ECSOFiM: Journal of Economic and Social of Fisheries and Marine. 2021. 08(02): 211-225 e-ISSN: 2528-5939
Permalink/DOI: http://dx.doi.org/10.21776/ub.ecsofim.2021.008.02.05

THE FISHERIES ECONOMY IN THE MAHAKAM RIVER: BENEFITS AND FACTORS THAT AFFECT IT

EKONOMI PERIKANAN DAERAH ALIRAN SUNGAI MAHAKAM: KEUNTUNGAN DAN FAKTOR YANG MEMPENGARUHINYA

Auliansyah[*1)], Yesi Aprianti[1)], and Andra Sulindrina[1)]

[1)] Development Economics Study Program, Department of Economics, Faculty of Economics and Business, Mulawarman University, Samarinda-Indonesia

Received: April 04, 2021 / Accepted: April 25, 2021

ABSTRACT

This study combines input variables and natural influences to measure fishing yields as productivity. The research was conducted in the central area of the Mahakam River watershed. The purpose of this study is to calculate the income of fishermen at each level of tidal levels and to analyse what factors that affect fisheries productivity. The research uses a mixed method analysis. The data used are primary data obtained by using a structured interview technique through a questionnaire to fishermen who live in the research location, the sampling technique of respondents using the purposive sampling technique. Data were analysed using profit analysis techniques and multiple linear regression. The results of the data analysis show that the highest profit for fishermen is when the conditions of the highest tide go to the lowest tide. Significantly, the fishermen's catch is influenced by two factors, namely the fishing location and their experiences.

Keywords: fisheries economy, productivity, profit, the fishermen's catch.

ABSTRAK

Penelitian ini mengkombinasikan variabel input dan pengaruh alam untuk mengukur hasil tangkap neyalan sebagai produktivitas. Penelitian dilakukan pada kawasan tengah daerah alisan Sungai Mahakam. Tujuan penelitian ini adalah melakukan klasifikasi fase kondisi fisik perairan selanjutnya menghitung keuntungan jangka pendek dan memproyeksikan faktor yang mempengaruhi pendapatan tersebut dalam jangka panjang. Penelitian ini menggunakan analisis *mixed method* dengan menggunakan teknik wawancara terstruktur melalui kuesioner pada nelayan dengan metode *purposive sampling*. Data dianalisis menggunakan teknik analisis keuntungan dan regresi linear berganda. Hasil analisis data menunjukkan, keuntungan tertinggi nelayan berada pada saat kondisi perairan pasang tertinggi menuju surut terendah. Secara signifikan, hasil tangkapan nelayan dipengaruhi oleh dua faktor yaitu lokasi penangkapan dan pengalaman nelayan.

Kata kunci: ekonomi perikanan, produktivitas, keuntungan, hasil tangkapan nelayan.

INTRODUCTION

The fisheries sector has an important role for Indonesia's development. The sector is one of the mainstay sectors capable of having an economic impact on society by providing employment and increasing foreign exchange through exports of fishery products (Bappenas, 2014; Warren and Steenbergen, 2021). Furthermore, fish resources are a source of food for Indonesia because 54% of the fulfillment of animal protein comes from fishery products (FAO, 2014). Indonesia's fishery production base comes from capture and aquaculture activities, these activities originate from marine and land waters.

[*] *Corresponding author: Auliansyah, auliansyah@feb.unmul.ac.id*
Development Economics Study Program, Department of Economics, Faculty of Economics and Business, Mulawarman University, Samarinda-Indonesia

Furthermore, WPPNRI are divided into two categories which are; Marine waters (WPPNRI-*Perairan Laut*/WPPNRI-PL) and WPPNRI Land Water (WPPNRI-*Perairan Darat*/WPPNRI-PD), marine waters are divided into 11 WPPNRI and land waters are divided into 14 WPPNRI. The division aims to facilitate supervision, classification, and follow-up plans for resource management in each WPPNRI (Koeshendrajana et al., 2019).

The WPPNRI-PD has regulated through the Regulation of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia Number 9 of 2020 concerning the WPPNRI in Land Waters. Based on this regulation, the territory of East Kalimantan's land water is in the WPPNRI-PD 436 which includes rivers, lakes, reservoirs, swamps, and / or other standing water. Observing these regulations, the research locations are included in the Mahakam River area and the sub-watershed areas including the Kedang Pela River, Belayan River, Enggelam River, Melintang Lake and Semayang Lake (Soetopo, 2007; Jusmaldi et al., 2019). These land waters have been used for a long time as a fishing ground by people who lives along the river and above the lake.

Various studies have been conducted to determine the diversity of fish in the East Kalimantan land waters. This research was carried out from the upstream to the estuary / delta area of the Mahakam River including the sub-watersheds and surrounding lakes. As research conducted by Christensen (1992) during 1982 to 1987 found 147 species of fish in the Mahakam River. Still in the Mahakam River, starting from Melak District in the upstream to Samarinda City in the downstream Kottelat (1995) found 174 types of fish. Then Haryono (2006) found 15 types of fish in Semayang Lake and Melintang Lake. Nasution et al., (2008) found 19 and 24 fish species in the Muara Kaman River and Semayang Lake. Furthermore, the latest resea rch conducted by Suyatna et al., (2017) found 44 types of fish in the Mahakam River from the middle to the downstream. Furthermore, the latest research conducted by Jusmaldi et al., (2019) found 26 types of fish in the upstream area of the Mahakam River. These research show that fish resources can be found along the Mahakam River and the sub-watersheds including the surrounding lakes. This presented clearly in Table 1.

Table 1. Number of Fish Species in Mahakam River

Research Sites	Number of Fish Species	Researcher Name and Year
Mahakam River	147	(Christensen 1992)
Mahakam River (Upper Melak District - Downstream Samarinda City)	174	(Kottelat 1995)
Semayang Lake and Melintang Lake	15	(Haryono 2006)
Kaman River Estuary & Semayang Lake	19 & 24	(Nasution et al. 2008)
Middle to Lower Mahakam River	44	(Suyatna et al. 2017)
Upstream of the Mahakam River	26	(Jusmaldi et al. 2019)

Source: Compiled from various sources, 2020

Observing the data presented in Table 1, it is known that there has been a decrease in the quantity of fish species in the Mahakam River. This fact is worrying, as it could threaten the livehood and the source of income to 3,707 fishery household whose make the Mahakam River as their fishing area. Mahakam River has a major role to East Kalimantan's community, the water is also used as a source of raw water. The Mahakam watershed and sub-watershed become transportation areas for transporting mining products, timber and people. In addition, it is also used for irrigation, fishery cultivation, sand mining, ports and shipyards. The Mahakam watershed has hundreds of tributaries which are used by rural communities and coal mining companies as a *waterway* (Tambunan, 2014).

