several studies to assist coastal community planning [7, 24]. It has also often been observed that small-scale fishers respond dynamically to resource fluctuations [25] but there has been no systematic attempt to build approaches to fisheries management that take these adaptations into account. It is the aim of this paper to bring to the fore the adaptive responses of small-scale fishers to resource fluctuations and other shocks and uncertainties, so that the search for creative solutions to current fisheries management problems can draw on an understanding of the adaptive strategies of fisherfolk themselves [26]

Phenomena that occur on land include abrasion, flooding and activities carried out by the community, namely the construction of settlements, clearing of forests for rice fields, construction of ponds and ultimately have an impact on coastal ecosystems. Likewise, phenomena in the sea, such as tides, storm waves and so on [27]. This natural phenomenon also occurs on the coast of Demak [28]. Water pollution and unpredictable weather are situation that coastal communities in Demak Regency often experience. Another natural factor that also causes environmental damage is high waves which cause damage to coastal ecosystems so that there are no barriers to reduce tsunami waves [29]. So this research has the aim of: 1). Analyzing the Socio-Economic Ethnography of Tambakbulusan, 2). Investigating coastal vulnerability in Tambak Bulusan, 3). Explore the adaptation and mitigation in dealing with the vulnerability of resources and communities in coastal areas, 4). Formulate adaptive strategies through a co-management approach.

METHODOLOGY

This research study took place in Tambakbulusan, Demak Regency, Central Java. Tambakbulusan Village is a village located on the coast of Demak. The area of Tambakbulusan Village is 470,047 Ha and is divided into 4 hamlets, namely Tambakbulusan Hamlet, Tambak Gembolo Hamlet, Tambaktengah Hamlet, and Tambakkontrak Hamlet, and is bordered by the area to the north, namely Morodemak Village, to the south is Surodadi Village, to the west is the Java Sea, and to the east is Banjarsari Village. The potential of this village lies in the pond sector, MSMEs, and tourism (Setyowati et. al., 2022). Tambakbulusan Village is one of the villages with a very wide pond potential. The main commodities of the village's mainstay pond community are shrimp and milkfish (Ministry of Communication and Information of the Republic of Indonesia, 2021). This study interviewed Small-Scale Fishers (SSFs) with a total target of 57 small-scale fishers . The study requires the characteristics of respondents to apply the purposive sampling technique, namely Small-Scale Fishers (SSFs) who live in Tambak Bulusan, Demak Regency and are of productive age (15-64 years).

This study uses primary and secondary data, where primary data is obtained based on field surveys by researchers and secondary data. This study applies quantitative and qualitative approach methods to the research process (mixed method) (Creswell & Creswell, 2018). In research, mix methods will be classified into sequential methods or sequential models. In the first stage, the researcher will use a quantitative method, then it will be analyzed in more detail using qualitative methods to strengthen the results of quantitative research conducted in the first stage (Creswell, 2014). The quantitative approach to explain the respondent profile as well as the demand and purposive sampling was chosen as the sample determination method to collect data using semi-structured interviews. A quantitative approach is applied to answer research objectives number 1,2,3. A qualitative approach

is needed in this study to add information on coastal characteristics (objective 1) and coastal communities and co-management strategies (objective 4).

RESULT AND DISCUSSION

Tambakbulusan has a community with diverse livelihoods (Sholekhah, 2022) that various livelihoods include livestock, industrial workers, and trade. However, the area near the coast makes pond farmers and sea fishers the main source of income for the people of Tambakbulusan Village. Tambakbulusan mostly consists of land used for ponds covering an area of 89% (Cao et al., 2024). This fits in with the characteristics of the Tambakbulusan Village land, namely relatively flat plains, low elevation, mangrove ecosystems that support fisheries cultivation, and tidal water quality that supports cultivation in ponds. (Allan et al., 2023).

