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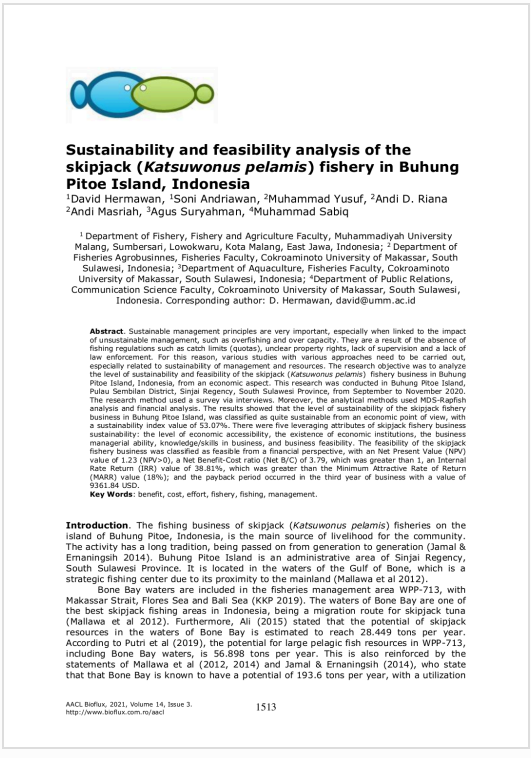

Sustainability and feasibility analysis of the skipjack (*Katsuwonus pelamis*) fishery in Buhung Pitoe Island, Indonesia

[1]David Hermawan, [1]Soni Andriawan, [2]Muhammad Yusuf, [2]Andi D. Riana [2]Andi Masriah, [3]Agus Suryahman, [4]Muhammad Sabiq

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Key Words: benefit, cost, effort, fishery, fishing, management.

Introduction. The fishing business of skipjack (*Katsuwonus pelamis*) fisheries on the island of Buhung Pitoe, Indonesia, is the main source of livelihood for the community. The activity has a long tradition, being passed on from generation to generation (Jamal & Ernaningsih 2014). Buhung Pitoe Island is an administrative area of Sinjai Regency, South Sulawesi Province. It is located in the waters of the Gulf of Bone, which is a strategic fishing center due to its proximity to the mainland (Mallawa et al 2012).

Bone Bay waters are included in the fisheries management area WPP-713, with Makassar Strait, Flores Sea and Bali Sea (KKP 2019). The waters of Bone Bay are one of the best skipjack fishing areas in Indonesia, being a migration route for skipjack tuna (Mallawa et al 2012). Furthermore, Ali (2015) stated that the potential of skipjack resources in the waters of Bone Bay is estimated to reach 28.449 tons per year. According to Putri et al (2019), the potential for large pelagic fish resources in WPP-713, including Bone Bay waters, is 56.898 tons per year. This is also reinforced by the statements of Mallawa et al (2012, 2014) and Jamal & Ernaningsih (2014), who state that that Bone Bay is known to have a potential of 193.6 tons per year, with a utilization

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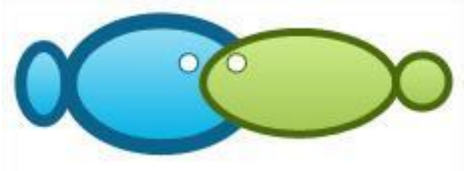

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rate of 43.96%. Fish that are still projected to be developed in Bone Bay are small pelagic fish, tuna, skipjack and mackerel.

This high potential is also supported by the socio-economic and socio-cultural preferences of the people on Buhung Pitoe Island. Generally, the people of Buhung Pitoe live as fishermen who catch tuna. High potential and community preferences are the main indicators for the development of skipjack in the area. However, it is necessary to carry out various studies, including an analysis of the sustainability and feasibility of the skipjack fishery business based on economic aspects.

This study aimed to analyze the fisheries resource management, if economic benefits could be obtained while maintaining the sustainable availability of fish resources, and social harmony. This refers to the concept of sustainable development, as contained in the Brutland report "Development to provide the human needs today, without reducing or destroying the ability of future generations in providing their needs" (WCED 1987). The main concept of resource utilization is related to the purpose of meeting human needs (Azqueta & Delacámara 2006). In other words, in a fishery context, the extraction of fish resources is intended to provide the needs of human life, especially food. However, if the utilization of fish resources is not managed properly, it can lead to over-exploitation. Moreover, the extraction of coastal and marine resources often creates conflicts in their use horizontally between fishermen, and vertically with policy makers (Daris et al 2019, 2020). According to Fauzi & Anna (2002), the sustainable management approach is very important in relation to resource extraction, especially unrenewable resources. The principles of sustainable management are very important, especially when linked to the impact of unsustainable management, such as overfishing and overcapacity as a result of the absence of fishing (Yaskun & Sugiarto 2017). Therefore, various studies with various approaches need to be carried out, especially related to sustainability studies of management and resources.

