

# Analysis on the Livelihood Vulnerability of Lift Net Fisher Households, Tapanuli Tengah, Sumatera Utara

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**Abstract** - Fishermen are a group of people whose livelihood is very dependent on the condition of the marine ecosystem. Ecological damage in their waters caused by the impact of climate variability and illegal fishing activities causes their livelihoods to be threatened. This research uses a mixed research approach, namely quantitative and qualitative. Quantitative data was obtained through surveys of respondents with the help of questionnaires while qualitative data was obtained through in-depth interviews. The research found that lift net fishing households were in a vulnerable condition with a value of +0.23. This research also reveals that fishing households implement natural resource-based and non-natural resource-based livelihood strategies. These efforts are made so that fishermen can live and exist in society.

**Keywords:** Climate variability, fishing household, illegal fishing, lift net, livelihood vulnerability, livelihood strategy

## I. INTRODUCTION

Fishermen live in an uncertain environment. The uncertainty comes from the physical and social conditions where the fishermen live [1]. The sea is a place where fishermen carry out fishing activities and their productivity is influenced by climate change and non-climate change [2][3]. Climate change causes irregularities in rainfall intensity and sea surface temperatures [4]. Irregular rainfall intensity and changes in seawater temperature affect fish availability.

Fishermen generally live in coastal areas, areas close to the location of their fishing activities. This region is very fragile due to frequent storms and typhoons which result in environmental degradation and subsequently affect the income of many community groups, including coastal fishermen [5]. The increase in fishermen's vulnerability is not only due to climate change but is also influenced by agricultural and industrial practices that ignore sustainability aspects [6]. Wrong government policies in fisheries resource recovery also make fishermen vulnerable [7]. Illegal fishing practices have a real impact on reducing the income of traditional fishermen [8].

Fishermen are a community that is vulnerable to ecological change. Climate change and illegal fishing activities cause degradation of marine ecosystems that affect their livelihoods. This condition results in the vulnerability of fishermen's livelihoods. This research aims to examine the level of vulnerability of fishing households and livelihood strategies in response to exposure.

## II. METHOD

### A. Research Approach

This study conducted mixed research approaches, quantitative and qualitative. Quantitative data was obtained through a survey of respondents with the help of questionnaires. Qualitative data was obtained by in-depth interviews with informants.

### B. Place and Time

This research was carried out from July to August 2023. This research was carried out in Hajoran Village, Pandan District, Tapanuli Tengah Regency, North Sumatera Province.

### C. Selection of Respondents and Informants

Respondents were selected using a non-probability sampling approach. The respondent collection technique used a non-probability sampling approach. Respondents were selected based on their convenience and availability [9]. Respondents in this study totaled 45 people. The selection of informants in this research used purposive sampling. The number of informants was 5 people.

### D. Data Analysis

Quantitative data in this research was analyzed using the Livelihood Vulnerability Index (LVI) and qualitative data was analyzed qualitatively.

#### 1. The Livelihood Vulnerability Index (LVI)

LVI is an analytical tool used to calculate household vulnerability [10]. The LVI calculation begins by standardizing the index with a formula:

$$\text{Indeks sd} = \frac{Sd - Smin}{Smax - Smin}$$

Where Sd is the sub-component value, Smin is the minimum value of the sub-component and Smax is the maximum value of the sub-component. Next, the main component values are calculated using the equation:

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TABLE 1.  
DIMENSIONS, COMPONENTS AND SUB-COMPONENTS OF THE LIVELIHOOD VULNERABILITY INDEX (LVI)

Dimensions	Component	Sub-component
Exposure	Climate variability	Increased rainfall in the last 5 years Increase in wind speed in the last 5 years Increase in bad weather phenomena in the last one year Fishermen often experience problems in going to sea due to bad weather Sea trips have been reduced due to uncertain weather Lift net are often damaged in storms
	Illegal fishing	Fishermen in the last one year have seen trawling in the fishing ground area Some types of fish are difficult to find after the existence of trawl fishermen Coral reefs are damaged due to trawling Catches fell after trawling fishermen
Adaptive capacity	Natural capital	Mangrove conditions is good Utilizing mangroves Various types of fish caught Has an oil palm plantation
	Human capital	Family members work Family members work outside the fishing sector Fishing is not the main job for the head of the family Fishermen are in the productive age category Fisherman's education is more than 12 years Processing the catch
	Physical capital	Have more than one lift net Using more than one type of fishing gear Have a cell phone Have a motorbike Have a gold Own livestock
	Financial capital	Savings of more than IDR 3000,000.- Have a source of income outside the fishing business Receiving remittances from children or relatives (remittances) Accessing cooperatives/banks for business capital Recipient of government assistance
	Social capital	Solidarity between fishermen is still strong Once in debt to a fisherman Once in debt to a fishing boss Member of the fishing group
Sensitivity	Health	The household has a history of chronic pain Family members do not work/don't go to school because they are sick Family members do not have health insurance
	Human resources	Fishermen's income is below the minimum wage in Tapanuli Tengah Regency (IDR. 3,019,194.-) Less than 10 years of fishing experience Households depend on fishing businesses
	Food	Utilize part of the catch for personal consumption Difficulty obtaining clean water Household expenditure is more than 60% for food