As a result of the rapid human activity in the area, the concentration of *Polycyclic Aromatic Hydrocarbons* (PHAs) in the Mahakam River sediments exceeds the threshold set by WHO, that is, the total

average of PHAs reaches 604.99 ng/g (range=54.7–2256.15 ng/g) (Hadibarata et al., 2019). PHA predominantly due to human activities, if PHA exceed the threshold then it can cause cancer and damage aquatic ecosystems because it would cause mutagenic to the organisms (Zakaria and Mahat, 2006). The degradation which experienced by the Mahakam watershed and its sub-watersheds is also encounter by Lake Melintang and Dana Semayang. The silting and domestic waste pollution on the lake resulting in decreased of the water quality (Lombogia, 2016). The condition will be exacerbated with the use of fishing gear that is not environmentally friendly by fishermen in the form of stun and fish poison. Capture fisheries and aquaculture activities in both lakes continues to decline due to the use of gill nets and other intensive tools as well as limited cultivation seeds (Haryono, 2006; Sulistianto and Erwiantono, 2015).

Research with the topic of fisheries has been carried out from upstream to downstream areas, it is more dominant in downstream areas, namely the Mahakam River delta and estuary areas. From the various existing studies, it is still more focused on various topics such as: the potential of the Mahakam Delta, changes in mangrove cover as the impact of land conversion for aquaculture, management of fishery resources, the relationship between mangroves and fishery resources (Sidik, 2008; Zain et al., 2014; Abdunnur, 2019;). There is also research that discusses fishery productivity but technically has not touched on economic aspects (costs and benefits and is carried out in the Mahakam Delta region such as, research conducted by (van Zwieten et al., 2006).

Research that is more focused on the economic sector is important to do to determine whether the fisheries sector in the watershed is still profitable or not. Increasingly, higher fishing activity will lead to the increasing of fishing yields and fishermen's profits. Fishermen's contribution is not limited to labour and fishing equipment as capital, but this research is also conducted with a qualitative approach to measure factors that are thought to have an effect on the catches fish yield. Degradation in the Mahakam watershed and sub-watershed as well as Semayang Lake and Melintang Lake has an impact on the decrease of the number and type of catch, which affecting fishermen's income. Therefore, this study aims to calculate the profits of capture fisheries and see what factors that influence the number of catch besides the physical conditions of the waters that have changed due to climate change.

RESEARCH METHODS

Time and Location

The research was conducted from July to August 2020 in the villages around the Mahakam watershed and its sub-watersheds (Enggelam River, Belayan River and Kedang Pela River) as well as Melintang and Semayang Lakes. That Covers; Enggelam Village Estuary, Melintang Village, Sebemban Village, Muara Kaman Ilir Village and Muara Kaman Ulu Village. Administratively, these villages are located in Muara Wis District and Muara Kaman District, Kutai Kartanegara Regency, East Kalimantan Province. More clearly can be seen in Figure 1.

Data Types and Collection Methods

The data used are primary data obtained from structured interviews using a questionnaire. The object of this research is the people whose main profession is fishermen. Fishermen are selected purposively based on

a certain consideration made by the researcher, based on the characteristics of the object that have been previously known. Purposive case selection was carried out by identifying all the characteristics of the object by conducting preliminary studies and studying various things related to the research topic. The selected respondents must meet the following criteria: 1) main job is fisherman, 2) catch fish and live in the research location area, 3) a single fisherman and 4) having a boat and response equipment (not rented), and 5) have become a fisherman at least 5 years assuming they are familiar with the conditions of the waters. This study used 40 respondents that spread across the Mahakam River Basin and its tributaries (Enggelam River, Belayan River and Kedang Pela River) as well as Melintang and Semayang Lakes with the selection of respondents based on the criteria described in the research methods.

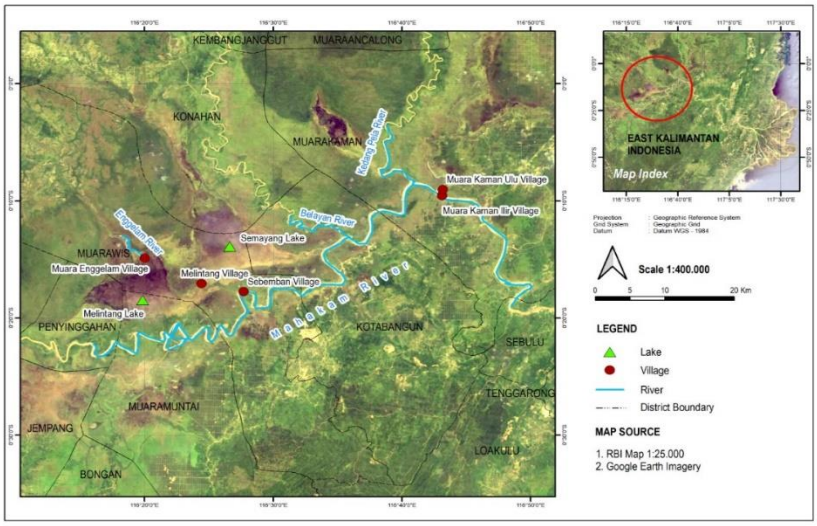

Figure 1. Map of the Research Location

Data Analysis Methods

This study uses a combination of qualitative and quantitative methods. This type of mixed research is called mixed method. This research is useful for describing complex phenomena, it can be seen from the comparisons between cases, and this research is able to analyse the combined results of quantitative and qualitative research so that the data will be clearer and complementary (Johnson and Cristensen, 2014). The approach in data analysis in mixed method research adapt a gradual explanatory strategy. Where the explanation of the research location problem can be detected in a complex manner. The researcher began to answer the problem of the uncertainty catch using a qualitative approach. Meanwhile, to calculate short-term benefits, a quantitative approach is used. The number of fishermen's catch is the focus of the variables that will be studied. The flow of data analysis can be seen in Figure 2. The qualitative approach is done by direct interview to fishermen based on the research instruments contained in the questionnaires of the studies. The research instrument used has passed the process of testing the validity and reliability of the instrument. The purpose of the interview is to obtain causal data on fishermen's low fishing yields. Then after obtaining the data, the researcher continues a qualitative approach with the aim of conducting deeper exploration of the factors that affect fishermen's catch.

