Article

Vulnerability Analysis of Small Fishermen's Household Livelihoods in Tegal City

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Abstract

Small fishermen are known for being very dependent on fluctuating fish resources and the nature of open access fisheries which together cause resource degradation, poverty and marginalization. The problems of small-scale fisheries include low economic performance and limited ability or expertise in facing global pressure, including climate change. Based on the problems faced by small fishermen as described, it is certainly a separate danger on the fishermen's livelihood system which causes the livelihoods of small fishermen to be more vulnerable. The purpose of this study was to analyze the level of vulnerability of the livelihoods of small fishermen's households. This research used quantitative methods supported by qualitative data. The study was conducted in Muarareja Sub-Districts, Tegal City, Central Java. This study was conducted using a livelihood vulnerability index questionnaire and in-depth interviews. Data was collected from forty respondents. This study found the fact that small scale fishermen both top and bottom layer in Muarareja village in which this study was conducted was not too vulnerable (resilient). However, they have a fairly good adaptive capacity with the use of capacity by using the livelihood capital optimally upper layer fishermen tend to use physical and financial capital to carry out exploitation and spatial strategies. On the other hand, the lower layers of fishermen mostly use their social capital such as affiliation with groups, high trust and patron-client systems based on moral economy.

Keywords

adaptation; small scale fishermen; livelihood; vulnerability

INTRODUCTION

Climate change is a global phenomenon that has a negative impact on living systems and the level of vulnerability, especially for those who live in coastal area. The society vulnerability is closely related to the level of poverty and adaptability. The level of vulnerability for a climate change is very different from one region to another, even though they are in the same country (Liverman 2007; IPCC 2014). The priority level is related to conditions and complexity of exposure (Climate change exposure), community sensitivity and their ability to adjust (Metzger 2006; IPCC 2007). The low understanding of fisheries about climate change puts them in a risky position such as the climate change that changes their livelihood systems (Su-

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bair et al. 2014).

Fishermen live in an uncertain environment. The uncertainty that has become the characteristic of fishermen's life is rooted in the physical and social conditions in which the fishermen's activities take place. The sea is a physical environment where fishermen are looking for fish or other marine biota that are not easily caught because they move around or migrate according to the season (Indrawasih and Wahyono 2009). Fishermen are considered as a population group that is very vulnerable to changes in terms of environmental and weather conditions because they only rely on fish resources that are volatile and their availability depends on nature. In addition, fish resources are common resources and open access as a source of their income. Fishing is full of uncertainties such as the inability to maintain the access to the fishing grounds or fish stocks and uncertainty in patterns or environmental / natural factors that affect the abundance and quality of fish in local waters.

Many factors affect the vulnerability in a particular place and point of time (situational). The factors that influence the vulnerability of fishermen's livelihoods can be weather conditions, fishing area, fish stock availability; including also due to major changes such as changes in fish prices, global climate change, institutional changes, social capital, market shifts, changes in policy regimes. (Chen and David 2015). In fact, there may be tens or hundreds of factors that contribute to the vulnerability.

Small fishers are functionally vulnerable groups, meaning rural people who are not economically safe and are very sensitive to external changes such as market inaccessibility, high transportation costs, low infrastructure provision (roads and communication networks) and poor public services (health, education). (Jazairy et al. 1992; Bene 2009). They are also marginalized because socioeconomic, geographical and political conditions receive less attention from decision makers (Pauly 1997). Marginalization can be observed from the lack of access to credit, infrastructure conditions and poor physical capital in rural areas. However, on the other hand, fishermen do not consider themselves to be poor as long as they have access to fisheries because they can obtain food and basic needs from fishing, even if they are vulnerable to danger and pressure (Salas et al. 2007).

The problems of coastal fisheries management that can be identified by Sudharmo (2016) in Tegal City are as follow: (1) overfishing, (2) damage to the marine environment related to coastal environmental degradation, and (3) low income levels of fishermen. This assumption appears because of the increasing number of fishermen causing a decline in fish productivity. Therefore, hazard exposure, such as the increasing number of fishermen and overfishing conditions in the waters of Tegal City is capable of causing can cause vulnerability to the livelihoods of small fishermen in Tegal City. Vulnerability (vulnerability) is the degree of a system that undergoing loss due to exposure to a hazard and interference or pressure (Turner et al. 2003 in Berkes F 2007). The formulation and key parameters of vulnerability are stress / pressure faced by the household livelihood system, its sensitivity (sensitivity), and adaptive capacity.