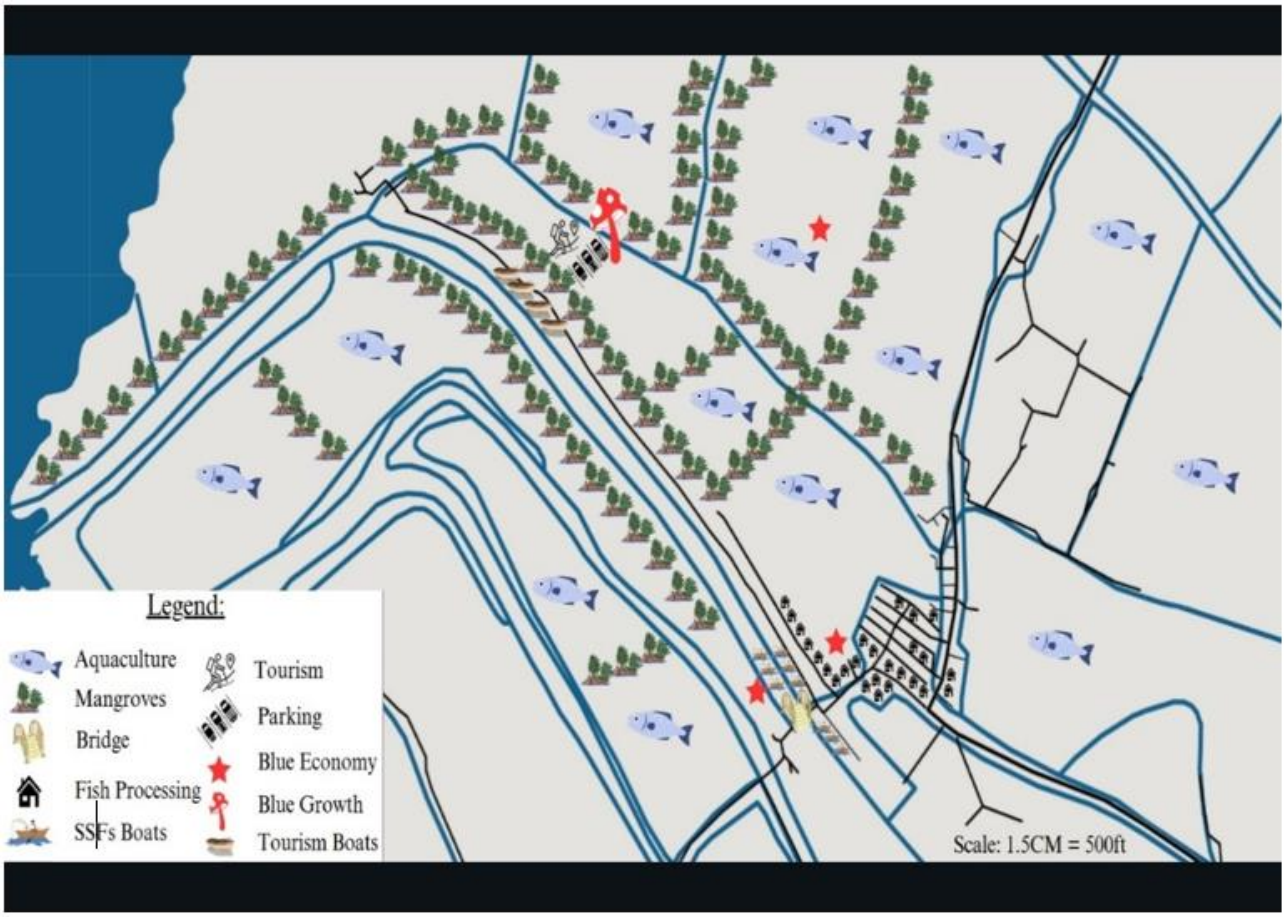

Figure 2. Socio-Economic Activity of Tambakbulusan.
Note:
Blue Growth: Tourism
Blue Economy: Fish Processing; Small Scale Fisheries; Aquaculture

Based on Figure 2, the social and community conditions of TambakBulusan Village are extremely noticeable. The large number of ponds and mangroves illustrates the economic condition of the community depending on the fisheries sector (Bhattacharya et al., 2024). The access road is surrounded by ponds and there is a river flowing towards the sea. To the north of Tambakbulusan Village there is a beach called Istambul Beach, one of the sources of livelihood for the people of Tambakbulusan Village which is used as a tourism spot. Some of the villagers usually don't go out to sea in the morning, always stand by in the tourist area to join the beach walk (Campbell et al., 2024). The social and cultural life of the Tambakbulusan people, which is still maintained today, has the potential to become a tourist attraction. Tambakbulusan Village not only offers beautiful and enchanting views, but also typical culinary products produced by the local community (Tegar & Saut Gurning, 2018). Tourist attractions in Tambakbulusan Village include natural attractions such as mangrove forests and Glagah Wangi Beach, as well as

cultural attractions such as the Syawalan tradition, tambourine art, and the boat carnival every August per year. The productive business products produced include mangrove dodol, mangrove chips and various seafood preparations.

Tambakbulusan Village MSMEs operate independently and have a separate legal entity from the village government (Qian et al., 2023). One of the MSMEs in Tambakbulusan Village is run by fishers 's wives. Fishers 's wives make processed fish production for the Tambakbulusan Village community which can help the household economy (Bari et al., 2024). The fish preparations are in the form of ingkung milkfish, otak-otak milkfish, grilled milkfish, and presto milkfish. Making preparations made from fish and mangrove fruit. These basic materials are used by the fishers 's wives to take advantage of basic materials that are easily available and at affordable prices. The contribution of fishers 's wives in helping the family economy is none other than improving the welfare of their household (Sarker et al., 2024). These products are usually sold through social media and in markets. Sales via social media have spread to Sulawesi, Sumatra, Kalimantan, and even overseas. However, for sales at the market there are very few buyers due to the lack of public knowledge about processed mangroves and this results in a lack of attraction for visitors at the market (Mamat et al., 2020) (Rahmatillah1 & Saefuloh, 2022).

Table 1. Fishers Characteristic in Tambak Bulusan.

Variable	Indicator	% Of Respondent	Notes	
Age (years)	<30	0	Min	: 32
	30-40	9	Max	: 71
	41-50	29	Mean	: 52
	>50	62		
Level of education	0	0	Min	: 6
	1-6	85	Max	: 12
	7-9	11	Mean	: 6
	10-12	4		
	>12	0		
Income per fishing trip (USD)	Fishing gear : bubu payung (crab trap)		Min	: 124
	<125 USD	62	Max	: 153.5
	>125USD	38	Mean	: 128
	Fishing gear : purse seine		Min	: 80
	< 125 USD	83	Max	: 156
	>125 USD	17	Mean	: 120

Fishers had an average optional trip duration 1 of 3 days. The location for fishing had a range less than 12 miles. Table 1 shows a summary of the characteristics of fishers in the Tambakbuusan village, Demak Regency. The age range of respondents was mostly in the range of >50 years, with the average of 52 years old. The level of education of fishers was: 85% of fishemen had 1-6 years of studies (elementary school). The survey showed that the highest income (per month) of fishers with purse seine was 156 USD and the lowest was 120 USD. And for fishers who have bubu payung was 153.5 USD abd lowest was 124 USD

This study analyses vulnerability of socio-economy-environments using the vulnerability index with modification accordingly (scale 1-10). The dimensions are: Exposure, Sensitivity, and Adaptive Capacity. Based on the provisions of this research, the closer the number is to 1, the more vulnerable the dimension is, so it can be explained as follows on Figure 3.