$$M_d = \frac{\sum_{i=1}^n \text{Indeks } S_d}{n}$$

Where  $M_d$  is the main component value,  $S_d$  Index is the sub-component value,  $n$  is the number of sub-components. The next step is to categorize the main components into contributing factors to produce exposure, adaptive capacity and sensitivity values using the formula:

$$CF_d = \frac{\sum_{i=1}^n W_M M_d}{\sum_{i=1}^n W_M}$$

Where  $CF_d$  is the contribution factor (exposure, adaptation capacity and sensitivity) of household  $d$ ,  $M_d$  is the main component of household  $d$ ,  $W_m$  is the weighted value of each main component and  $n$  is the number of main components. The final step adds up the three contributing factors to the equation:

$$LVI-IPCCd = (ed - ad) * sd$$

Where  $LVI-IPCCd$  is the LVI of household  $d$ ,  $ed$  is the exposure value of household  $d$ ,  $ad$  is the adaptive capacity value of household  $d$  and  $sd$  is the sensitivity value of household  $d$ . Identify the level of vulnerability using a scale of -1 (resilience) to +1 (vulnerable) [11].

## 2. Qualitative Data Analysis

Qualitative data was analyzed using a qualitative data analysis model, namely data reduction, data presentation and drawing conclusions [12].

## III. RESULTS AND DISCUSSION

### A. General Description of the Research Location

Hajoran is a village in the Pandan sub-district, Tapanuli Tengah district, North Sumatera province. The astronomical coordinate point is located at  $1^{\circ} 11' 00''$  to  $2^{\circ} 22' 0''$  N and  $98^{\circ} 07' 0''$  to  $98^{\circ} 12' 0''$  E. This village consists of 4 hamlets with an area of 1.5 km<sup>2</sup>. The topographic conditions are lowlands and beaches with a land height and sea level of 11 MDPL. The area borders directly on the waters of the Indian Ocean so community activities that develop in this area are the fisheries sector.

The availability of clean water comes from Hill Water and the Regional Drinking Water Company [13].

### B. Population

The population is 3027 people with a population density per km of 2018 people. The population sex ratio

is 109, meaning that among 100 female residents, there are 109 male residents. Meanwhile, the population according to religion is 2,274 Muslims and 753 Christians.

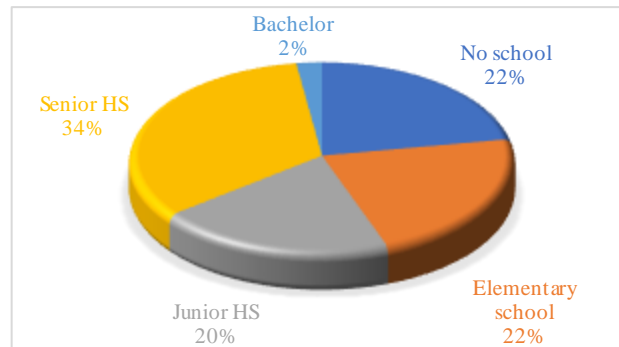


Figure 1. The Characteristics of Respondents Based on Education

### C. Infrastructure and Facilities

Based on the data obtained, the road condition is asphalt. Meanwhile, the only transportation facilities available are land transportation, there is already public transportation with fixed routes.

The village has 1 facility unit, namely Pelangi Kindergarten which has 64 students and 3 teachers. 1 unit of worship facilities, namely the Silaturahmi Hajoran Mosque. Non-Muslim residents usually carry out their worship in neighboring villages or Pandan City.