The framework in this study is adapted from Ellis's research framework (2000), Dharmawan (2007), Hahn et al. (2009) by identifying the sources of exposure that have occurred in the location of the study then analyzing the vulnerability of fishermen's livelihoods assessed from three indicators, namely exposure, adaptive capacity and sensitivity. To deal with vulnerability and maintain the continuity of their livelihood, each fisherman's household will adopt a different strategy according to its ability to utilize and access livelihood capital. Therefore, this study wants to try to answer the main question, "What is the level of vulnerability of small fishermen's household livelihoods and how is the strategy carried out by small fishermen households in addressing livelihood vulnerability?"

METHODS

The location of the study was conducted in the village of Muarareja, Tegal City, Central Java Province, Indonesia. The location was chosen because this village is a typical small-scale fishing village on the coast of Tegal City. Most of the Muarareja villagers work as small-scale fishermen. This research was conducted between July 2018 and January 2019.

The unit of analysis in this study is small fishing households. The criteria for the sample are fishermen's households which have lower layers with vessels with a capacity of 5-7 GT and fishermen households with upper layers with 8-10GT vessel capacity. The sample respondents were 40 small-scale fishermen who worked around the Muarareja area. Thus, the research method used was purposive sampling. The research paradigm used is post-positivistic. Primary data collection in this study used a questionnaire adopted and modified from the research of Hahn (2009) and Azizi (2017).

The questionnaire contained information on respondents' profiles and questions consisting of questions relating to the vulnerability of fishermen's livelihoods in terms of the percentage of exposure, adaptive capacity and sensitivity of livelihoods of fishermen's households. Supporting data or secondary data were also collected from government agencies such as the Muarareja village office, Tegal Barat sub-district office, Tegal City Statistics Bureau, Tegal City Marine and Agriculture Office. The data were analyzed using descriptive statistics. Determination of the level of vulnerability refers to the calculation of the Livelihood Vulnerability Index (LVI) of Hahn (2009). $LVI\text{-}_{IPCCd} = (e_d\text{-}ac_d) * sd$, where e_d is the calculation of exposure scores (exposure, danger-and threats to fishermen's livelihood of fishermen d; acd is the calculation of adaptive capacity scores (the average socio-demographic, livelihood strategies, and social network weight scores) of fishermen d and sd is the calculation of the sensitivity score of the community d. $LVI\text{-}_{IPCCd}$ is scaled from -1 (lowest vulnerability) to +1 (highest vulnerability) (Hahn et al 2009).

RESULTS AND DISCUSSION

Description of Objects of Study of Small-Scale Household Fishermen's Livelihoods

The livelihood systems of small fishing households are very dependent on the sea, aquatic resources and especially fish. It is known that the Muarareja Village community in Tegal City is a community whose majority of the livelihood is dominated by fishermen. From all of the respondents, only 20 percent had other side jobs such as farm laborers, stalls, builders and cleaners in fish storage warehouses in Tegalsari Village. The contour of the village of Muarareja is lowlands that are directly adjacent to the north Java ocean, the contour of the dike and mangrove forests. There is no agricultural area so that the livelihoods of the households of Desa Muarareja automatically depend heavily on the fisheries sector. The educational background of the fishermen in Muarareja Village, Tegal City are mostly graduated from Elementary School (SD). The average age of the fishermen in the village of Muarareja is still in the productive age of 41.23 years old. The average experience of working as a fisherman is 25 years old. Agunggunarto (2011) stated that the high level of experience affected the number of catches because they were able to recognize the catchment area well. The average age of fisherman crews is in the productive age range. According to Firdaus et al. (2013) it shows their ability to work harder and be able to accept and understand and adopt new innovations/technologies easily and quickly.

The fishing gear mostly used by small fishermen in Muarareja is around (trammel net), Bubu (crab fishing gear), "waring" nets and fishing rods. The ships used are motor boats. Bottom layer fishermen only have 1 boat engine while upper layer fishermen have 2 engines. Every small fisherman household in Muarareja Village is on average recognizing that they do not have a fixed income every month. The income of fishermen is very dependent on the conditions of

the season. The number of trips to the sea in one month depends on the season calendar (Table 1).