The profit analysis in this study is the economic calculation of the production process. According to Sugiarto et al., (2002) the production process is a process carried out by a company in the form of combining input (resources) to produce output. Calculating the profit received by fishermen in one catch, grouped into

phases based on natural conditions. This is done to see the natural factors (water conditions) that are the object of income for fishermen. Fishermen's profits are calculated using a cost analysis approach. The revenue from the sale of fish is reduced by the total cost, so it will be known about the profit of the fishermen. The profit of fishermen is analysed based on the theory put forward by (Samuelson & Nordhaus, 2010). Gradually the analysis is to calculate the total costs needed by fishermen in one fishing trip, the total costs include fixed costs (building a boat, procuring boat engines, maintaining boat engines, making and assembling fishing gear, fishermen consumption), variable costs (fuel oil). The total cost can be written in the following equation (Samuelson and Nordhaus, 2010):

$$TC = FC + VC \quad (1)$$

TC = Total Cost, FC = Fixed Cost and VC = Variable Cost.

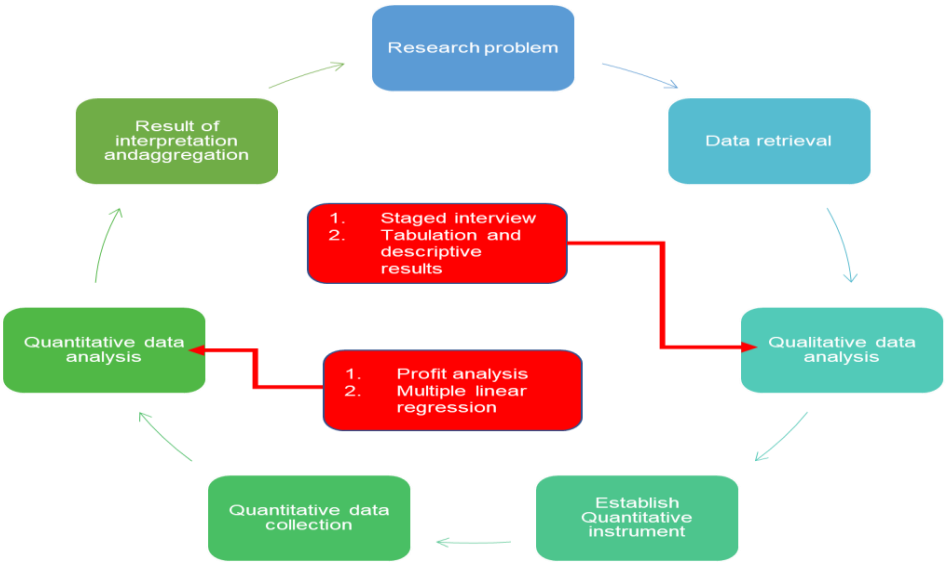

Figure 2. The Research Analysis Flow

In FC, there are costs that can be issued routinely within a certain time depending on the usage period of the equipment, such as: costs for building boats, procuring boat engines, maintaining boat engines and making and assembling fishing gear. Therefore, this stage also calculates fixed costs by considering the period of use or service life which can be written mathematically (Samuelson and Nordhaus, 2010):

$$FC = \frac{Value\ of\ capital\ goods}{Life\ service} \quad (2)$$

Furthermore, to determine fishermen's income, the selling price of fish is identified according to the type of each respondent and then averaged. The mathematical equation can be written as follows (Samuelson and Nordhaus, 2010):

$$TR = P.Q \quad (3)$$

TR = Total Revenue, P = Price (average price of fish by species), Q = Quantity (number of catches by type per trip). After the TC and TR are known, the fishermen's profit or income can be written as follows (Samuelson and Nordhaus, 2010):

$$\pi = TR - TC \quad (4)$$

Knowing the factors that affect fishermen's catch in the long run, the prediction data is carried out by using multiple regression analysis. Ensuring the feasibility of the model and data used, the researcher used the feasibility test model (coefficient of determination, F test and t test) and classical assumption testing. The measurement of the estimated variables that affect fishermen's catch is explained by the following equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e \quad (5)$$

Where: Y = fishermen's catch; X_1 = Fishing area; X_2 = Experience; X_3 = Capital; X_4 = Government assistance.

The regression equation is formed from a review of qualitative approaches and production theory approaches. The Y variable in this study is the final result (output) of the fishermen's economic activity in the form of the fish catches per day in kilograms. Production is generated by utilizing several inputs or inputs which are used as explanatory variables (variable X).

In this model, the variables that emerge from the qualitative approach are X1 = Experience and X2 = Complete Area. Experience is measured by units of the year. The catch area is categorized and sorted based on a scale of 1 - 7 regions. The wider and better the geographic conditions of the capture waters, the greater the value assigned to these variables. Meanwhile, the relationship between input and output is arranged in a micro-scale production function in the form (Nicholson 2002) q = f (K, L, M,); Where, q represents the output of fish catch by fishermen during one fishing period. The harvest is an accumulation of the largest fish species and quantities obtained by fishermen. K represents the capital used during that period, which is projected based on the amount of fixed capital / assets owned and used by fishermen to increase their catches. The L component represents the input of the number of workers involved in one fishing period, but this variable is not used in this study because the lab or used in one fishing boat is only one person and does not change. Furthermore, the M indicator represents other inputs used, in this case the researcher looks at government involvement. This variable uses a *dummy* technique, where if the fisherman gets help from the government, then a symbol (nominal scale) is given as one, and otherwise a zero symbol is given.