Material and method

Research location and time. This research was conducted in Buhung Pitoe Island, Pulau Sembilan District, Sinjai Regency, South Sulawesi Province, Indonesia, from September to November 2020.

Research data. Research data includes primary and secondary data. The primary data was obtained from interviews with 30 fishermen respondents. The number of respondents refers to Yusuf & Daris (2018), who state that the sample size should be at least 30 for determining correlational and causal relationships. According to Nasution (2003) and Nazir (2004), a structured interview is carried out formally, systematically and completely. Secondary data was obtained from the fishery office of Sinjai District, and the Village Office of Buhung Pitoe. Secondary data include data on government assistance programs for fishermen, data on the construction of fishing facilities and infrastructure, and data on the number of fishermen. The attributes of sustainability assessment of skipjack fisheries on Buhung Pitoe Island used in this study are presented in Table 1.

The attributes of the assessment of the feasibility analysis of skipjack fishery business in Buhung Pitoe Island are presented in Table 2.

Table 1

Sustainability attributes of skipjack fishery in Buhung Pitoe Island, Indonesia

No	*Attribute*	*Score*	*Remarks*
1	Fishermen income	0;1;2	
2	Business feasibility	0;1;2	
3	Availability of labor (vessel crew)	0;1;2	
4	Institutional economics	0;1;2	0; bad
5	Economic accessibility	0;1;2	1; moderate
6	Business management	0;1;2	2; good
7	Knowledge and skills in business	0;1;2	
8	Business partnerships	0;1;2	
9	Government support	0;1;2	

Table 2

Attributes of feasibility analysis of skipjack fishery business in Buhung Pitoe Island

No	*Attribute*	*Units*
1	Business investment costs	USD/unit
2	Catches	Kg/trip
3	Operating costs	USD/trip
4	Maintenance costs	USD/year
5	Other cost (taxes)	USD/year
6	Bank interest (assumption of loan)	%
7	Price of fish	USD/kg

Data analysis method. This research used a quantitative analysis approach, consisting of the sustainability and the feasibility of the skipjack fishery business analysis. The sustainability analysis was intended to determine the level of management and leveraging variables of the skipjack fishery business on Buhung Pitoe Island from an economic aspect. The analysis was carried out using the MDS-Rapfish method approach developed by Pitcher (1999).

MDS-Rapfish is a statistical technique for a quick assessment of the relative status of an entity, quantitatively assessed against a predetermined set of attributes grouped into evaluation or discipline (Kavanagh & Pitcher 2004). Furthermore, the estimated score for each attribute is given on a scale from worst to best. The MDS-Rapfish technique is a method of determining the index/level of sustainability and the factors that affect its sustainability or so-called sustainability leverage attribute. The leveraging attribute of sustainability is an indicator of the level of sustainability sensitivity which is measured based on the Root Mean Square (RMS) value (Pitcher & Preikshot 2001; Kavanagh & Pitcher 2004; Pitcher et al 2013). In other words, the attribute (factor) that has the highest sensitivity is the one with the highest RMS value, in the sense that the role of attributes is the highest in the change of the sustainability index. The determination of the main leverage attribute was carried out using the middle value approach. According to Yusuf et al (2020), the law of the middle value is one of the laws in determining the main attribute in the MDS-Rapfish analysis, in addition to the law of extreme value/bar and the law of pareto optimum. Furthermore, it is stated that the law of the mean value is estimated by dividing the highest attribute value in half and making it the baseline value. Furthermore, the higher value (compared to the middle value) is the value of the main leverage attribute, while the lower value (compared to the middle value, which is the baseline value) is not included in the leverage attribute.

Feasibility can be measured based on various indicators, including economic and financial indicators. The financial aspect is an indicator of the main feasibility of a skipjack fishery business. Other indicators of feasibility are the feasibility of legal aspects, feasibility of technical aspects, feasibility of market and marketing aspects, feasibility of managerial and human resources aspects, and feasibility of institutional aspects (Kasmir

& Jakfar 2006). In this study, the feasibility of the business is seen only from the feasibility of the financial aspects, including four main indicators. The business feasibility analysis was carried out using a financial analysis approach. It was intended to estimate the feasibility level of fishing efforts for skipjack tuna on Buhung Pitoe Island by comparing the benefits and costs. According to Wiratama et al (2017), financial analysis compares costs and benefits to determine whether a business will generate a benefit, using the following indicators: net present value (NPV), net B/C ratio, internal rate of return (IRR) and payback period (PP). The financial analysis was carried out with the help of Microsoft Excel software.

Net Present Value (NPV). This is the present value of the net benefit to be obtained in the future, and represents the difference between the present value of the benefit stream minus the present value of the cost stream (Gittinger 1986). In the calculation of NPV, the relevant interest rate is required. The interest rate can be obtained by maintaining the interest rate of long-term loans applicable in the capital market, or by using the interest rate of loans to be paid by businesses (Sutojo 2000). According to Gray et al (1996), the formula used to calculate NPV is the following:

$$NPV = \sum_{t=1}^{n} \frac{(Bt - Ct)}{(1+i)^t}$$

Where: Bt - gross benefit of the year-t; Ct - gross cost of the year-t; i - bank interest rates; t - investment period (t = 0,1,2,…,n).