TABLE 2.  
THE RESPONDENT CHARACTERISTICS BASED ON AGE LEVEL

Responden age	Frequency	Percentage (%)
Early adulthood (18-40)	14	31
Middle adulthood (41-60)	29	64
Advanced adulthood (61+)	2	5
Total	45	100
Minimum		29 years
Maksimum		63 years
Average		46 years

This village only has 1 traditional market with a semi-permanent building condition. This market only operates once a week and 4 times a month, namely on Thursdays. People are more familiar with this market with the term "onan kamis". Other economic facilities, namely 1 restaurant, 19 food and beverage stalls/stalls and 6 grocery shops. Communication infrastructure, namely 1 cell phone tower and 4 communication services that reach the entire village area with very strong signal conditions.

### D. Developing Village Index

The village index value in 2020 is 0.5021 [14]. Based on this index, this village is included in the underdeveloped village category.

### E. Respondent Characteristics

The education level of respondents in Figure 1 shows that only 2% graduated from college. Meanwhile, 34% graduated from Senior High School, 20% graduated from Junior High School, 22% graduated from Elementary School and 22% did not attend school. This condition indicates that the respondent's education level is relatively low.

The average age of respondents in Table 2 is 46 years. The age level is still in the productive category. Someone in their productive age will be able to work more

optimally and more quickly in accepting and understanding the adoption of the latest innovations/technology [15]. Apart from that, productive age is a period where a person can carry out various businesses to meet the living needs of his household. This means that it is easier for someone of productive age to carry out various sources of income as a form of the dynamics of the income strategy they choose.

Characteristics of respondents based on ethnicity, namely 36% are Batak. 29% are Bugis, 27% are Nias, 4% are Javanese and 4% are from other ethnic groups (Minang and Banjar).

The characteristics of respondents based on population status show that the majority or around 56% are immigrants, and the remaining 44% are natives. They come from areas in Indonesia such as Padang, Nias, Sulawesi, Pare-pare and Kalimantan.

Respondents' experience in going to sea or carrying out fishing activities is dominated by having sea experience of more than 10 years. Experienced fishermen will find it easier to carry out fishing activities because they already have local wisdom and can recognize fishing grounds well. A person who has worked as a fisherman for a long time, both as an owner and as a crew member, has a greater ability to identify sea conditions, understand how to maintain and repair ships and has a strategy to produce fish that is good in quality and quantity to increase his income.

TABLE 3.  
 LIVELIHOOD VULNERABILITY INDEX (LVI) VALUE OF FISHERMAN HOUSEHOLDS

Main Component	Main Componen Value	Dimension Score
<b>Exposure</b>		0.94
Climate variability	0.91	
Illegal fishing	0.98	
<b>Adaptation capacity</b>		0.52
Natural capital	0.54	
Human capital	0.54	
Physical capital	0.53	
Financial capital	0.32	
Social capital	0.72	
<b>Sensitivity</b>		0.54
Health	0.31	
Human resources	0.67	
food	0.65	
Livelihood Vulnerability Index (LVI)		0.23

*F. Analysis of Livelihood Vulnerability Index (LVI) Fishermen's Household*

Livelihood vulnerability is a condition where individuals or households experience pressure and shocks to the sources of livelihood they already have so that the sustainability of their livelihood is threatened [16]. Fishermen who use passive fishing gear have more vulnerable livelihoods than fishermen who use mobile fishing gear [17]. The results of the data processing were obtained by fishing households in a vulnerable condition (+0.23). Table 3 shows that the exposure index for fishing households is 0.94, while the adaptation capacity index is 0.52 and the sensitivity index is 0.54. Exposure to climate variability and illegal fishing activities has a real impact on fishermen's livelihoods. It is known that

the adaptive capacity value of fishermen is low because fishermen have not accessed and made maximum use of the five livelihood capitals they have.

*1. Exposure in Fishing Households*

Exposure is an event or potential hazard that can affect livelihood systems [18]. The intensity of exposure experienced by fishing households is a result of climate and non-climate impacts that affect fishermen's livelihood systems. Table 3 shows that the fisherman household exposure index value is very high, namely 0.93. The highest exposure comes from ecosystem degradation due to the impact of the use of trawl fishing gear in fishermen's fishing areas.