RESULTS AND DISCUSSION

Characteristics of the Research Location

The research location is in the middle of the Mahakam River (Middle Mahakam Area). (Christensen, 1992) states that the middle area of the Mahakam River includes the Tenggarong, Sebulu and Kota Bangun areas. Currently, these areas have been expanded, the results of which include Muara Wis District and Muara Kaman District. The areas of Muara Wis and Muara Kaman sub-districts are fed by the Mahakam River and several sub-watersheds such as the Belayan River and the Kedang Pela River in addition, the Melintang Lake and Semayang Lake. These rivers and lakes are fishing areas by the people who live in the vicinity. If you look at the fishing system owned by fishermen, fishermen in the area are traditional fishermen Generally, the fisheries in the land waters are small scale, they didn't have a port which makes the data collection of their captures and did their harvest is consumed by their own

or sold locally (Kartamiharja and Satria, 2000). Number of households, production and the economic value of capture fisheries in land waters in the two districts is presented in Table 2.

Table 2. Number of Households Catch Fisheries and Their Potentials

Districts	Number of Household catch Fisheries	Number of boats without motor and outboard motors	Total Catch (Tons)	Catch Value (IDR 000)
Muara Wis	1,058	1,365	6,253.66	290,231,968
Muara Kaman	2,649	1,734	6,373.15	337,949,707

Source: Central Statistics Agency, 2019

Table 2 shows the number of in land fisheries households in Muara Kaman District is greater than that of Muara Wis District. Based on data from BPS Kabupaten Kutai Kartanegara (2020) 41% of the total 2,583 households in Muara Wis District work in the fisheries sector and 25% of the total 10,401 households in Muara Kaman District work in the fisheries sector. The fishery sector in these two sub-districts provides a significant contribution to fish production when compared to the total fish production in Kutai Kartanegara Regency. Muara Wis Subdistrict contributed 6,253.66 (18%) tons and Muara Kaman District contributed 6,373.15 (19%) tons from a total of 34,394.51 tons of capture fisheries production in the land waters of Kutai Kartanegara Regency. Furthermore, from the total harvest, each has an economic value of up to 290 billion rupiah (18%) and 337 (21%) billion rupiah from a total of 1.5 trillion rupiah (BPS Kabupaten Kutai Kartanegara, 2020).

The research is conducted in five villages that consists of; 1). Muara Tenggelam Village, 2). Melintang Village, 3). Sebembam Village, 4). Muara Kaman Ilir Village and 5). Muara Kaman Ulu Village. All of the villages are spread through two districts which are Muara Wis Districts and Muara kaman District. Based on the observations, the research location villages have great potential in increasing fishing yields, with characteristics as shown in Table 3.

Table 3. Characteristics of Research Sites

Village	Districts	Characteristics		
		Mahakam River Border	Muara Kaman River & Mahakam Border	Above the Lake and Muara Enggelam River
Muara Enggelam	Muara Wis			√
Melintang	Muara Wis			√
Sebemban	Muara Wis	√		
Muara Kaman Ilir	Muara Kaman		√	
Muara Kaman Ulu	Muara Kaman		√	

Source: Observations, 2020

The characteristics of the research location consisted of three; 1) villages located on the edge of the Mahakam River, 2) villages located on the estuary of the sub-watershed and on the banks of the Mahakam River and 3) villages located above the surface of the lake and estuary of the sub-watershed. The characteristics of these villages also determine the occupation of the village community. Like the villages of Muara Enggelam and Melintang, because they are located above the surface of the lake and the Muara Enggelam River which is always submerged in water all year round, the main livelihood of the community is fishermen. Meanwhile the people from Sebemban Village, Muara Kaman Ulu and Muara Kaman Ilir works as fishermen and farmers.

The characteristics of the village area greatly influence fishermen in determining their fishing area. Based on the results of interviews that have been conducted. It can be described that fishing locations by village as follows:

1. Muara Enggelam village catches fish in the Enggelam River and Melintang Lake.
2. Melintang Village catches fish in the Lake Melintang and Lake Semayang waters.
3. Sebemban village catches fish in the Mahakam River and Lake Semayang waters.
4. Muara Kaman Ilir and Muara Kaman Ulu villages catch fish in the Kedang Pela and Belayan Rivers.

The amount of catch in each of these areas are varies. Period 1, which is, at low tide, fishermen generally only get Kendia and Repang fish. The catches from the two fish were also less. However, as the volume of water in the Mahakam watershed increases, the types and numbers of fish will increase (Table 4). Table 4 shows fishermen catch fish by combining more than one waters in one catch. If fishermen combine fishing areas between river and lake waters, the types of fish caught can reach 20 to 24 types of fish. Compared to combine two lake waters, the fishermen can only obtain 10 species of fish, however, if fishermen catch fish in the waters as river waters and lakes then the fishermen can catch fish as much as six to 14 species of fish. If you look at these findings, they are not much different from the findings from previous studies as presented in Table 1. The total area of the Mahakam watershed reaches 7,724,365 Ha covering four districts namely West Kutai Regency, Malinau Regency, Kutai Regency. Kartanegara and East Kutai District, in addition to one area of Samarinda City (Departemen Kehutanan, 2010). Furthermore, the Melintang and Semayang lake has the total area of 11.000 ac and 13.000 ac respectively (Wahjono, 2015).

This study found that the characteristics of the economic in the capture fisheries business in land waters, in the research location are very different from the characteristics of the economic in marine fisheries in East Kalimantan. At the research location, fishermen are free to market their catch to any collectors in their village and can even market it directly to consumers. Meanwhile, fishermen in sea waters, they tend to be bound by the *pinggawa-sawi* system so that fishermen are obliged to sell their catches to a *Pinggawa*. *Pinggawa-Sawi is* the traditional socio- economic system of the Bugis-Makassar Ethnic coastal community, Lampe (2015) which also applies to the Bugis-Makassar ethnic community who live in the coastal area of East KalimantanThis shows that in these villages, the price of fish is purely the price from the fishermen that applicable in the market, without any additional distribution costs attached to the fish. In line with Kartamiharja & Satria (2000) states that the perpetrators of economic activities in mainland public waters fisheries are fishermen's families and there is almost no employer-fisherman relationship system. The social system of fishing communities in land waters is more egalitarian. Marketing of the products or catches is a tangible manifestation of a community-based economy.