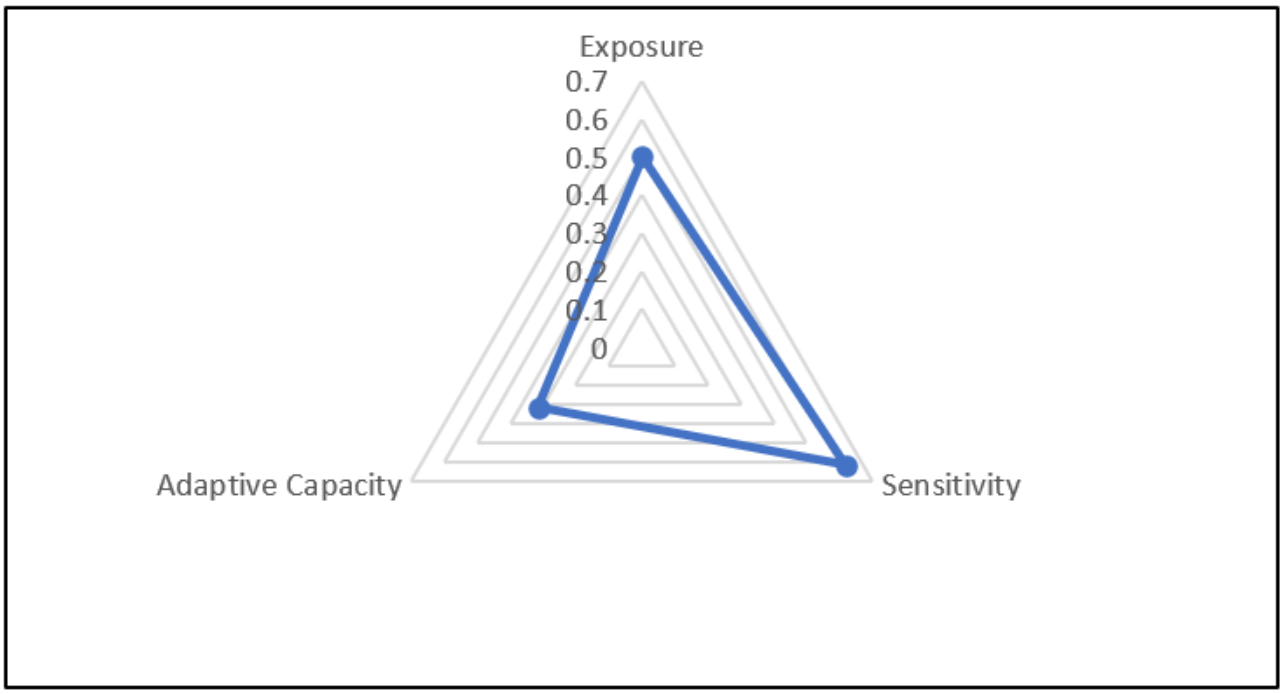

Figure 3. Vulnerability: Investigating Coastal Vulnerability in Tambak Bulusan.
Note: Exposure: resources in encouraging activities; weather; pollution effects; income; conflict
The Adaptive Capacity is measured through cooperative members; help from family and peers; access to loans; access to capital; access to training and educational facilities
Sensitivity: the community is sensitive to the problem encountered; environmental and social interactions; disaster-prone environment; environmental infrastructure.

The diagram shows three main dimensions: Exposure, Sensitivity, and Adaptive Capacity. Based on the provisions of this research, the closer the number is to 1, the more vulnerable the dimension is. In this study, if the value is close to 0.7, it indicates that the exposure level is very high. In the context of livelihoods, this high exposure means that these livelihoods are very vulnerable to external threats such as climate change, natural disasters, or other factors that can disrupt the sustainability of economic activities. The exposure felt by small-scale fishers here is related to the environment. Such environmental exposure refers to all chemicals and compounds that come into contact with society [34]. The second perceived exposure is climate change: extreme weather often results in difficulties in carrying out livelihoods. Extreme weather such as floods, droughts, storms or changes in seasonal patterns can significantly impact livelihoods, especially those dependent on agriculture, fishing or sectors related to natural resources. A high value on the Exposure dimension can indicate that the area or livelihood is very vulnerable to extreme or erratic weather changes, which can result in large losses.

The value is close to 0.5, indicating that livelihood sensitivity is at a moderate level. This means that even though livelihoods have been exposed to threats, the system's ability to withstand or absorb the impact of threats is still moderate, so it is vulnerable but not completely dependent on small changes. Social changes, such as urbanization and shifts in work patterns, can make fishers 's livelihoods more vulnerable. For example, young people may leave fishing jobs to work in the service or industrial sectors, resulting in a labor shortage in the fisheries sector. In addition, fishers 's access to markets, technology and social networks can also be disrupted, increasing their vulnerability to economic and social change. If fishers cannot adapt quickly, these changes could worsen their conditions in the long term.

This value is close to 0.4, indicating that the adaptive capacity is at a lower level. This means that the ability of individuals or communities to adapt to changes or threats is very limited, which increases the vulnerability of these livelihoods. In the context of livelihood vulnerability, it is important to increase adaptive capacity to reduce overall vulnerability, either through training, access to resources, or improving infrastructure that can support the sustainability of these livelihoods.