However, climate change and demands for repaying bank loans sometimes also affect the number of fishing trips of the fishermen in Muarareja Village, Tegal City. At present, the uppermost fishermen go on sail for 3-4 days per trip. While some of the lower layers are daily fishermen (8-10 hours of fishing) and some are fishing for 1-2 days per trip. This is done in order to obtain maximum results or at least reach a "capital cap". The profit sharing system between ship owners and Ship Fruits (ABK) for these small fishermen is 50:50 after deducting the cost of supplies. This means that 50% to the owner and the remaining 50% is divided by the number of ABK owned. The catches obtained by top fishermen are directly sold to the trader. Muarareja Village only has 2 big traders who are also the ship owners / bosses as well. Meanwhile, lower-level fishermen sell their catch to TPI in the "neighboring" village in Tegalsari TPI. This is because TPI Muarareja is currently inactive because it is only used for auctioning small types of fish such as rebon and anchovies.

During the western season, the majority of bottom layer small scale fishermen are out of work or they would fix their fish nets. However, their wives would help the family financial matter by working as laborers in a salted fish fillet business. Some also sell snacks, groceries and open food stalls in the outskirts of Muarareja beach. While upper layer fishermen in which most of them owned fishing gear and are equipped with 2 machines, they are not too affected by the waves so they will still go to sea even though the weather conditions are not conducive.

Exposure conditions in Tegal City and the Vulnerability Level of Tegal City Small Fishermen's Livelihoods

Exposure describes events or potential hazards/stress levels that can influence a system of livelihood (Hahn et al. 2009). The livelihood systems of small fishing households are very dependent on the sea, aquatic resources and especially fish. Therefore, it is very clear if climate change and weather are sources of exposure for the livelihoods of small fishermen. In addition, sources of exposure that have the potential to be a source of vulnerability to the livelihoods of small fishermen in Muarareja Village, Tegal City are the conditions of the waters in Tegal City that have shown symptoms of overfishing. This is indicated by the increase in the number of fishing boats and the decline in fishermen's catches. According to BPS Data from Tegal City in Figures from 2015 to 2017, the number of fishing vessels totaling 635 in 2015 and increased to 877 vessels in 2017. In addition, when viewed from capture fisheries production in Tegal City tended to decrease, namely 27,451,503Kg in the year 2015 fell to 22,095,171Kg in 2017.

Exposure experienced by fishermen households in Muarareja village is quite high. One of them is the high competition between the fishermen and the tight catching area of fishing operations due to increasing numbers of fishermen. This then has an impact on the pattern of increased exploitation which then triggers conflicts between fishermen due to frequent friction between fishermen. Conflicts that are often experienced are due to the interconnection between fishing gear. This form of conflict is like an act of stealing fishing gear. This action is suspected to be frequently carried out by Arad fishermen. Besides, Arad fishermen fellow are also inseparable from conflicts such as connections with arad's fishing gear due to the limited fishing area, causing damage to fishing gear. However, for the same-sex case Arad only ends up in an argument. Kinseng (2007) states the potential of capturing fisheries resources in Indonesia will tend to undergo an increasing number of scarcities. Therefore, conflicts among fishermen will increasingly occur and will become much brutal concerning the issue of livelihood. Sources or exposure to economic aspects such as limited capital or the desire to do vertical mobility will cause the fishing households become entangle in debt or loans.

The processed results of LVI data obtained from the LVI formula = (value of ex-

posure - adaptive capacity value) x sensitivity value can be seen in (Figure 1). It is known that the lower layer fishermen households (0.04) are more susceptible to livelihoods to the exposure faced by upper-layer small fishermen households (-0.03).

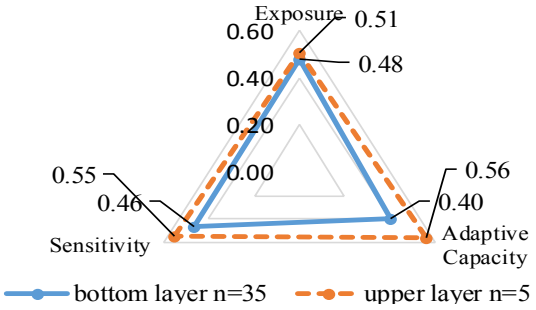

Figure 1. Small-scale household Livelihood Vulnerability Index (LVI) Graph of Desa Muarareja, Tegal City in 2019 (Source: Primary Data Processed 2019)

