Avalaible online at http://journals.ums.ac.id, Permalink/DOI: 10.23917/jep.v22i2.15569

Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi dan Pembangunan, 22 (2), 2021, 139-152

Sustainable Livelihood Framework Approach of Communities in Agricultural Sector of Middle Mahakam River, East Kalimantan Indonesia

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Received: August 2021 | Revised: October 2021 | Accepted: November 2021

Abstract

The Mahakam Watershed (DAS) supports various economic activities such as; coal mining, oil and gas mining, plantation activities, agriculture, fisheries and forestry. As a result of these activities, the Mahakam watershed experiences various problems, such as: water pollution and siltation. These impacts disrupt fishing and agricultural activities. Therefore, this study aims to analyze sustainable livelihood strategies for people who work as fishermen, fish farming and farmers. The sample in this study was selected using a purposive sampling technique, and to obtain data a structured interview technique was used through a questionnaire. Then data collected were analyzed using the Sustainable Livelihood Framework (SLF) approach. Based on the results of the analysis, the group of capture fishermen are at a low level of sustainable livelihoods, and groups of fish cultivators and farmers are at a high level of sustainable livelihoods.

Keywords: farmer; fisherman; Sustainable livelihood strategies; Mahakam River
JEL Classification: Q01, Q22, Q53, Q56

How to Cite: Gani, I., Gaffar, E. U. A., Muliati, M., Auliansyah, A. (2021). Sustainable Livelihood Framework Approach of Communities in Agricultural Sector of Middle Mahakam River, East Kalimantan Indonesia, 22(2), 139-152. doi:https://doi.org/10.23917/jep.v22i2.15569

DOI: https://doi.org/10.23917/jep.v22i2.15569

1. Preliminary

Mahakam River has major economic role in East Kalimantan because it is the cornerstone of the distribution of various products from upstream to downstream (Prayoga, 2016). In terms of ecology, the Mahakam Watershed (*Daerah Aliran Sungai* in bahasa) is an ecosystem in which there are biotic, abiotic and cultural activities that make this area very complex from upstream, middle and downstream due it is a unified system (Departemen Kehutanan, 2010). As a river ecosystem, this area is characterized by water fluctuations between the dry and rainy seasons which vary greatly throughout the year (Sulistianto & Erwiantono, 2015). The middle area of the Mahakam River or Middle Mahakam Area (MMA) includes Tenggarong, Sebulu and Kota Bangun areas, followed by the surrounding lakes (Lake Jempang, Lake Melintang and Lake Semayang called the Middle Mahakam Lakes (MML) (Christensen, 1992; de Jong, Ragas, Nooteboom, & Mursidi, 2015; Nooteboom, 2015) i.e. slow-flowing and faster-flowing rivers, lakes, small waterbodies and swamps. Water quality in large rivers was stable in the short but not the long term. In all other ecotypes variability was higher, with marked fluctuations being recorded in small waterbodies. A total of 147 indigenous freshwater fish species have so far been identified from the Mahakam. The zoogeographical consequences are discussed. Migratory patterns were inferred for four fish species, Helostoma temmincki, Leptobarbus hoe-venii, Puntius schwanenfeldii and Thynnichthys vaillanti.

Juvenile H. temmincki (< 3 cm SL. Currently the area has developed into several sub-districts such as Loa Kulu, Muara Muntai, Muara Kaman, Kenohan and Muara Wis Districts. These sub-districts are fed by the Mahakam River and its tributaries, including the Enggelam River, Belayan and Kedang Pela. Mahakam River and its tributaries as well as the lakes around it have a very large role for human activities who live or work in the vicinity. Along the river, you can find coal mining activities, plantations, wood molding companies, petroleum activities, shipbuilding, ports and fisheries. Mahakam River flow plays an important role as a transportation route (waterway) to transport the production results of these activities as well as a transportation route for transporting people (Hadibarata, Kristanti, & Mahmoud, 2020; Susilowati, Leksono, & Harsono, 2012; Tambunan, 2014).

This research focuses on two business sectors, namely fisheries and agriculture. Most of the people who live in the MMA area work as farmers, fishermen and fish farming. Farmers use the banks of the Mahakam River to grow crops such as corn, cassava, sweet potatoes, peanuts, soybeans and green beans. In addition, the farmers also grow vegetables and fruits such as: cucumber, chayote, long beans, watermelon, banana, jackfruit and papaya. Furthermore, people who work as fishermen and fish farmer take advantage of river and lake flows as fishing areas and areas for installing floating net cages (Departemen Kehutanan, 2010; BPS Kutai Kartanegara Regency, 2020).