Explore The Adaptation and Mitigation in Dealing with the Vulnerability of Resources and Communities in Coastal Area

Adaptive capacity is one of three measures of vulnerability and is also considered an important attribute of resilience. Adaptive capacity is defined as the capacity of individuals, groups and organizations to build resilience through collective action in social-ecological systems during ongoing change. According to (Nelson et al, 2007) The adaptive capacity of a social system in facing change refers to the socio-economic conditions that enable

adaptive responses. Adaptive capacity depends on many factors such as perceived understanding of change, available resources, and memory of previous adaptive responses. As explained by Kerner and Thomas (Tompkins dan Ager 2004) Adaptive capacity attributes include diversity of responses, collaborative capacity, connectivity, abundance/reserves and learning capacity.

Response diversity refers to the various ways in which tasks are carried out in a social-ecological system so that it remains functional (Simar, 2020). In this research, response diversity is used to see how fishers respond to the environmental changes they face. Based on the results of interviews with responses

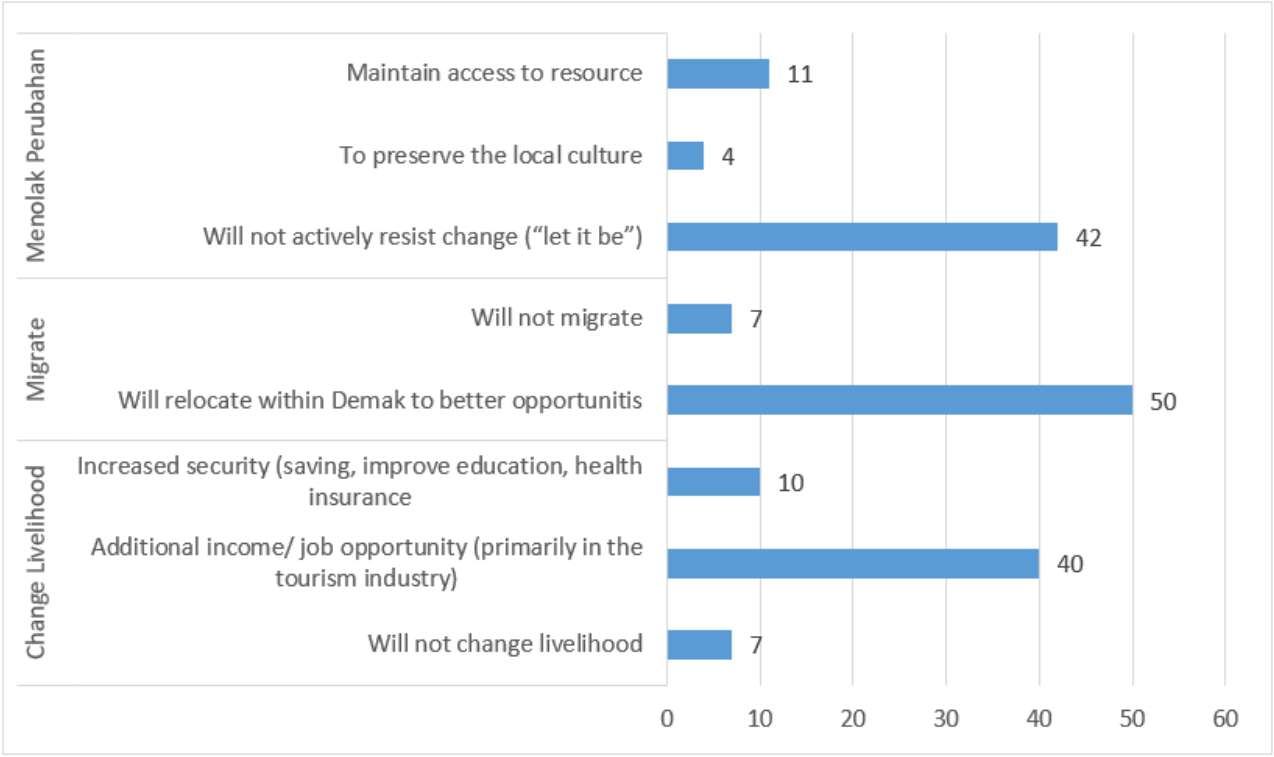

Figure 4. Fishers Responses Regarding Adaptive Capacity (semi-structure interview n=57)

Based on Figure 4, it shows that more than 50% of respondents chose to adapt by having another job or additional income, namely being involved in tourism development at Tambak Bulusan Beach. Given the ongoing fluctuations in income in fisheries, and the continuous decline in fishery catches over the past ten years, fishers are choosing to change their livelihoods to provide security and a steady income for their families. (Berkes, 2007). As many as 50 respondents stated that they would not move from that location even though changes had occurred on the grounds that they had lived in that location for a long time and no longer had the capital to move from that location. Most respondents admitted that they could not reject the changes that were taking place. However, 11 respondents rebelled to maintain access to resources.

Connectivity in a social system is measured by how easily resources and information can be exchanged, with varying levels of connectivity influencing the system's adaptive capacity and resilience. To deal with the changes occurring in the Demak coastal area, especially in Tambak Bulusan Village, the community can adapt in the form of improvements. connectivity, reflected in the growth of local associations, awareness, frequency of meetings, and use of social media. This connectivity helps them deal with change.