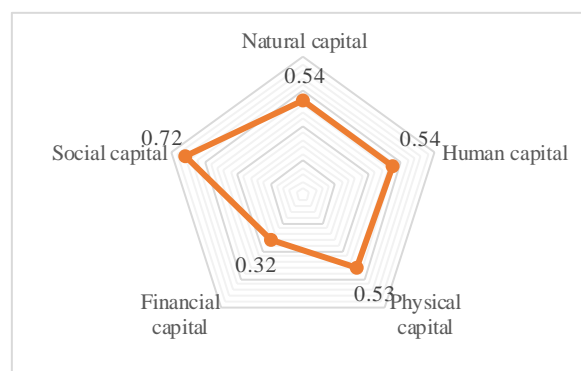


Figure 2. Control of Fishermen's Household Livelihood Capital

*2. Adaptive Capacity of Fishing Households*

Adaptive capacity is the ability of a system to adapt to pressure [19]. Adaptive capacity in this research uses five livelihood capitals, namely physical capital, financial capital, natural capital, human capital and social capital [20]. Based on Table 3, the value of adaptation capacity for Tancap fishing households is 0.52.

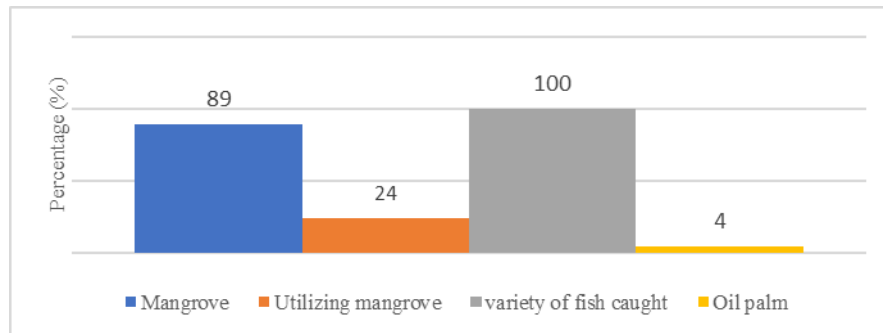
The natural capital that fishermen have as in Figure 3 is that the condition of the mangroves around their village is still maintained. Generally, fishermen access and utilize the resources available in the mangrove area

for fishing, looking for wood to support trees and house posts. Apart from that, fishermen who own land use it by planting oil palm as an effort to increase income.

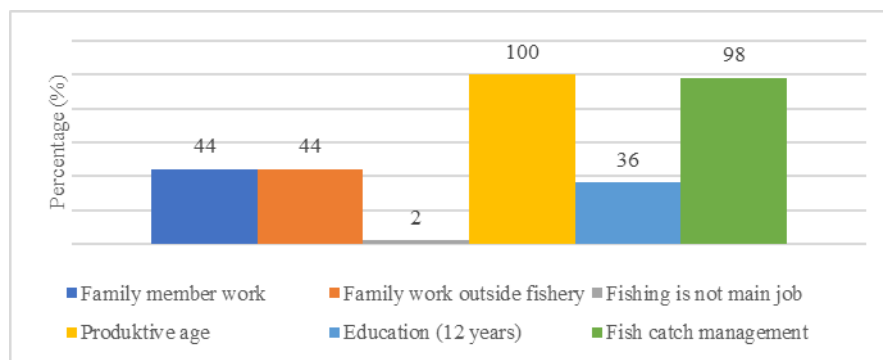
The human capital of fishing households is quite high. This can happen because almost all fishermen process their catch into dried anchovies (Figure 4). Processing the catch is one of the conditions so that the products they produce can be accepted by consumers. The process of boiling the fish is carried out for 5-10 minutes in a boiling device made from an iron drum, then the fish is dried in the sun for 6 hours. Fishermen realize that anchovies are a type of fish that is easily

damaged because they are small and rot easily, so they use traditional preservation efforts. The processing business carried out by these fishermen indicates that

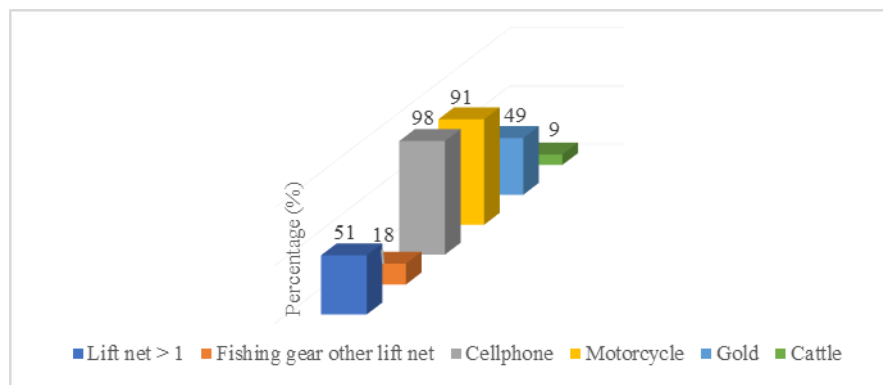
they have learned to produce products of high quality and value and provide durable/long-lasting products to consumers.