Mahakam watershed is a habitat for various types of fish. Christensen (1992) mentions that there are 165 species of fish that live in the Mahakam River. Then various studies continued to be carried out in more specific areas such as the Mahakam River from Melak District to Samarinda City Kottelat 1995) found 174 species of fish. Furthermore, in Lake Semayang and Lake Melintang found 15 species of fish Haryono (2006), the mouth of the Kaman River and Lake Semayang are 19 and 25 species of fish, respectively (Nasution et al, 2008). In the middle to downstream Mahakam River 44 species of fish Suyatna et al, (2017), then the last research in the upper reaches of the Mahakam River 26 species of fish (Jusmaldi et al, 2019).

Between 2009 and 2013, the Mahakan watershed lost 128 thousand hectares of natural forest due to mining activities, Forest Concession Rights (HPH) and plantations, leaving 4.1 million hectares of natural forest or equivalent to 50% of the total area of the watershed (Prayoga, 2016). The impact of forest loss will affect the quality of water fertility as the forest area decreases as a source of nutrients. Furthermore, it will have an impact on decreasing river water discharge and silting due to high sedimentation at the riverbed. Currently the Mahakam watershed area continues to experience degradation caused by various economic activities. The form of degradation in the form of high concentrations of Polycyclic Aromatic Hydrocarbons (PHA) in the Mahakam River sediments exceeds the threshold set by WHO, PHA is dominated by human activities, if PHA exceeds the threshold it will cause cancer and damage aquatic ecosystems because it will cause mutagenicity in organisms (Hadibarata et al., 2020; Zakaria & Mahat, 2006). In addition to degradation in river flows, lakes also experience various problems due to fishing activities that are not environmentally friendly. Sulistianto & Erwiantono (2015) revealed that in the last few years, many problems began to emerge related to fishing and cultivation activities carried out by the community. The use of destructive fishing gear (stun and poison) and the availability of good quality fish seeds and the high price of feed are problems that are being faced by the community. In addition, there is silting and pollution of domestic waste in the lake which results in decreased water quality (Lombogia, 2016).

The environmental damage of the Mahakam watershed has an effect on the decline in the productivity of the fisheries sector in this region. As a result, it will have an impact on fishermen's income and threaten the sustainability of livelihoods for the people who live around them. Furthermore, the impact of this damage will have an impact on the opportunity for greater agricultural land clearing along with the continued decline in fisherman catches, because the agricultural sector is an alternative livelihood for the people

who live in this area. As a society that depends on the condition of the natural resources around it, of course, people need strategies to maintain their existence. There are various research approaches to see how the form of adaptation of individual and community livelihoods in the face of environmental change, from the various existing approaches, the Sustainable Livelihood Framework (SLF) approach is an alternative to approach the form of adaptation as a result of environmental changes based on assets owned by each individual. The SLF approach is suitable for use in the tropics (Ferrol-Schulte, Wolff, Ferse, & Glaser, 2013). Several studies using this approach include (Deswandi (2017) looking at the livelihood strategies of fishermen in coastal areas and river flows in Nagari Sungai Pisang, West Sumatra. Furthermore, Wijayanti et al, (2016); Yuniarti & Purwaningsih (2017); Sri & Febriamansyah (2019), each of which analyzes the sustainable livelihoods of fishermen in Lake Nagari Guguk Malalo, analyzes the livelihoods of farming communities in the Bengawan Solo watershed and analyzes household food security. The degradation of Mahakam River watershed threatens the sustainability of livelihoods for fishermen, fish farmers and farmers. Currently, there are not many studies that discuss the form of individual adaptation as a result of the degradation of rivers and lakes. Therefore, this study aims to analyze sustainable livelihood strategies for people who work in the fisheries and agricultural sectors who live on the banks of the Mahakam River and on the surface of Melintang and Semayang Lakes.

2. Research Methodology

2.1 Time Frame and Location

The research was conducted from August to September 2020 in two sub-districts of five villages located in two districts namely: Muara Enggelam, Melintang and Sebembang villages in Muara Wis District, and Muara Kaman Ulu and Muara Kaman Ilir, villages in Muara Kaman District. Map of the area can be seen in Figure 1.