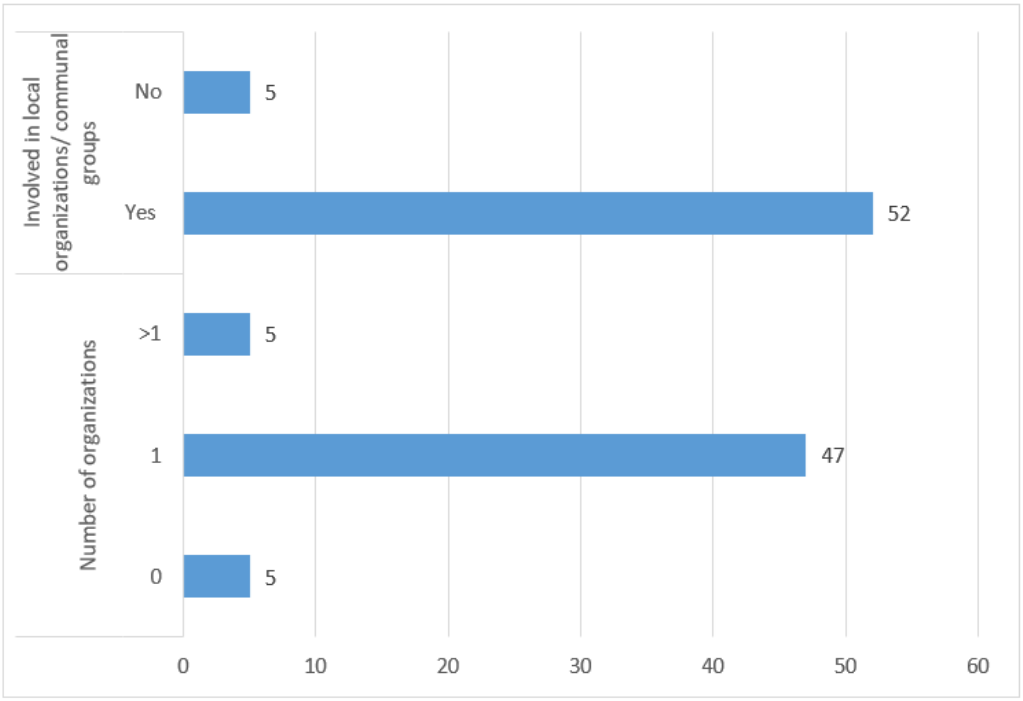

Figure 5. Small-scale fishers' responses are related to local connectivity (n=57).

Based on Figure 5, it shows that as many as 52 respondents are involved in local organizations, and as many as 47 respondents are members of 1 organization as a suggestion for fostering connectivity, namely fishers groups. By joining fishers in fishers 's group organizations, they hope to gain social support, access to resources, and a collective voice that strengthens sustainable management and improves fishers 's welfare and competitiveness. Collaborative capacity refers to the ability of stakeholders such as community members, leaders, and government to work together in a coordinated manner with a shared understanding to ensure system functionality. To see the form of collaborative capacity, respondents were asked about their involvement in decision making for managing natural resources and society.

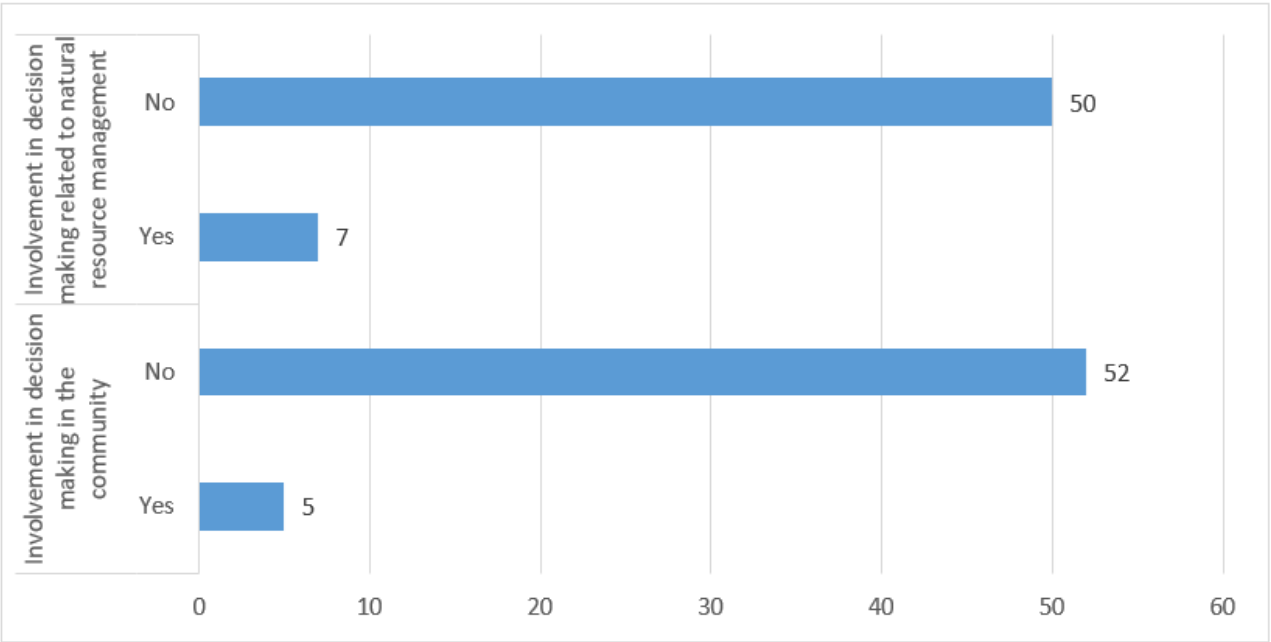

Figure 6. Respondent involvement in decision making (n=57).