Table 4. Types of Fish Captured based on the Catching Area

No	Fish Species	Fishing Area (*Fishing Ground*)						
		D Melitang & S Enggelam	D Melintang	D Melitang & S Semayang	D Semayang & S Mahakam	D Semayang	S Kedang Pela	S Belayan
1	Betok	√		√		√		
2	Baung	√		√	√	√	√	
3	Swamp Sepat	√	√	√	√	√		

No	Fish Species	Fishing Area (*Fishing Ground*)						
		D Melitang & S Enggelam	D Melintang	D Melitang & S Semayang	D Semayang & S Mahakam	D Semayang	S Kedang Pela	S Belayan
4	Siamese Sepat	√	√	√	√	√		
5	Cork	√		√	√	√	√	√
6	Toman	√		√	√	√	√	√
7	Catfish	√			√	√	√	√
8	Support	√	√		√			
9	Pimple	√	√		√	√	√	
10	Kandia	√	√	√	√	√	√	
11	Silli				√			
12	Even	√	√	√	√		√	
13	Salab	√			√	√	√	
14	Betutu	√			√			
15	Belida	√	√		√			
16	Patin	√			√	√	√	√
17	Bentilap	√			√			
18	Lais	√	√		√	√	√	√
19	Soft	√			√			
20	Lempam				√			
21	Gala Shrimp				√	√	√	√
22	Indigo	√		√	√			
23	Bawal				√			
24	Mas	√		√	√			
25	Eel				√	√		
Total Type		20	8	10	24	14	11	6

S. = River; D. = Lake
Source: Primary Data, 2020

The Cost of Capture Fisheries Activity

The costs incurred to catch fish are relatively cheap when compared to the income that fishermen might receive. The total cost interval incurred is IDR 38,000 to IDR 250,000,000 with an average cost of IDR 76,000. There is a gap between the lowest cost and the highest cost, this is due to various factors, including: the size of the boat, the type of wood used to make the boat, the boat engine type and capacity, the fishing gear and the geographical / terrain that the fishermen have to travel. The fishermen's starting point is from the catching waters, the greater the operational costs that must be incurred.

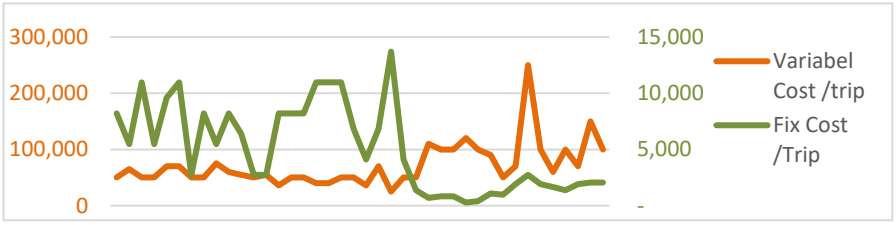

Figure 3. Graphs of Fixed Costs and One-time Variable Costs

Figure 3 shows the costs incurred by fishermen. Costs are grouped into fixed costs and variable costs. Fixed costs are calculated in rupiah units, by registering the equipment used by the service, namely boats and fishing gear. Furthermore, it is assessed that fishermen's fixed equipment is divided based on the age of use so that the fixed costs per trip can be found. The fixed costs incurred by each fisherman are different. This is due to differences in the capacity of the boats and the number of fishing gear they have.

The variable cost in the case of fishermen's catch is the operational cost incurred each time, namely to buy fuel. These costs vary due to the distance the boat takes off and the distance to the fishing location. The

variable cost will increase depend on the distance of the fishing point. There are 15% of fishermen who incur variable costs of <IDR 50,000 and 62.5% of fishermen incur variable costs of <IDR 100,000. If we look at Figure 4, it shows that those who incur low variable costs, will incur relatively high variable costs and vice versa. Furthermore, 22.5% of fishermen spend on the variable costs of IDR 100,000 to IDR 150,000. Data checking conducted by researchers, shows that there is one respondent who incurs a variable cost of IDR 250,000, - is the same respondent with the most income / catch.

The Benefits of Capture Fisheries Activity

As part of the river ecosystem, the research location is characterized by water fluctuations between the dry and rainy seasons which vary widely throughout the year (Sulistianto and Erwiantono, 2015). Therefore, the maximum profit of fishermen is analysed based on fluctuations in the water surface. This study divides the surface fluctuation into three categories based on the period. The first period shows that the low tide was reached the lowest temperature which start from July until October. Period two describes the condition of the highest tide level from November to February and period three describes the condition of the water level from the highest tide to the lowest tide (March to June). This is done to reduce bias in calculating profit. Likewise in a company, the tidal period is assumed to be the same as the production period, so that in calculating profit there are three production periods in one year. The maximum profit can be seen in the Table 5.

Table 5 shows that fishermen in Muara Enggelam and Melintang villages carry out fishing activities throughout the year, in contrast to fishermen in Sebemban, Muara Kaman Ilir and Muara Kaman Ulu villages who do not fully catch all year round. The differences can be seen in revenue and profit, where in period 1 the fishermen in Sebemban, Muara Kaman Ilir and Muara Kaman Ulu villages were worth Zero or none.

Table 5. Profits of Fishermen by Village

Village	Aggregation	Total Cost (IDR)	Total Names (IDR)			Profit (IDR)		
			Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
Muara Enggelam	Max	80,959	300,000	1,497,500	2,763,000	220,411	1,417,911	2,683,411
	Average	65,583	124,385	643,892	1,444,077	71,443	639,379	1,472,801
	Min	52,741	72,000	354,200	716,000	7,126	277,626	663,259
Melintang	Max	60,959	300,000	524,000	1,132,000	239,041	483,890	1,091,890
	Average	52,562	198,000	404,738	874,925	145,438	352,176	822,363
	Min	40,110	114,000	243,500	589,600	57,151	192,541	538,641
Sebemban	Max	76,849	-	492,000	2,043,200	-	415,151	1,966,351
	Average	56,553	-	210,333	1,007,733	-	153,781	951,181
	Min	38,699	-	64,000	365,000	-	20,890	310,890
Muara Kaman Ilir	Max	252,740	-	290,000	2,964,000	-	192,041	2,711,260
	Average	104,819	-	166,000	1,006,327	-	79,326	901,508
	Min	50,959	-	60,000	132,000	-	8,630	31,178
Muara Kaman Ulu	Max	152,055	-	450,000	2,670,000	-	297,945	2,517,945
	Average	97,808	-	192,600	1,446,600	-	202,507	1,348,792
	Min	61,644	-	168,000	663,000	-	66,630	561,630

Source: Primary Data Analysis Results, 2020

This is because at low tide, fishermen prefer to plant corn and vegetables on the edge of the Mahakam River which has dried up. Meanwhile, fishermen in Muara Enggelam and Melintang villages have no other choice but to catch fish, because their settlements are flooded all year round, so there is no alternative livelihood except for aquaculture using floating net cages. The costs incurred by fishermen are varies from village to village. Fishermen who have catchment areas, combined between rivers and lakes, have higher costs compared to fishermen whose catchment areas are lakes only, even though they combine two lakes (Table 3).