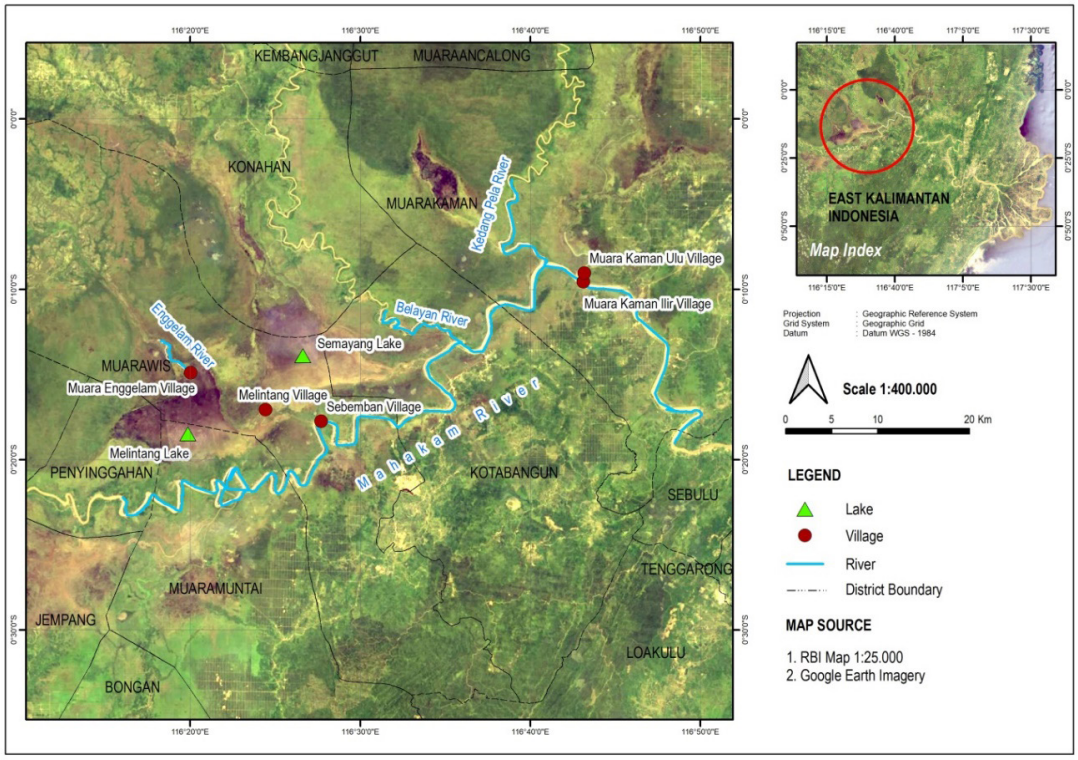

Figure 1. Research Location Map (adopted from Auliansyah et al (2021)

2.2 Types, Sources, and Methods of Data Collection

Data used in this reseach mainly primary data obtained from structured interviews using a questionnaire. The object of this research is the people who work in the fisheries and agriculture sectors. Overall, the respondents in the study were 42 people representing the entire research area, this number was considered representative because the conditions and characteristics were the same or homogeneous. Fishermen, fish farmers and farmers were selected purposively based on a certain consideration made by the researcher, depend on the characteristics that were previously known. The implementation of this purposive case selection is done by identifying all the characteristics of the object in a preliminary study related to the research topic. Respondents selected must meet the following criteria: i) work of fishermen, fish farming and farmers, ii) catching and cultivating fish as well as farming and living in the study area, iii) have equipment to do work (not hired one), and iv) have become fishermen, fish fish farmer and farmers for at least 5 years assuming they have experienced the degradation of the Mahakam watershed.

2.3 Data Analysis

The measurement of the sustainable livelihoods index (sustainable livelihood framework) in this study is based on the quantification of the sustainable livelihoods framework developed by the Department for International Development (DfID) and refers to (Krantz, 2001; UNDP, 2017). This measurement is based on the following formula:

$$f = \sum_{j=1}^{n} \omega_j X_j$$

Where f is the index value (0 f 1); n is an indicator on asset j (j=1,2,3, ...n); j is the weight for each indicator; and Xj is the coefficient of each calculated indicator. Based on this formula, the composite index for the five assets studied, namely natural assets, human resources, financial, social, and physical assets can be obtained through the following equation:

$$S = \omega_1 X_{natural} + \omega_2 X_{human} + \omega_3 X_{finance} + \omega_4 X_{social} + \omega_5 X_{physic}$$

Where S is the index of sustainable livelihoods; and is the index for each of the aforementioned assets (natural asset, human asset, finance asset, social asset and physic asset).

3. Results And Discussion

3.1 Characteristics of Research Sites

The population in the research location tends to be centralized and not spread throughout the village area. The areas between villages are separated by agricultural areas, plantations, lakes and rivers. This geographical condition also determines the choice of work that can be done by the surrounding community. In general, the main occupations of the people in the research location are fishermen and farmers. In addition, there are also people who work for plantation companies, mining companies, traders, and government employees. Of the five research locations, Muara Kaman Ulu and Muara Kaman Ilir villages are those with the largest population. As of 2018, the population in the two villages was 3,609 and 2,875, respectively. Although the population in Muara Kaman Ulu Village is bigger than in Muara Kaman Ilir Village, the population density level in Muara Kaman Ilir Village is higher than in Muara Kaman Ulu Village. This is because the area of Muara Kaman Ilir Village is narrower than the area of Muara Kaman Ulu Village. As for the villages in Muara Wis District, the population of Melintang Village is more than the villages of Muara Enggelam and Sebemban. The total population of this village is 1,726, 1,285 and 1,010, respectively. The details are presented in Table 1.