Based on Figure 6, it shows that the majority of respondents are not involved in decision making, both community decisions and natural resource management decisions. The low involvement of respondents in community decision making and natural resource management in Tambak Bulusan shows dependence on local authorities.

Table 2 are reserve by small-scale fishers in TambakBulusan Demak. Reserves are surplus capital available in the form of natural, economic, and social resources that help societies face change or difficult situations, with the importance of awareness of these reserves as they support system diversity, resilience, and readiness.

Table 2. *Reserve* by small-scale fishers (n=57).

Category		Frequency
Income	< Rp 2,7 Million	13
	>Rp 2,7 Million	44
Asset	Land	54
	Boat	57
	Motorcycle	50
Household equipment	Gas stove	50
	Television/radio	51
	Fan	53
	Refrigator	36
Utility access	Electricity	57
	Water pum	57
	Toilet	54
Roof Material	Tile	44
	Metal	13
Wall Material	Cement/Brick	47
	Wood/ Plywood	10
Floor Material	Cement	33
	Tile	10
	Soil	9
	Wood	5

Respondents have an average monthly income of more than IDR 2.7 million, this means that the respondent has an income above the Demak Regency UMR, which is the minimum wage standard determined based on basic needs. The majority of respondents also own assets such as land, boats and motorbikes, as well as household equipment. Respondents' access to utilities is also good, because many fishers have this access. Although the materials of respondents' houses such as roofs, walls and floors vary, Learning Capacity in system adaptation refers to the ability to acquire the knowledge and skills necessary through training or experience to maintain system functionality, and can be learned at the individual or household level to address issues of injustice. Learning capacity can be seen from how respondents communicate to exchange information as shown in Figure 7.

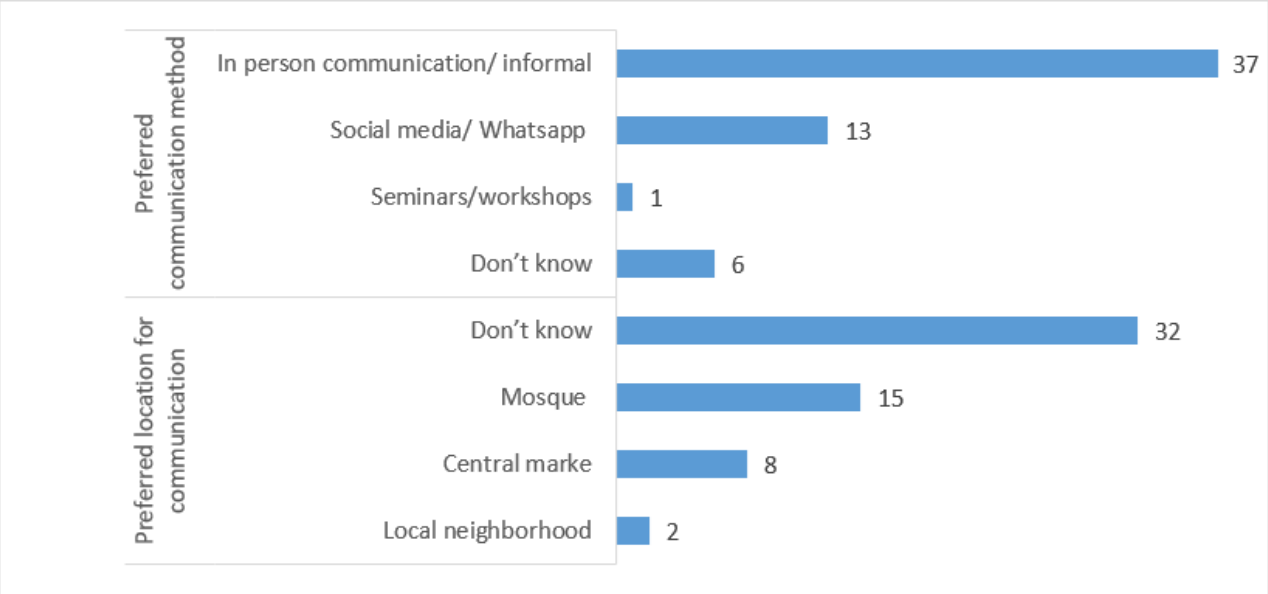

Figure 7. Respondents' preferences in communication and learning capacity (n=57).

Respondents communicate a lot with the surrounding environment by means of face-to-face communication/informal chats. Informal communication is one of the most effective ways of communication for fishers in Tambak Bulusan which enables the exchange of knowledge and coordination needed to face changes and challenges.

Adaptive Strategy Through a Co-Management Approach

Stakeholders in fisheries resource management are defined as individuals, groups or organizations that in one way or another have a mutual interest, are involved or are affected (positively or negatively) by certain actions that hold considerable political and/or economic influence in the use of the resource [35]. Stakeholders are more relevant when referring to groups and/or organizations that have an interest in a system. We can call stakeholders "actors" which include groups and/or organizations that have interests and influence in a system that has certain goals [36, 37].

Table 3. Actors in the coastal management of Tambak Bulusan, Demak Regency.