**Figure 3.** Control of Natural Capital in Fishing Households



**Figure 4.** Control of Human Capital in Fishing Households



**Figure 5.** Control of Physical Capital in Fishing Households

Based on Figure 4 also shows that all fishermen are of productive age. Fishermen who are still young and of productive age tend to be more open to innovation and new technology in the fishing industry. This can help them improve production efficiency and produce better results. Apart from that, in terms of access to financing, fishermen of productive age can more easily access the financing and resources needed to develop their fishing business. They can apply for loans or get assistance from financial institutions or the government to increase their production capacity.

In terms of physical capital, the majority of fishing households have cell phones for communication and also have motorbikes for transportation. Figure 5 shows that 51% of fishermen have more than one lift net and 18% of fishermen have other fishing gear besides lift nets (gill

nets and fishing rods). Fishermen who have more and more varied fishing gear have the opportunity to get higher catches than other fishermen.

Based on Figure 6 shows that the financial capital component index for fishing households has the lowest value. Several things cause the financial capital of fishing households to be low, namely low ability to save, a homogeneous livelihood structure, limited contributions from relatives who are outside the area when fishermen experience difficult conditions and the lack of fishing households receiving assistance from the government.

The social capital index of fishing households has the highest value compared to other capital, this is because the bonds of solidarity between fishermen are still strong. Ships are very important assets for the

sustainability of fishing businesses. In certain conditions, when a fishing boat is damaged in the middle of the sea, other fishermen who see it will volunteer to help and pull

the damaged fishing boat to bring it ashore. Strong bonds of solidarity can also be seen when fishermen protect each other's drying fish from cats and sudden rain.

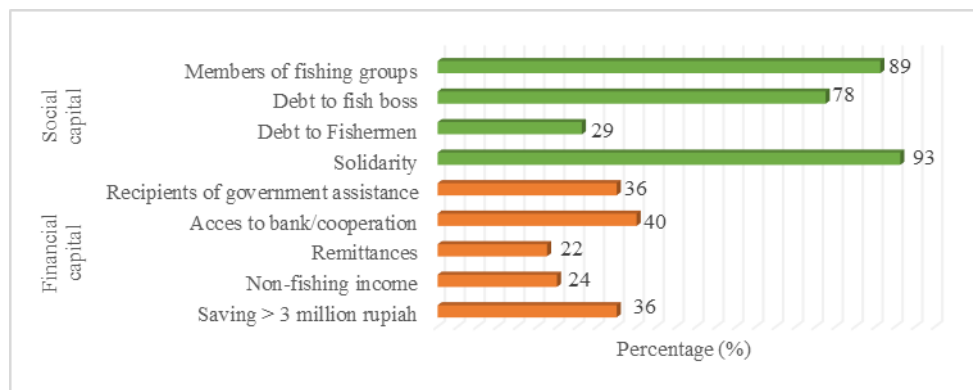


Figure 6. Control of Social Capital and Financial Capital in Fishing Households

### 3. Sensitivity of Fishing households

Sensitivity is the ability of a system to respond to changes, both positive and negative [21]. In the context of coastal communities, the higher the level of sensitivity in a system, the more vulnerable the system will be and the lower the level of sensitivity, the more the system will be able to withstand changes that occur [22]. In Table 3, it is known that the sensitivity index for fishing households is 0.54. In terms of the food component, the majority, or 76% of fishing households still depend on catches for daily consumption (Figure 7). The use of

caught fish for consumption will affect the sales revenue of fishermen's catches. Apart from that, regarding the food component, it is known that some fishing households still depend on water that comes from nature for their daily needs. During the dry season, which occurs from June to September, the availability of clean water will be very limited because water sources on the hills dry up. To meet their needs for water used for drinking, bathing and washing, they usually ask or buy water from neighbors who subscribe to the Drinking Water Company.