Even though the respondents are living in the same area, the research locations have their own geographical characteristics which affect the chosen occupation to make a living as presented in Table 1. The settlements of the residents in the villages of Muara Enggelam and Melintang are above the water so that the majority of people work as fishermen and fish farmers. Unlike the villages of Sebemban, Muara Kaman Ilir and Muara Kaman Ulu, the residents can work as fishermen and fish farmers and farming on the banks of Mahakam river. The characteristic of population based on the geographical area are shown in Table 2.

Table 1. Demography of reseach area

Villages	Districts	Population	Area Km²	Population Density/ Km²	Occupation (Subsector)
Muara Enggelam	Muara Wis	1.285	10.684	0,12	Fishery
Sebemban	Muara Wis	1.010	5.671	0,18	Farming &Fishery
Melintang	Muara Wis	1.726	16.488	0,10	Fishery
Muara Kaman Ilir	Muara Kaman	2.875	180	15,97	Farming & Fishery
Muara Kaman Ulu	Muara Kaman	3.609	340	10,61	Farming & Fishery

Source: BPS Kutai Kartanegara Regency Processed 2020

Table 2. Geographical characteristics of the research location

Village	Characteristic		
	Mahakam River Banks	Mouth of Sungai Kaman & Mahakam River Banks	Surface of the Lake & th Mouth of Enggelam River
Muara Enggelam			√
Sebemban	√		
Melintang			√
Muara Kaman Ilir		√	
Muara Kaman Ulu		√	

Source: Field observations

3.2 Sustainable Livelihoods Framework

Analysis of sustainable livelihoods for people who work in the fisheries and agriculture sectors in Muara Kaman and Muara Wis districts is classified into five assets, namely; 1) natural assets, 2) human resource assets, 3) financial assets, 4) social assets, and 5) physical assets. All the assets as a whole will provide information on how to sustain the livelihoods of fishing communities, fish farmers and farmers in the research area. The framework for sustainable livelihoods of people working in these sectors can be described as follows:

3.2.1 Fisherman

3.2.1.1 Natural Asset

Natural wealth has a major contribution in supporting human livelihoods around it. Natural assets in the framework of sustainable livelihoods are translated as human accessibility to natural resources such as rivers, seas, grasslands, forests and so on (Serrat, 2017). In addition, in the same context, natural assets are also interpreted as ownership of assets such as land, floating net cages, and the productivity of the land/cage plots produced. Fishermen in the two research areas are spread over five villages, namely Muara Enggelam, Sebemban, Melintang, Muara Kaman Ilir and Muara Kaman Ulu. All fishermen in this area can access fishing locations, namely the Mahakam River, Enggelam River, Belayan River, Kedang Pela River, Melintang Lake and Semayang Lake. These locations have a diversity of fish up to 174 species, both consumption fish and ornamental fish that have high economic value such as belida, bentilap, jelawat, toman, cork, and so on. There are at least 24 species of fish that live in the waters of the research location, but on average fishermen only catch 9 types of fish depending on the season and the dominant fish cycle at that time. The results showed that there were 45 percent of fishermen who caught fish in only one location (lake or river only) while the remaining 55 percent used both locations, both rivers and lakes. Overall, the index figure for natural assets in fishing communities is 0.27.

3.2.1.2 Human Resources Assets

Great natural wealth must be balanced with the ability of humans around it to take advantage of these assets. This ability is represented by skills, physical strength and health, as well as the experience of fishermen in developing livelihood strategies to remain sustainable. The indicators for compiling human resource assets in this study include age, fishermen's education, number of household dependents, health conditions, experience and working hours. The results of the study found that the average catch fisherman in the research area was 47 years old with the youngest fisherman being 25 years old and the oldest being 65 years old. The level of formal education that has been taken by the majority of fishermen is elementary school level with an average work experience of 22 years. The data shows that the number of dependents of fishing fishermen's families is an average of 5 people with the number of children who are still at school age an average of 3 people. The health conditions of the fishermen who are respondents in the study are generally in good health with several health complaints that are generally suffered by those entering middle age (hypertension). Apart from the health complaints submitted by respondents, it turns out that this does not affect the duration of work of fishermen, which is an average of 9 hours/day. Similar to the index obtained in the calculation of natural assets, in human resource assets the weighting of all indicators is known to be an index number of 0.27.