Actor	Indicators	Actors
Academicians	• Provide contributions and recommendations on study results • Community development • Providing direct assistance for mangrove restoration efforts • Providing direct assistance to improve the local community's economy	• Universitas Diponegoro
Government	• Providing facilitation assistance for equipment to support local economic development	• Department of Fisheries and Maritime Affairs Demak Regency • Environmental office Demak Regency
Community	• Strengthening local institutions to strengthen communities and improve the local economy • Facilitate access to obtain assistance from external parties (academics or government)	• Fishers group • Village Supervisory BoardKelompok Sadar Wisata
Business	• Business development towards community empowerment	• Travel agent • Fish Processing Business • Processing mangrove business • Hotel or accommodation • BumDes

Coastal management in Tambak Bulusan is supported by four elements: A-B-C-G (*Academician, Business, Community, and Government*) [36]: academician supported by several nearby universities such as Diponegoro University. Academician supported by several nearby universities such as Diponegoro University Tambak Bulusan. Supported by the government, the Demak Tourism Department and the Maritime Affairs and Fisheries Service which provides facilitation in both local economic development and mangrove conservation. In addition, the community also has an active role in preserving mangroves and bridging knowledge across all levels of society to provide an understanding of the importance of preserving coastal and marine ecosystems. The community, through a group of business activists, is also trying to develop mangrove tourism, either through collective self-sufficiency or applying for assistance to the government. Lastly, business, which is strengthened by raising awareness of the need to preserve coastal ecosystems and realizing that it is important to develop the local economy so as to increase people's income. Figure 8 shows the implementation of the Role of Stakeholders in the effectiveness of abrasion prevention.

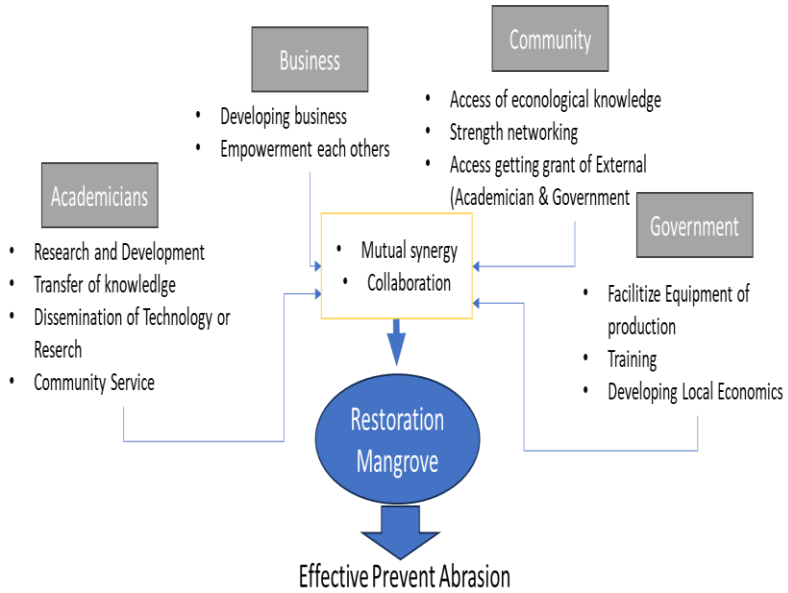

Figure 8. Implementation of The Role Stakeholders in The Effectiveness of vulnerability to viability strategy

The vulnerabilities faced by the TambakBulusan Demak community are climate change, the potential for abrasion, rising sea levels, and small-scale capture fisheries practices that are not environmentally friendly. Based on [38] facing changes that trigger vulnerabilities by understanding how fishers or rather how organizations respond to pressures that affect their communications. Organization in this case does not refer to one formal institution, but includes various actors in coastal management stakeholders. Based Furoida et al. (2021) Stakeholders are more relevant when referring to groups and/or organizations that have an interest in a system. Based on Table 3 dan Figure 5, There are four elements of actors involved, namely academics, business, society and government. These stakeholders have roles and responsibilities in achieving strategic goals created by a policy or system or governance [39]. Efforts to achieve these strategic goals are driven by interrelated interests, ending in interactions that influence and are influenced [36].

Academics have a special role in developing research and disseminating research results on mangrove restoration, local business development, and transferring knowledge regarding environmentally friendly extractive practices (both aquaculture and capture fisheries). while business has a major role in strengthening the importance of preserving marine and coastal ecosystems through developing local businesses and strengthening the local economy. while the government has a major role in providing funds, guidance and facilitation in managing coastal resources and developing local businesses. Finally, communities have almost the same role as businesses, namely strengthening the reasons for the importance of maintaining sustainability through the transfer of knowledge so that they have awareness of environmental sustainability and the formation of social capital to support collaboration with other stakeholders. One way to deal with vulnerability is through stakeholder cohesion which requires cooperation [36]. A properly integrated system will create successful resource management; starting from the community's ability to realize collective action [40].

A coastal management system involving four stakeholder elements can be an improvement over the community-based management concept which fails to accommodate rapid changes in factors that influence resource demand. [41]. Community-based management does not have sufficient capacity to manage common property rights [42]. Co management with the involvement of indicators to highlight key performance [35]

Table 4. Co-Management Stakeholders.