Based on the results of the LVI calculation, when a comparative analysis of the vulnerability index in other studies is conducted, for example, the vulnerability index of the local fishermen in Subang Regency studied by Azizi (2017) is 0.459. Meanwhile, the vulnerability index of farmer households in the Amalia study (2016) found that the highest value of LVI was 0.72 and the lower layer was 0.66 in the surrounding forest in East Kalimantan. Wahyuni (2016) also calculated the vulnerability index for paddy farmer households in the Central Timor Regency to obtain a value of LVI 0.398 for Boronubaen Village and 0.412 for Taunbaen Village. Thus, overall the value of LVI of small-scale fishermen households in both the upper and lower layers in Muarareja Village, Tegal City is included in the low level of vulnerability or sufficiently resilient. Therefore, in general, from the results of this study it can be said that fishermen households in coastal areas are more resilient than farmer households in critical areas.

The Adaptive Capacity Level of Muarareja Village Fishermen's Households

Adaptive capacity is the ability of the system to adjust to pressure (Hahn et al. 2009). This self-adjustment is made available by a fisherman household. The description of the sources of income of small fishermen households in the upper and lower layers of Muarareja Kota Tegal Village for on fishing, off fishing and non-fishing can be seen in Figure 2.

Box 1 illustrates that small-scale fishing households in Muarareja village have several other sources of income to support their livelihoods. Therefore the TKR and PAD households were able to survive in facing the existing pressure exposure.

Box 1. Small Scale Fishermen's Household Economic Adaptation Strategy in Muarareja Village, Tegal City

In TKR households, the wives helps to meet the needs of the family by working as salted fish processing laborers. The wage for female processing salted fish laborers is usually around Rp. 20,000-35,000 / day. Their working time is from 7.00 a.m until 5.00 p.m. (the local time). The work is done 3-4 days a week. In addition, other income was also obtained from the effort to open a shop selling snacks and daily necessities (groceries) and food stalls on the shores of Muarareja with the average income around Rp. 100,000 - Rp. 150,000 per day. Meanwhile, some fishermen whose children have already worked will get monthly remittances from them. Like PAD who is a fisherman with a 5GT boat, PAD goes fishing every day (10-12 hours) with an income of IDR 50,000 - IDR 100,000 per trip. In the western season (October - January), he is just out of work or just fixing his net. However, he has a child who works as an ABK laborer on the Trawl Ship in a neighboring village (Tegalsari) whose income is also quite large at Rp. 35,000,000 per two months. Besides that, at the end of each year the fishermen who are members of the Joint Business Group (KUB) will definitely get basic food assistance worth Rp. 300,000 - Rp. 500,000.

Source: TKR (45 years), PAD (60 years)

Based on the data on the graph of the fishermen's income sources, it is known that upper-layer fishermen households have a high dependency level of fish resources, while small fishermen households with lower levels of deployment tend to be lower.

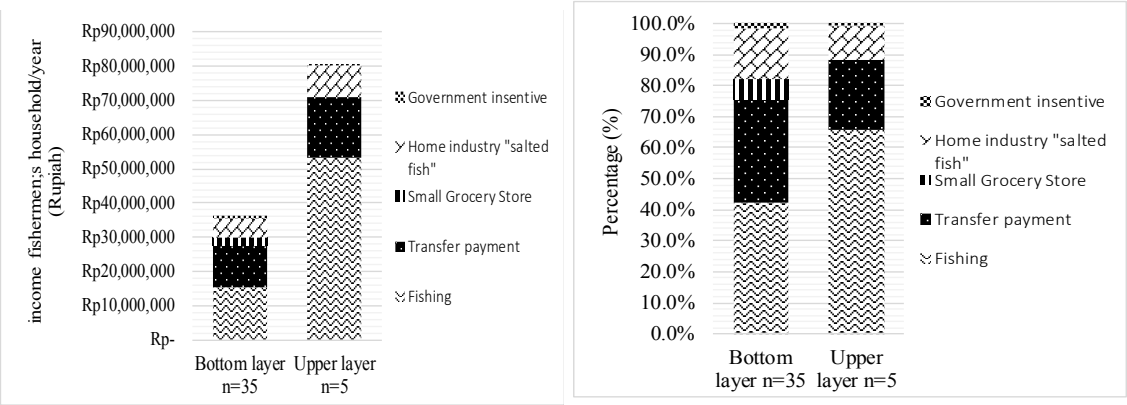

Figure 2. Structure of Household Income for Small Fishermen in Muarareja Village, Tegal City in 2019 (Source: Primary Data 2019).