3.2.1.3 Financial Assets

Financial assets have an index number of 0.38 and represent the fulfillment of individual/ household needs derived from production elements supporting business productivity, salaries and wages, savings, debt, and so on. In this study, it is known that fishing fishermen have an average productivity of being able to catch fish as much as 14 kg/day, regardless of whether the type of fish catch has high economic value or not. On average, fishermen do not have a workforce but are assisted by 1 unpaid worker who is usually a member of the fishermen's household. The income of fishermen is very dependent on water conditions, namely the conditions of the lowest low tide, highest tide and from the highest tide to the lowest low tide (Auliansyah et al., 2021). The condition of these waters affects the number of catches so that it has an impact on the income of fishermen. This study found that fishermen have maximum income when the water is at high tide towards low tide, where fishermen can get a profit of Rp. 2,711,260 per day and income will drop drastically when the waters recede, where fishermen earn a profit of Rp. 7,126 per day. The average purchase and maintenance capital for fishing gear is Rp. 2,050,000 per year and the capital per capture is Rp. 38,000 to Rp. 250,000 per day, depending on the distance from the house to the fishing location. The percentage of savings ownership is stated by 10 percent of fishing fishermen, and 1 in 40 fishermen stated that they had applied for credit to a formal financial institution. The low savings are actually not only experienced by fishermen, but almost the majority of people in developing countries who have low per capita incomes. This happens because most of their income is used for consumption, especially for meeting basic needs.

3.2.1.4 Social Asset

Social assets consist of indicators that reflect how social activities of fishing communities are being utilized to achieve sustainable livelihoods. In general, social assets are intangible and cannot be measured because they are related to qualitative values but the benefits can be sensed. Indicators for social assets in this study include access to formal and non-formal loan/credit applications, involvement in groups/communities, and assistance from the government in the form of working capital and counseling/training. The results showed that 35 percent of fishermen had received counseling and training conducted by relevant agencies and non-governmental organizations, both counseling intended to increase fishermen's productivity and those related to the environment. As many as 37.5 percent of fishermen have received assistance from the government in the form of production inputs and/or capital assistance, whilst involvement in groups, almost half of the fishermen stated that they belonged to fishing

groups, associations, and other non-formal social groups. Interesting findings on this social asset indicator can be seen in the indicators of credit accessibility and external parties that are relied on during a crisis. In the credit indicator, only 2.5% of fishermen stated that they had applied for credit while the rest said they had never applied one. In some cases found in the literature, the limited accessibility of fishermen's credit could be caused by several things, such as difficulties in meeting the collateral requirements requested by banks, the absence of business financial reports, and so on. However, apart from these formal matters, there is a possibility that fishermen already have access to non-formal credit so that access to formal credit is not really needed. This argument is based on a response to a question about who to rely on during a crisis where 60 percent of fishermen will ask for help from their families, 13 percent of collectors, and 2.5 percent of landlord (*ponggawa*). This explains that among fishermen there is still a fairly high interaction of kinship relations with the calculation of the index number of 0.41.

3.2.1.5 Psysical Asset

The ability of households to collect physical assets that support fishermen's sustainable livelihoods is based on several indicators, namely vehicle ownership, capacity of fishing gear used, and the availability of roads and electricity in the area where they live. The index number for physical assets owned by fishermen in the study area is 0.50, the highest compared to other asset index figures. Based on vehicle ownership, fishermen who only have one type of vehicle (motorboat) are 40 percent, while the remaining 60 percent own two types of vehicles both two-wheelers and motorboats. In addition to vehicles, physical assets in the form of ownership of fishing gear are also taken into account as one of indicators of this asset. Fishing gear is classified into three categories: the fishing gear used includes modern, moderate, or traditional fishing gear. This classification is based on the minimal modification of the fishing gear used since the beginning of catching up to the present. The results of the study stated that 45 percent of fishermen in the area already use modern fishing gear, 17.5 percent of fishermen use fishing gear with a moderate classification, and the remaining 37.5 percent still use traditional fishing gear. Physical facilities and infrastructure such as the type of road used to the house/business location and accessibility to electricity. As a result, 40 percent of fishermen only have access to water (lakes and rivers) while the remaining 60 percent have access to land roads made of wood, and access to water (lakes and rivers). Furthermore, 80 percent of fishermen can enjoy 24-hour electricity in the research area, while the other 20 percent have limited access or less than 24 hours. The following is a pentagon diagram of the sustainable livelihood framework for capture fishermen in the study area.

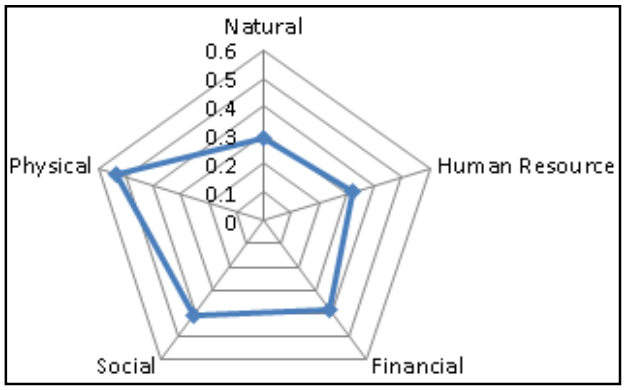

Figure 2. Fishermen Asset Pentagon

3.2.2 Fish Farming

3.2.2.1 Natural Asset

For fish farmer respondents, natural assets consist of indicators related to natural endowments that are owned around their place of residence and can be used to support sustainable livelihoods. The index number generated from this asset is 0.71 with the following indicators: 1) The village environment is located in water, land, or both; 2) Types of fish cultivated by fishermen; 3) Number of harvests per year; and 4) Harvest yields in each period. The survey results show that most fish farmers live in villages located in water areas and cultivate an average of 2 types of fish in their cages. Types of fish that are cultivated include carp, value, cork, and toman. The frequency of harvesting in one year is at least

twice and maximum five times, depending on the size of the cages and the type of fish cultivated by each farmer. Furthermore, it is known that the harvest per period of all fishermen is 1,377.5 kg with an average harvest per farmer of 68.9 kg.