As for fishermen in Muara Kaman Ilir and Muara Kaman Ulu, their average expenditure is twice as high (IDR 104,819 and IDR 97,808, respectively) compared to Muara Enggelam, Melintang and Sebemban villages, respectively IDR 65,583, IDR 52,562 and IDR 56,553. This difference occurs, because the distance between the fishing areas of Muara Kaman Ilir and Muara Kaman Ulu villages is farther compared to the villages of Muara Enggelam, Melintang and Sebemban. Fishermen experiences the maximum profit in the third period because the fish catch is increasing in terms of species and quantity. Based on the results of data analysis, the highest profit for fishermen is in Muara Enggelam Village. The average profit of fishermen in the village reaches IDR 1,472,801 per fishing trip. Then in sequence, the villages of Muara Kaman Ulu, Sebemban, Muara Kaman Ilir and Melintang, respectively IDR 1,348,792, IDR 951,181, IDR 901,508 and IDR 822,363. In the third period, the types of fish in these villages can reach 25 types of fish and the number of fish once caught can reach a maximum value of 321 kg.

The increase in profits in the second and third period did not last long, because as the number of catches increased, fish stocks in collectors continued to increase, this had an impact on the continuing decline in fish prices. This happens because the fishing rate is greater than the market absorption rate. The fishermen's strategy is to maintain and maximize the price of fish by processing it in the form of dry fish and processing the fish into crackers or separating meat and bones for sale to fish collectors. This is done by fishermen in order to keep getting maximum profit on the selling price of fish, and fishermen are preparing to return to the natural cycle where the water conditions will return to low tide. An illustration of the profits and costs of fishermen in one year can be seen in Figure 4.

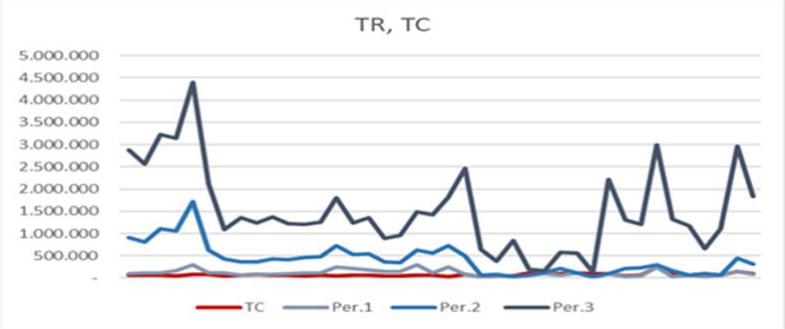

Figure 4. Fishermen Profit Graph

This study also analyses changes in profits for each fisherman. The findings depicted in Graph 3 show the changing conditions of fishermen's profits at all periods. Most fishermen, increased revenue in the first and second period, but still there are some fishermen that their income remain the same. Meanwhile, in second to third period, it can be seen that all fishermen experienced additional income. Fishermen whose income are below the average rate on the third period will obtains some additional income from farming which compatible with other fishermen. Figure 4 also described that the costs incurred to catch fish are relatively cheap when compared to the income that fishermen might receive. The total cost interval incurred is IDR 38,000 to IDR 250,000,000 with an average cost of IDR 76,000. There is a gap between the lowest cost and the highest cost, this is due to the terrain / geography factors that the fishermen have to cover. The longer the distance from the starting point with the catching areas, the greater the operational costs that will be occurred.

Factors that Affect the Fishermen's Catch

The finding in this study is that fishermen get a bigger profit during the tidal conditions towards low tide (period 3), where there is an increase in fish species and the volume of it in the fishing area. This shows the factor of natural influence, which greatly determines the benefits that fishermen can obtain. In an effort to increase fishermen's harvest, fishermen cannot fully depend on natural conditions because fishermen cannot fully predict when the tidal conditions become receding. Therefore, this study also analyses the factors that affect the fishermen's response in a measurable way.

Table 6. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Catch Results	40	14.00	321.00	102,9000	63,94541
Capture area	40	1.00	7.00	4.3500	2.14297
Experience	40	6.00	50.00	22.9750	11.88511
Catching tool	40	1.00	5.00	3.000	1.15470
Government_ Assistance	40	0.00	1.00	0.3750	0.49029
Valid N (listwise)	40				

Source: Primary Data Processed, 2020

There were respondents who were able to catch 321 kg of fish in one fishing trip, however there were also respondents who only caught 14 kg in the same season. This does not show the profit of fishermen. Fishermen's profit can be determined by multiplying the number of catches by type of fish by the selling price for each fish. The number of responses is an accumulative number of fish species obtained, with an average gain of 102.9 kg per fishing trip. The standard deviation is quite high which illustrates the gap in the number of fishermen's catch which varies widely between fishermen. The area of the catchment is an ordinal data that symbolized by based on the large of the area and the geographic conditions. The average value of 4.35 (4) means that most of the fishermen do the catchment activity in the area No. 4 (Semayang Lake and Mahakam river). If it confirms by the amount of the huge number of types of fish in the catchment area then area No. 4 is the area that have the most fish species (See Tabel 4).

In production theory, more input is being used; more output will be obtained. Because of this, it is hypothesized that more fishing gears used, more fish will be caught. As well as government assistance will affect the fishermen's catch. The data in Table 6 shows that there are respondents who use 5 fishing gear (maximum value) to catch fish once, but there are also respondents who only use 1 fishing gear. With an average value of used tool of 3, it indicates that the use of tools is distributed, where the average value is the same as the median value of the data. Meanwhile, for government assistance, it is dummy data with numbers 0 and 1. One is the nominal scale for fishermen who receive assistance. Based on the findings at the research location, the production theory and hypothesis are not suitable. Using more than one type and the number of fishing gear does not guarantee the number and types of fish caught, this can be proven by the results of regression analysis, where the fishing gear variable does not significantly affect the number of fish catches.