This is because the largest source of income for small fishing households in the upper layers is dominated by the results of fishing. The ownership of physical capital is quite well-managed by small upper-level fishing households, such as good boat conditions, fishing gear and available capital, will eventually increase their adaptability to avoid high friction between ships and catching more fish by going further farther. Adaptive ability using capital or physical facilities for fishermen is quite good. Many fishermen already have mobile phones for communication between fishermen, usually to communicate with each other when to go out to sail. Utilization of TPI Muarareja is still not optimal until now TPI Muarareja only operates for the auction of small fish, rebon and shrimp. Therefore, there are also many fishermen who choose to directly sell to middlemen / collectors and some sell their catches to TPI in neighboring Village, Tegalsari TPI.

Lower-level fishermen households utilize social capital more. During the famine season, a number of lower-level fishermen households utilize the network they have to move to other vessels that remain at sea. The use of social capital in the livelihoods of small fishing households in Muarareja Village is quite optimal in increasing the adaptive capacity of fishermen. High solidarity can be seen from the system of cooperation, teamwork between ship owners and crew members at the time of fishing. Although the management of tasks in small-scale fishermen has not been clearly specialized, they all do their work together and are not hindered by social status (owner and crew). Box 2 illustrates that social adaptation strategies are the most dominant strategic choice for each small-scale village fisherman household Muarareja, Tegal City.

Box 2. Household Strategies for Small-Scale Fishermen in Muarareja Village, Tegal City
Village social activities, mutual cooperation in the Muarareja Village environment still exists apart from the cooperation when fixing the net. Another example is when there are fishermen who have an interest or want to recondition their house, they say they will help each other. Fishermen are also like humans in general like social beings who cannot live without others. This is reflected in the relationship between payable accounts between fishermen for daily life in the dry season or for urgent needs such as when children are sick. Although the fishermen's debt is not large, it is around Rp. 100,000 - Rp. 300,000 for daily needs. These receivables owed by fishermen are usually carried out by ABK to the owner of the ship (skipper), this happens because there has been a close relationship between each other meaning considering them like a close relative. In addition, this will keep the crew from moving to another ship. The participation of fishermen in fishing groups also makes it easier for them to obtain assistance from the government, such as fishing gear, ice boxes, diesel fuel and other fishing equipment. The system of providing assistance takes turns because of the large number of members in one group. Source: SKN (50 years)

The condition of the use of social capital by lower-level small fishing households is in accordance with that described by Scott (1976). As far as a patron (a large ship-rich household) protects his clients (poor fishing households) in rural communities from economic and food difficulties in bad months, the patron will be considered as a good protector. The patronage relationship that exists between fishermen in Muarareja Village is still based on morality. Therefore, as stated by Mirajiani et al. (2014) that the relationship can provide guarantees for the client's livelihood is relatively broader.

Sensitivity Level (sensitivity) Households Small fishermen in Muarareja Village, Tegal City.

Sensitivity is the extent to which the system will respond to changes, both positively and negatively (Hahn et al. 2009). The level of sensitivity of small fishermen households in Muarareja Village, Tegal City is quite high. The sensitivity is assessed from food needs and ship ownership. Fisherman households are very dependent on the fish they catch. Small fishermen households in Muarareja Village, almost all fishermen sell all the fish they catch directly or in the form of fresh fish. This is done because the nature of the product is easily damaged. So that when the catch decreases, or the condition is not so fresh, it will affect the income of the money used to fulfill their basic needs including food.

Many fishermen claim to want to do vertical mobility. The vertical mobility was done by stopping being crew members and then having their own boat. Funds are obtained from the results of loans from banks with guaranteed land and house certificates. However, it is known that

The impact of the increasing number of vessels in addition to exacerbating overfishing conditions is that many fishermen admit the difficulty in finding crew members. Increasing the number of ships, the competition between fishermen is also higher so that it indirectly affects their productivity.

Sociological Vulnerability Analysis and Strategy for Livelihoods of Small-Scale Fishermen Households in Responding to Vulnerabilities.