3.2.2.2 Human Resources Asset

The indicators used to compile human resource assets include the age of fish farmer, education, number of household members, health conditions, and work experience. Overall the index obtained from the calculation for this asset is 0.72, higher than the same asset for fishermen respondents. Fish farmer in the study area are 38 years old on average, have a junior high school education, the average number of household members (household members) attending school is 1 person, with fewer household members dependent than fishing fishermen. Furthermore, it is known that there are 87 percent of respondents who do not complain about their health condition and the average length of work as fish farmer is 9.5 years.

3.2.2.3 Financial Asset

The sustainability of fish farmer's livelihoods seen from financial support is indicated by the number 0.73 with four compiling indicators, namely working hours per day, number of workers, total revenue for each harvest period, and ownership of savings as a representation of financial wealth. In the first indicator, the average working hours needed to manage cages is 4.8 hours with details of activities including spreading feed 2 to 3 times a day (depending on the type of fish being cultivated), cleaning cages, and monitoring nets/other equipment used. for business purposes. Based on answers from fish farmers, they do not use paid labor, but are assisted by other family members. Regarding the question of the revenue received, the average turnover per year is Rp84,012,500 with the lowest and highest turnover of cage fishermen Rp18,500,000 and Rp187,000,000. Furthermore, the percentage of fishermen who have savings is only 25% of the total research respondents.

3.2.2.4 Social Asset

The indicators for compiling social assets consist of four indicators, namely involvement in formal and non-formal groups such as farmer groups, associations and so on, counseling, parties to rely on during a crisis and whether they have ever received assistance from the government. These indicators are considered to represent social assets that support fish farmers to maintain their livelihoods with an index value of 0.40. Of the four indicators, there is one indicator that is not taken into account because the answers of all respondents stated that they had never received counseling from external parties. 25 percent of cage fishermen said they were involved in formal or non-formal social groups, while the remaining 75 percent said they were not in any group. Responses to questions from those who are relied upon during a crisis are almost balanced between families and collectors/ retainer. 60 percent said that they relied on their family and another 40 percent depended on collectors/ retainers when things went wrong in their business.

3.2.2.5 Physical Asset

The calculation of the index number for physical assets is composed of four indicators, namely the area of cage unit ownership, vehicle ownership, and the availability of electricity and road access with an index number of 0.66. Based on the survey results, it is known that the number of 2x3 meter cages owned by fish farmer varies between 6 and 20 cage units, and if the average number of cages for each fisherman is 10 units. Judging from the aspect of vehicle ownership, 10 percent of fishermen are known to have no motorized vehicles, both two-wheeled and motorized, 75 percent have motorboats as a means of transportation to their place of business, and 15 percent have two types of motorized vehicles, namely two-wheeled vehicles and motorboats. Accessibility to basic infrastructure is seen from the availability of roads and electricity for fish farmers. All fish farmer stated that they have a pretty good road access even though it is made of wood/bridge over the water. However, regardless of road accessibility, only 25 percent of fish farmer can enjoy 24-hour electricity infrastructure. The pentagon diagram of the fish farmer's sustainable

livelihood framework consisting of five assets can be seen in Figure 3.

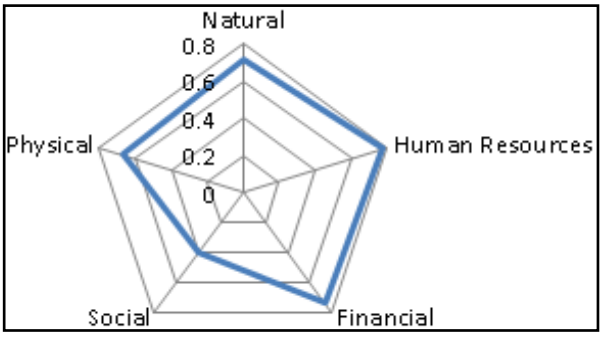

Figure 3. Fish Farming Asset Pentagon

3.2.3 Farmer

3.2.3.1 Natural Asset

For farmer respondents, natural assets consist of four indicators, which are the type of commodity planted, the area of land, the number of harvests per year, and the number of yields/production. Based on the results of data analysis, the index number generated for this asset is 0.62. The majority of respondents who work as farmers in this study live in Muara Kaman Ulu village, 30 percent live in Sebemban village, and the remaining 10 percent cultivate crops in Muara Kaman Ilir village. On average, farmers are cultivating 2 type of crops and fruits alternately depending on the growing season. The commodities planted include watermelon, cayenne pepper, melon, long beans, peanuts, eggplant, water spinach, rice and oil palm. Agricultural land ownership owned by farmers is on average 1 hectare with the number of times harvested and land productivity varies greatly depending on the commodities planted.