Using variables of catching area, experiences, and the amount of fishing gear used also the assistances from the government on the catch of the respondent from the most accumulative catch, have obtained a correlation of 0.727. This figure shows that the four variables used have a strong relationship with the fishermen's catch, which is 72.7%. The formed regression model can be declared fit for use. This indicated by the regression significance of 0.000. Together, the variables of fishing area, experience, the

number of fishing gears used and assistance from the government are stated to have an effect on the fishermen's harvest. R square of 0.529 means that 52.9% of the catch can be described by the independent variables used in this study. While the other 47.1% show that the fishermen's catch described by other variables outside the formed regression model. The influence of natural factors on fishermen's catch makes the value at a reasonable condition, where it is still difficult to predict and measure factors caused by nature. The regression model used forms the following equation:

$$Y = -33{,}715 + 17{,}486X_1 + 1{,}457X_2 + 8{,}540X_3 + 3{,}865X_4$$

The variable of fishermen catch uses accumulative catch data of the most fishermen for each type of fish in units of kilo grams (Kg) per trip. So that the constant -33,715 can be interpreted that in the condition that they do not catch in the waters of the Mahakam watershed, they do not have experience and fishing gear, and there is no help from the government, fishermen can lose 33,715 kg of their catch. When comparing these results with the minimum value of the fishermen's catch, it is known that the constant value is still higher. This shows the importance of the variables used in increasing fish catches.

Table 7. Multiple Regression Analysis Results

	Unstandardized Coefficients		**Standardized Coef.**	**t**	**Sig.**
	B	Std. Error	Beta		
(Constant)	-33,715	33,729		-1,000	.324
Fishing areas	17,486	4,446	.586	3,933	.000 *
Experience	1,457	0.769	.271	1,896	.066 **
Catching tool	8,540	6,848	.154	1,247	.221
Help_ Government	3,865	17,350	.030	.223	.825
Summary:	R	0.727		F	9,816
	R Square	0.529		Sig.	0.000

* sig. α ≤ 1% ** sig. α ≤ 10% Source: Primary data processed, 2020

Table 7 also provides information on the coefficient and significance of the variables. The fishing area variable (X1) is stated to have a significant effect on the fishermen's catch. The coefficient value of 17.486 indicates a big influence on fish catch, where if the fishing area is expanded, fishermen will be able to get an additional fish catch of 17.486 kg. These findings indicate a value greater than the minimum value of the fishermen's catch. Expanding the catchment area is if fishermen are able to catch fish in lakes and rivers with the conditions of the highest tidal phase towards low tide. Further findings suggest that experience has a significant effect on the 10% error level. Where if the experience of fishermen increases a year, fishermen will be able to increase their fish catch by 1.457 kg. Experience is not limited to the size of the year, but with increasing experience, other factors that are attached to the experience also increase. Namely, with the length of experience, fishermen are considered to have knowledge of natural conditions, knowledge of fishing areas and have good strategies in dealing with changing conditions of fish species and numbers due to natural conditions.

Fishing gear variable, which describes the fixed capital owned by fishermen in catching fish, is stated to have no significant effect on the amount of fish catch. This means that the more fishing gear used by fishermen to catch fish, it does not cause an increase in catch. Ownership of boats/*katinting* is not included in the fixed capital calculation, because it has become a requirement in determining the sample. The fishing gears used by the respondents in catching fish include: splints, traps, scatter nets, drift gill nets, fixed gill nets,

long rods, long lines, and curtain, scoops, and shrimp patches. The government assistance variable is stated to have no significant effect on the fishermen's catch. Based on the calculations made, it is known that only 37.5% of fishermen received assistance from the government in the form of fishing gear and engines for their boats / katinting. This insignificant variable can be caused by many constraints, including effective and /or right on target. Another thing that is not significant is most of the fishermen who receive assistance, catch fish in less strategic areas and have not taken measurements of changes in catch after receiving this assistance.

The results of the regression analysis are in line with those revealed by Nasution at al. (2017) where fishing location and fishermen experience are the main factors that can influence fishing, fishing location is related to the habitat and ecological function of the water area and experience is related to the level of fishermen's knowledge of the characteristics of each water area. Furthermore, the type of fishing gear is not significant because the use of it is highly dependent on the physical conditions of the waters (Nasution et al., 2017). According to the fishermen, it is very rare for the government to provide assistance to increase fishery production, so it is only natural that this variable is not significant because fishermen in the research location do not depend on government assistance.

CONCLUSION AND SUGGESTION

Conclusion

Fishermen's profit is divided into three periods based on water surface conditions, fishermen have the greatest profit in the third period, where the waters are in the highest tide to the lowest tide. Apart from the physical condition of the waters, the fishermen's catch is significantly influenced by two factors, namely the fishing area and the experience of fishermen.

Suggestion

In order for the fisheries economy sector to be sustainable and to avoid degradation of the aquatic environment, and to consider the factors that affect the catch, the researchers recommend that the assistance provided by the government to be shifted to efforts to improve fishing areas to restore fish habitat conditions in the Mahakam watershed area.

REFERENCES

Abdunnur. 2019. Study of Management of Marine Bio-Resources of Mahakam Delta Area of East Kalimantan. *Systematic Reviews in Pharmacy* 10(2):270–78.

Badan Pembangunan Nasional [Bappenas]. 2014. *Kajian Strategi Pengelolaan Perikanan Berkelanjutan*.

Badan Pusat Statistik [BPS] Kabupaten Kutai Kartanegara. 2020. *Kutai Kartanegara Regency in Figures*. Tenggarong: BPS Kutai Kartanegara.

Christensen, Mikkel S. 1992. Investigations on the Ecology and Fish Fauna of the Mahakam River in East Kalimantan (Borneo), Indonesia. *Internationale Revue Der Gesamten Hydrobiologie Und Hydrographie* 77(4):593–608.

Departemen Kehutanan. 2010. *Laporan Final Rencana Pengelolaan DAS Terpadu Di DAS Mahakam*.