No	Key Performance	Indicators	Evaluation (Grades 1 to 10)			
			Academicians	Business	Communities	Government
1	Clear management boundaries	The managed area has different physical boundaries so that the public can know it	10	10	10	10
		Communities can understand and observe boundaries based on existing ecosystems	10	10	10	10
		The community uses nature in accordance with the agreed limits	10	10	10	10
2	Membership needs to be determined	Only people who are members have the right to utilize natural resources in restricted areas	10	10	10	10
		Members participate in coastal management (mangroves)	10	10	8	6
		The number of members is not too large because it can limit effective decision-making	7	7	7	7
3	Group cohesion	The managed area is close to residential areas	10	10	10	10
		High level of homogeneity (familial, ethnic, religious, customs, beliefs, ideology)	10	10	10	10
		Understand the problem, strategy and results (coastal/mangrove management)	10	8	4	8
4	Existing organizations	The community already understands the traditional community-based system	8	4	8	8
		The community already understands the existence of the organization	10	10	10	10
		There are communities that are representatives of stakeholders and resource users who participate in fisheries management	10	10	10	10
5	Benefits over than costs	Compliance with community-based management exceeds the cost of instruments	7	7	7	7
		There is hope from individuals that comes from participation	10	10	10	10
		Individuals obtain greater returns from the capital spent.	8	4	4	8
6		People who gather information about marine and coastal resources also make decisions about management arrangements	8	10	10	8

No	Key Performance	Indicators	Evaluation (Grades 1 to 10)			
			Academicians	Business	Communities	Government
	Participation from influential communities	Management settings largely affect the individuals who create and change their settings.	10	10	10	10
		Individuals understand and are affected by the rules that are drafted.	6	4	8	6
7	Enforcement of management rules	All members of the community can carry out law enforcement and monitoring	6	4	4	6
		All members of the community understand the rules in theory and their application.	6	4	4	6
8	Legal Right to Organize	The government has regulations to define and clarify responsibilities and authorities	6	4	4	6
		Legal rights are owned by organizations/groups in making and regulating regulations according to their needs	6	10	10	10
9	Cooperation and leadership at the community level	Actively the community has the will and incentive to participate (money, time, energy, money) in the management of forest resources	10	10	10	10
		In the management process, there is a group of individuals who have responsibility in leadership	10	10	10	10
		The most appropriate form of cooperation here is:				
		1) Implementation of coaching and training activities	10	10	10	10
		2) Deliberation	6	4	4	6
10	Decentralization and delegation of authority	The government has established policies/regulations for the decentralization of administrative functions	10	10	10	10
		All members of the community can carry out law enforcement and monitoring	1	3	2	4
		In delegating authority/responsibilities is well structured.	4	6	6	4
11	Coordination between the government and the community	Coordination in monitoring management arrangements, conflict resolution, strengthening the enforcement of local regulations by taking a partnership approach, coordination is carried out by:				
		a) Local Government	8	8	4	10
		b) Community	8	6	4	7
		c) Academicians	10	10	10	10
		The partnership approach will facilitate coordination between stakeholders	10	10	6	8
		The partnership approach facilitates monitoring management and conflict resolution from different levels of stakeholders	9	4	7	9
Average Score			**8.35**	**7.85**	**7.68**	**8.35**
Category			**Very High**	**High**	**High**	**Very High**

Assessments from academics, business people, the community and government show that in general all groups rate several key performance indicators related to community-based natural resource management highly. The community already understands the existence of the organization, even the public understands traditional community-based systems less than academics and the government. From the indicators benefits over than costs has mixed reviews, with some feeling individual returns are still not optimal. The participation of influential communities is also highly valued by academics and business people, but the public has a slightly different view. Cooperation and leadership at the community level rated 'very good', even though the implementation of deliberation is considered low by the community and business people. Decentralization and delegation of authority well received, however law enforcement by community members is still a problem. Last, for indicator Coordination between the government and the community, we can see disparity in assessment, with the public rating it lower than academics, indicating challenges in establishing effective coordination. Overall, there are several areas that require improvement, especially in enforcement of regulations and increased coordination between government and communities.

Co-management identified in Tambak Bulusan described as "co-*management as a State-nested system*". Meanwhile, private actors may be trusted to manage or use state-owned resources. [43]. Co management in Tambak Bulusan show that division of power and responsibility between governments, local resource users and academics show good value to stakeholders, especially on indicators of clear boundary management and community leadership. although there are still challenges in enforcing regulations, community participation, and coordination between

government and society. Improvement efforts are needed, especially in law enforcement, equitable participation, and increasing public awareness and understanding of the importance of sustainable natural resource management. Result for table 4 show that the goals for co-management: there is active collaboration between stakeholders who have their respective roles in monitoring, assessing and enforcing resource management plans [44] has been quite successful in coastal management in Tambak Bulusan.

CONCLUSION

Coastal areas, such as in Tambakbulusan, are dynamic and productive ecosystems, but face various environmental challenges such as sedimentation, climate change, land subsidence, and pollution which are exacerbated by human activities. Many small fishers in this region have low incomes due to inadequate fishing technology, environmental damage and climate variability. This research aims to analyze socio-economic ethnography in Tambakbulusan, investigate coastal vulnerability, and explore adaptation and mitigation in dealing with resource and community vulnerability in coastal areas. This study also attempts to formulate an adaptive strategy through a co-management approach. This approach shows a division of responsibilities between government, local resource users, and academics which provides positive value, although there are still challenges in enforcing regulations, community participation, and coordination between government and community. The findings show that co-management in Tambakbulusan has succeeded in building active collaboration between stakeholders to monitor, assess and enforce resource management plans. However, there needs to be improvements in law enforcement, equitable participation, and increased public awareness of the importance of sustainable natural resource management.

Future research should focus on a few key areas to build on the findings from this study: Further research could explore how the potential for introducing sustainable fishing technologies and alternative livelihood options for small fishers. Research could focus on how technological advancements can alleviate poverty, improve incomes, and enhance environmental sustainability. Examine the long-term effects of the co-management approach, particularly how sustainable practices evolve over time in response to changing environmental and socio-economic conditions in Tambakbulusan.

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