3.2.3.2 Human Resources Asset

Human resource assets are composed of several indicators, namely age, education of the head of a farmer's household, number of household members attending school, health conditions and years of being a farmer. Based on the results of the analysis, it is known that the index number for human resource assets is 0.62. Compared to other respondents' professions in this study, the average age of farmers tends to be higher, namely 43 years. Similarly, indicators of the number of household dependents and the number of household members attending school. The average for these two indicators is 4 people each with 2-3 people still in school. In terms of health, 20 percent of farmers have mild health complaints along with increasing age, namely hypertension and diabetes, while 80 percent of other respondents do not experience any health complaints. The profession as a farmer has been carried out by the respondents for quite a long time, varying from 3 to 30 years, but on average the profession as a farmer is carried out for more than 11 years.

3.2.3.3 Financial Asset

For financial assets, the calculated index number is 0.73 and consists of four constituent indicators, namely hours worked per day, number of workers, turnover per year, and access to credit. On average, farmers work 8 hours per day without hiring employees. All agricultural operations are carried out alone with unpaid workers who are members of the farmer's family such as his wife and children or other family members. The average number of unpaid workers in the operation of this farmer's business is 1-2 workers. The average business turnover per year is known to be Rp. 66.040.000,- with the percentage of respondents who have applied for credit to banks by 10 percent.

3.2.3.4 Social Asset

Similar to other groups of respondents, the index of farmers' social assets consists of four indicators, namely involvement in social groups both formal and non-formal, having received counseling related to business development or other counseling, parties to rely on during a crisis in life, and questions related to assistance from the government in the form of social assistance and agricultural business assistance. Based on the author's calculations, the index number for farmers' social assets is 0.56. Judging from the involvement of the group, 65 percent of farmers stated that they were involved in formal and social groups such as farmer groups and ethnic/religious associations, while the remaining 35 percent did

not belong to any groups. Involvement in formal or social groups is considered very important in supporting the livelihoods of farming communities because generally in communal activities such as this, important information related to business and society can be immediately known by every member of the group. Responses to questions related to government assistance noted that 60 percent of farmers had never received assistance from the government, while another 40 percent had received government assistance in the form of seeds and agricultural tools. The question regarding the existence of agricultural extension was confirmed by 45 percent of the respondents, while the rest stated that they had never received agricultural extension from any party. The next indicator is a reliable party when there is a crisis in farmers' lives such as crop failure or other events. In this regard, 50 percent of respondents said they would ask for help from their children, 45 percent would contact other families for help, and another 5 percent would ask for help from children or other families.

3.2.3.5 Physical Asset

The index figure for physical assets is 0.64 with several indicators making up the index, which are vehicle ownership, agricultural machinery ownership, distance from home to business location, as well as road infrastructure, electricity and telecommunications facilities. In the first indicator, it is known that all farmers have physical assets in the form of two-wheeled vehicles, while for the agricultural machinery indicator 60 percent of farmers do not use agricultural machinery, 5 percent use a sprayer, 30 percent use machines to help the harvest process, and 5 percent the rest use tractors to support agricultural activities. On average, farmers have to travel a distance of 4-5 kilometers to reach their agricultural land with the type of road being traversed in the form of dirt roads (farming roads), wood (bridges), or a combination of the two. In terms of electricity and telecommunications infrastructure, the village area inhabited by farmers has 24-hour access to electricity and a telecommunications network. However, this telecommunications network is still limited to telephone networks, not data, so internet access is still limited. The following is a pentagon diagram of the sustainable livelihoods framework for farmer respondents.

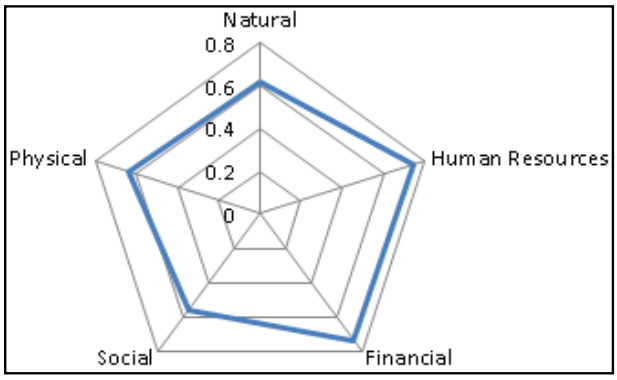

Figure 4. Farmer Farming Asset Pentagon

4. Conclusions

A sustainable livelihood strategy is intended as a combination of various means used by a person to still be able to achieve their livelihood goals based on their capabilities and assets. This strategy can be used to overcome short-term problems such as crop failure and climate change, or to deal with long-term problems such as preparing children to help their parents when they can no longer work. Households that have a lot of assets, both physical and other assets, tend to have more choices than households with limited assets. This has implications for the different adaptation strategies used between households in ensuring their livelihoods remain sustainable in both the short and long term. A review of the results of the study obtained the following conclusions:

a. Difference

The economic activities carried out by community in research area are highly dependent on nature, both those who live in water and land areas. The differences in livelihoods in fishing and fish farming communities are mainly in natural assets, human and financial resources, while physical and social assets have many similarities. In human resource assets, this difference is mainly seen from the average age, where fish farmer has an average age

of ten years younger than fishermen. This condition more or less affects the attitude of acceptance of innovation in technology and ultimately has implications for business productivity which is classified in financial assets. The relationship among indicators in human capital was also confirmed by similiar study in Malaysia where the factors of gender, age, educational achievement had significant relationships with the strategies construction among the youth (Yassin, Shaffril, Hamzah, & Idris, 2018). Within the environment context the finding of this study was in line with the work of some researchers in small scale fisheries in some countries. Environment in most study plays a major role due to the high dependency of those who work in agricultural sectors (Matiku, Zuwarimwe, & Tshipala, 2021; Su, Wall, & Wang, 2019). So that when the environment is polluted or damaged as the result of irresponsible human activities, it will seriously effect the livelihood of the community in surrounding area.

This study found that compare to the fishermen and fish farming groups of respondents, farmers have higher social assets. This circumtances might be related to the fact that farmers has higher involvement in formal and non-formal groups association so that various information on agricultural assistance, and/or technical counseling from the government can be immediately known by those who are members of the group. Other advantage of social involvement might be related to the financial access which allow the farmers to increase their productivity through access of credit mechanism (Kharisma, Remi, Hadiyanto, & Dwi Saputra, 2020; Misra, Chavan, & Verma, 2016; Parva & Moghaddasi, 2018)functional and regional distributions of agricultural credit during the decade. This study attempts to explore the relationship between agricultural credit and agricultural production/productivity. The state-level panel model attempted in this article suggests a positive impact of the intensity of agricultural credit on total factor productivity in agriculture. The impact was relatively stronger with respect to direct agricultural credit. A case study of the (combined.

b. Adaptation

All the responden group, i.e. capture and fish farming, and farmers have similar livelihood strategies in overcoming financial problems in term of reducing the risk of high dependence on natural assets. Some of the strategies adopted by those who work in the waters include processing the resulting product into other products with higher economic value such as dried/salted fish, fish fillets to be sold as a basic ingredient for making crackers, and renting boats. Other common activities found among those who work in the water are planting chillies, tomatoes and other horticulural plant. However due to the very small scale of economy and the sense of 'temporary' being these strategies was insignificant to fulfil the basic needs of the fishermen' household. Furthermore, due to the limited skill and lack of information about other field outside fishery then switching occupation to other work sectors is not an option. In contrast to the fishermen the farmers' coping strategies is utilizing the river/pond to maintain their livelihood, range from catch some seasonal fish to sell in the market, making fish farming ponds, and replacing crops that are more profitable in market. As stated in some studies there are various strategies in household to adapt to the natural life cycle and changes (Clay, 2018; Fang, Zhu, Zhang, Rasul, & Neupane, 2020; King, Nelson, & McGreevy, 2019; Reed et al., 2013). This study however found that the strategies used are only applicable in temporary basis and run in relatively small scale economy. The strategy of each household in the respondent group is highly dependent on the natural assets available around them, the current economic conditions and needs, the availability of capital and expertise, as well as on the size of the risk. Furthermore, the common characteristics of all these respondents are that the involvement of household members is very high in the selected activities and

these economic activities can change at any time according to need.

c. Vulnerabilities

The limited access of the community to infrastructure and research areas that are far from the center of the economy make people have choices whose economic resources are limited and highly dependent on the available nature. In this context vulnerability can also be interpret as food insecurity and poverty (Tuihedur Rahman & Hickey, 2020; Yaro, 2004). Although public infrastructure such as roads, education, and health are slowly being accessible, this does not necessarily reduce the vulnerability of the community. This study found that vulnerability of the community is mainly high when there is a change in seasons and river/lake water conditions. For fishing and fish farming, seasonal changes are interpreted as changes in productivity that can have implications for changes in income received, where when the water conditions are good, fish with high economic value will be abundant and vice versa. For fish farmer, water conditions have an impact on increasing costs to maintain the survival of fish kept in cages. On the farmer's side, natural conditions can also increase the vulnerability of life due to the limitations of the technology used. Crop failure either as a result of pest attacks and insufficient or too high rainfall can be one of the things that can put farmers in an unfavorable position.

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