Food and Agricultural Organization [FAO]. 2014. *Fisheries and Aquaculture Country Profiles. The Republic of Indonesia*.

Hadibarata, Tony, Achmad Syafiuddin, and Ayman A. Ghfar. 2019. Abundance and Distribution of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediments of the Mahakam River. *Marine Pollution Bulletin* 149(May).

Haryono. 2006. Ichthofauna of Semayang-Melintang Lakes Central Mahakam Area, East Kalimantan. *Jurnal*

Iktiologi Indonesia 6(1):75–78.

Johnson, R. Burke and Larry Cristensen. 2014. *Educational Research: Quantitative, Qualitatif, and Mixed Approaches*. 5th ed. USA: SAGE Publications, Inc.

Jusmaldi, Nova Hariani, and Norbeta Doq. 2019. Diversity, Potentiality, and Conservation Status of Fish Fauna in the Upper Mahakam's Tributaries, East Kalimantan. *Jurnal Iktiologi Indonesia* 19(3):391–410.

Kartamiharja, Endi Setiadi and Hendra Satria. 2000. Ecotogical Evaluation on Fisheries Reserve of Lake Batu Bumbun at Middle Mahakam River Basin, and Its Management Implication. *Jurnal Penelitian Perikanan Indonenesia* 6(2):22–32.

Koeshendrajana, Sonny, I. Wayan Rusastra, and Purwito Martosubroto. 2019. Wilayah Pengelolaan Perikanan Negara Republik Indonesia (WPPNRI) 713: Gambaran Umum, Potensi Dan Pemanfaatannya. Pp. 1–248 in *Potensi Sumber Daya Kelautan dan Perikanan WPPNRI 713*. Jakarta: AMaFRaD PRESS.

Kottelat, Maurice. 1995. The Fishes of the Mahakam River, East Borneo: An Example of the Limitations of Zoogeographic Analyses and the Need for Extensive Fish Survey in Indonesia. *Tropical Biodiversity* 2(3):401–26.

Lampe, Munsi. 2015. Pinggawa-Sawi Nelayan Bugis-Makassar Dalam Analisis Relasi Internal Dan Eksternal. *Jurnal Masyarakat Dan Budaya* 17(1):77–88.

Lombogia, Davidson Rofiano. 2016. Survey Permasalahan Danau Semayang Dan Melintang. *Jurnal Infrastruktur* 2(01):49–52.

Nasution, Syahroma Husni, Dian Oktaviani, Dharmadi, and Dede Irving Hartoto. 2008. Komunitas Ikan Dan Faktor Kondisi Beberapa Ikan Putihan di Sungai Muara Kaman Dan Danau Semayang. *LIMNOTEK* XV(1):10–21.

Nasution, Zahri, Dwiyitno Dwiyitno, Bayu Vita, and Indah Yanti. 2017. *Pengembangan Perikanan Tangkap Pada Ekosistem Rawa Banjiran Berbasis Suaka Perikanan Produksi Di Kabupatan Musi Banyu Asin*. 1st ed. edited by E. S. Kartamiharja and M. M. Kamal. Jakarta: PT. Raja Grafindo Persada.

Nicholson, W. 2002. *Mikroekonomi Intermediate Dan Aplikasinya*. 8th ed. edited by I. B. Mahendra and A. Azis. Yogyakarta: Erlangga.

Samuelson, Paul Anthony and William Dawbney Nordhaus. 2010. *Economics*. Nineteenth. edited by N. Fox. New York: McGraw-Hill/Irwin.

Sidik, A. 2008. The Changes of Mangrove Ecosystem in Mahakam Delta, Indonesia: A Complex Social-Environmental Pattern of Linkages in Resources Utilization. in *The South China: Sustaining Ocean Productivities, Maritime Communities and the Climate*.

Soetopo, T. 2007. "Banjir Dan Dinamika Pengelolaan DAS." P. 179 in *Pengelolaan DAS: dari wacana akademis hingga praktek lapangan*. Jakarta: Lipi PRESS.

Sugiarto, Herlambang Tedy, Brastoro, Rachmat Sudjana, and Said Kelana. 2002. *Ekonomi Mikro-Sebuah Kajian Komprehensif*. Jakarta: PT. Gramedia Pustaka Utama.

Sulistianto, Erwan and Erwiantono. 2015. Strategi Adaptasi Nelayan di Kawasan Danau Semayang Kabupaten Kutai Kartanegara. *Harpodon Borneo* Vol. 8(2):88–93.

Suyatna, Iwan, Muhammad Syahrir, Mislan Mislan, Yuni Irawati Wijaya, and Abdunnur Abdunnur. 2017. A Survey On Marine Fish Species In River of Mahakam East Kalimantan, Indonesia. *Omni-Akuatika* 13(2):89–98.

Tambunan, Efendy. 2014. Dampak Degradasi Lingkungan Terhadap transportasi Sungai Mahakam. *The 17th FSTPT International Symposium* (August):1133–39.

Wahjono, Heru Dwi. 2015. Water Quality Monitoring for Semayang Lake and Melintang Lake in Kutai Kartanegara District Using Online Monitoring System. *JAI* 8(1).

Warren, Carol and Dirk J. Steenbergen. 2021. Fisheries Decline, Local Livelihoods and Conflicted Governance: An Indonesian Case. *Ocean and Coastal Management* 202:105498.

Zain, Zairin, Sahala Hutabarat, Slamet Budi Prayitno, and Ambaryanto Ambaryanto. 2014. Potency of Mahakam Delta in East Kalimantan, Indonesia. *International Journal of Science and Engineering* 6(2):126–30.

Zakaria, Mohamad Pauzi and Alvin Azril Mahat. 2006. Distibution of Polycyclic Aromatic Hydrocarbon (PAHs) in Sediments in the Langet Estuary. *Coastal Marine Science* 30(1):387–95.

van Zwieten, P. A., Achmad Syafei Sidik, Noryadi, Iwan Suyatna, and Abdunnur. 2006. Aquatic Food Production in the Coastal Zone: Data-Based Perceptions on the Trade-off Between Mariculture and Fisheries Production of the Mahakam Delta and Estuary, East Kalimantan, Indonesia. P. 219 in *Environment and Livelihoods in Tropical Coastal Zones*, edited by C. Hoanh, T. Tuong, J. Gowing, and B. Hardy. Wallingford.