Livelihood strategies are formed from the ability of each household to combine the livelihood capital that they have and can access. Here are the livelihood strategies done by small fishermen households by activating some of the livelihood capital they have (Table 2). According to Steward and Micklin-Poston (1998), the whole series forms a livelihood system that is divided into four elements POET. The population, the increasing number of fishermen in Tegal waters has triggered social conflicts due to high competition and friction between fishermen. The Social Organization is then utilized to minimize conflicts and other exposure. Technology in the form of fishing gear owned by fishermen households is then modified or reproduced to increase competitiveness. The environment in this study is the oceans and fish resources in which they become the main source of their livelihood.

The sources of livelihood capital that are able to maintain the livelihoods of fishermen and reduce the vulnerability of their livelihoods are presented in Table 3. Social capital is an important component in a fishermen's livelihood system. Social capital is able to reduce transaction costs to work together, and facilitate cooperation. This reduces production costs and increasing adaptive capacity through building trust in which it can build a belief that working together will be mutually beneficial (Allison and Ellis 2001; Allison and Horemans 2006; Standford et al 2014).

Table 2. Fishermen's household livelihood strategy to address livelihood vulnerability

Social Layer	Exposure	Livelihood capital is activated	Strategy carried out
Upper layer fishermen household	The high competition between fishermen	Physical capital takes the form of ownership of ships and machinery with far greater conditions and capacities	Spatial Strategy: migration looks for a further catchment location
	Bank loan dependents must be repaid	HR capital in the form of the ability of HR personnel who are still in the productive age with sufficient experience.	Exploitation strategy: Increases the duration of capture time per trip
	Weather and climate factors	Physical Capital: Ownership> 1 type of fishing gear owned	Technology strategy: Replacing fishing gear, adjusting the type of game in season.
Bottom layer fishermen household	Weather and climate factors	Social Capital: utilizing trust in kinship ties and neighbor networks	Social Strategy: Some who choose to keep going to sea with a ship that is still operating. For those who are unemployed, to meet their needs they will owe their neighbors
	The high competition between fishermen	social capital: Limited capital causes them to continue to go to sea in local water locations with minimal results	Social Strategy: kinship ties and neighborhood networks can minimize conflict, patron client relationships minimize the cost of repairing tools because they are repaired with joint labor
All social layers of the Muarareja Village fishing households	Risk of going fishing	Social Capital: affiliation in groups of fishermen and cooperatives. Media for mutual sharing, ease of obtaining assistance and organizing a tradition of local trust	Social Strategy: take advantage of the sea / Labuan alms tradition. Which contains elements of local belief that by offering sea as well as establishing one village fishermen's solidarity is also a form of application for safety

Source: Primary Data 2019

Table 3. Source of resilience for small fishermen households in Muarareja Village, Tegal City

Source of resilient	Upper layer Fishermen's HH	Bottom layer Fishermen'sHH
Social Capital	Affiliation in groups & cooperatives	Participation in groups
	Power as a patron	Bonds of kinship
		Patron client relation
		High of Trust
Social Status	Mastery of greater physical and financial capital	
Internal &eksternal resources	The quality of human resources	The quality of human resources
	Remittance	Job Opportunities
	Bank loan	Remittance

Source: Primary Data 2019

CONCLUSION

Based on the results of the analysis that has been carried out, it can be concluded that:

The level of vulnerability of lower-income fishermen households is higher (0.04) than upper-layer fishermen households (-0.03). The difference in the level of vulnerability is caused by differences in adaptive capacity, but both are still in the range of low levels of vulnerability scale. The existence of strong social ties because of the

existence of trust values and social organizations (groups of fishermen and cooperatives) as the foundation of the fishermen. In addition, the existence of patronage between fishermen who are still based on the moral economy provides a guarantee of the livelihood of small fishermen to be larger / wider.

The livelihood vulnerability that shook fishermen's livelihoods was responded to by lower-level fishermen households using social strategies. This means that they are building stronger social capital to activate other livelihood capital. While upper-level fishermen households respond to the exploitation and spatial strategies where they build stronger physical capital to multiply and accumulate other livelihood capital.

From the above conclusions, the researcher has some suggestions that through this LVI analysis approach it is hoped that it can be applied as a practical tool for governments and development organizations to increase saving capacity to reduce sensitivity and evaluation of capture areas to reduce exposure faced by fishermen.

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