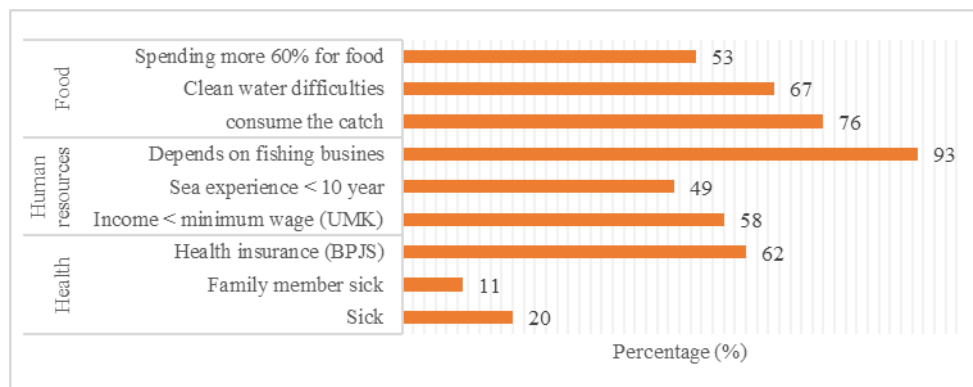


Figure 7. Components of Fishing Household Sensitivity

Rural households generally have low incomes so 60% of their expenditure is allocated to meeting energy (food) sufficiency [23]. Some fishing households spend their expenses allocated to food (Figure 7). This indicates the lower allocation of fishermen's income to savings. Saving is a positive activity that is useful as a way of dealing with risks resulting from disasters that require large funds. Fishermen who do not save will be vulnerable to disaster.

Based on Figure 7, it shows that 58% of fishermen have an income below the Tapanuli Tengah Regency Minimum Wage, which is IDR. 3,019,194.-. Fishermen's income is below standard, resulting in fishermen not being able to meet the needs of a decent living. In addition, low income causes limited access for

fishermen's children to education. Fishermen's children don't go to school because they don't have the money, resulting in fewer opportunities to escape poverty.

The health component index has the lowest value, this is influenced by the low number of fishermen and family members of fishermen who have a history of chronic disease. The level of fish consumption is high and fishing is a job that requires constant movement so that the body's metabolism runs well so that fishermen avoid the risk of chronic disease. The health of fishermen is important in supporting all activities in their lives. Poor health among family members is something that disrupts the functioning of the livelihood system because health problems hinder the ability of other family members to carry out their roles in earning a living.

Other family members have to spend time working because they have to take care of their sick family.

#### G. Livelihood Strategies Implemented By Fishermen

The uncertain income of fishermen due to the impact of climate variability and degradation of marine

ecosystems makes fishermen think hard about finding alternative income. They utilize and access livelihood capital to have a new livelihood. Livelihood strategies in this research are classified based on natural resources and non-natural resources.

TABLE 4.  
FORMS OF LIVELIHOOD STRATEGIES CARRIED OUT BY FISHERMEN

Natural Resource Base	Not Based on Natural Resources
<ul style="list-style-type: none"> <li>• Taking wood from mangrove forests</li> <li>• Palm oil plantation</li> </ul>	<ul style="list-style-type: none"> <li>• Grocery shop business</li> <li>• Processing wet fish into dry fish</li> <li>• Have more than one lift net</li> <li>• Diversify fishing gear such as gill nets and fishing rods</li> <li>• Raising local chickens</li> <li>• Depends on remittance</li> <li>• Depends on banks and savings and loan cooperatives for business capital and fishing gear maintenance capital</li> <li>• Depends on government assistance</li> <li>• Depends on loans to fish bosses for fishing operations</li> <li>• Fisherman's children work as company employees, motorbike mechanics and cell phone counters</li> </ul>

#### IV. CONCLUSION

Based on the Livelihood Vulnerability Index (LVI) assessment, the vulnerability value of lift net fishing households is +0.23. This value shows that they are in a vulnerable condition.

Fisherman households in facing income uncertainty make efforts to utilize and access the subsistence capital they have. The efforts in question are typologized based on their resource base. On a natural resource basis, fishermen utilize mangrove forest products and oil palm plantations. On a non-natural resource basis, fishermen open grocery stalls, raise local chickens, access banks and savings and loan cooperatives for capital for fishing businesses, diversify fishing gear and maximize the role of family members in earning a living.

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