A positive NPV value indicates that the revenue is greater than the value invested, while a negative NPV value indicates that the income is smaller than the expenditure. However, if the NPV calculation result is zero (NPV=0), it means that the investment or purchase is only a return on investment (no gain and no loss) (Kadariah 2001).

Internal Rate Return (IRR). This represents the level of return on business capital estimated based on the maximum interest rate that can be paid by the business (Gittinger 1986). IRR is also defined as a discount rate that causes NPV investment equal to zero (Kadariah 2001). IRR can be considered as the level of profit on net investment of a business, as long as the net benefit obtained is automatically reinvested in the following year. To calculate the IRR the following equation is used (Gittinger 1986):

$$IRR = i_1 + (i_2 - i_1)\ NPV_1/(NPV_1 - NPV_2)$$

Where: IRR - Internal Rate of Return; i_1 - discount rate when NPV is positive; i_2 - discount rate when NPV is negative; NPV_1 - NPV is positive; NPV_2 - NPV is negative.

The IRR is an indicator of business feasibility from the financial aspect, which is one of the references for calculating the efficiency of a business investment (Harding & Long 2018). In simple terms, the calculation of the IRR could be a basis for deciding if an investment is worthy or not. An investment deemed worthy must meet the criteria for a higher IRR than the minimum acceptable rate of return or the minimum attractive rate of return (MARR). MARR is the minimum attractive interest rate return of the business to be invested (Gallo 2016). In other words, if a person has capital (business funds) that will be invested in a business, he will get an increase in the value of his money by a certain percentage, which is certainly higher than cash interest when only deposited (saved in the bank). Therefore, the MARR value is an interesting indicator of an effort that will be carried out (Psacharopoulos 1994). Thus, the discounted cash flow represents a certain invested amount of funds that is assumed to grow by a certain percentage in the next few years.

Net Benefit Cost (Net B/C). This is a comparison between a positive present value and a negative present value (Kadariah 2001). In general, net B/C is formulated as follows (Gray et al 1996):

$$Net\ {}^{B}/_{C} = \frac{\sum_{t=1}^{n} \frac{(Bt)}{(1+i)^t}}{\sum_{t=1}^{n} \frac{(Ct)}{(1+i)^t}}$$

If the net B/C value is higher than 1, the benefits are greater than the costs incurred, so the business is very feasible to run. Conversely, if the net B/C is lower than 1, the benefits from the business are smaller than the costs incurred, and the business is said to be unfeasible. Benefit Cost Ratio represents a comparison between all benefit values against all cost values (Ha 2009). Moreover, net B/C also shows how many times the benefits are obtained from the costs in a business (Cellini & Kee 2015). In other words, net B/C, in analyzing a business, can reflect the profit ratio that will be obtained because the benefits will be reduced by the costs incurred during the assumed business life (Sen 2000). In addition, the net B/C takes into account cash flow over the life of the project/investment.

Pay Back Period (PBP). This represents a period that indicates how long the capital/investment invested in the business can be returned. The PBP is used with the aim to calculate the period of return on investment capital used to finance the business. According to Soeharto (2001), this technique is used to determine in what time the capital invested in the business will return. The formula used to assess PBP is as follows (Gray et al 1996):

$$PBP = \frac{Initial\ investment\ value}{Net\ cash}\ x\ 1\ year$$

The PBP is the number of years required to return the investment that has been spent in a business/project (Vajpayee & Sarder 2019). Investors or entrepreneurs often use PBP as a determinant in making investment decisions, whether their investment capital in a business will generate profit or not. Moreover, PBP shows how long it will take for the investment to return (Ardalan 2012). A project with a very long PBP is certainly less attractive to most investors.

Results and Discussion

Sustainability analysis. The results of the MDS-Rapfish analysis for the sustainability of the skipjack fishery business on Buhung Pitoe Island is presented in Figure 1.

The skipjack tuna fishery business sustainability index on Buhung Pitoe Island was 53.07, being quite sustainable. The level of sustainability is due to the level of income obtained from the capture of skipjacks, which is still relatively high; the average income of fishermen peaks at 15490.02 USD (data obtained from interviews), and the revenue in the reguler season is 7949.18 USD. The sustainability index is divided into four categories: 0 to 25 (discontinued), 26 to 50 (less continuous), 51 to 75 (moderately continuous) and 76 to 100 (continuous) (Fauzi & Anna 2002). Therefore, it can be concluded that the level of management of the skipjack fishery business on Buhung Pitoe Island is, from an economic aspect, relatively good.

Moreover, the skipjack tuna fisheries sustainability index is influenced by five main factors, namely: 1) the level of economic accessibility (RMS=11.51), 2) the existence of economic institutions (RMS=10.49), 3) business managerial ability (RMS=10.13), 4) business skills (RMS=8.03), and 5) business feasibility (RMS=6.09).

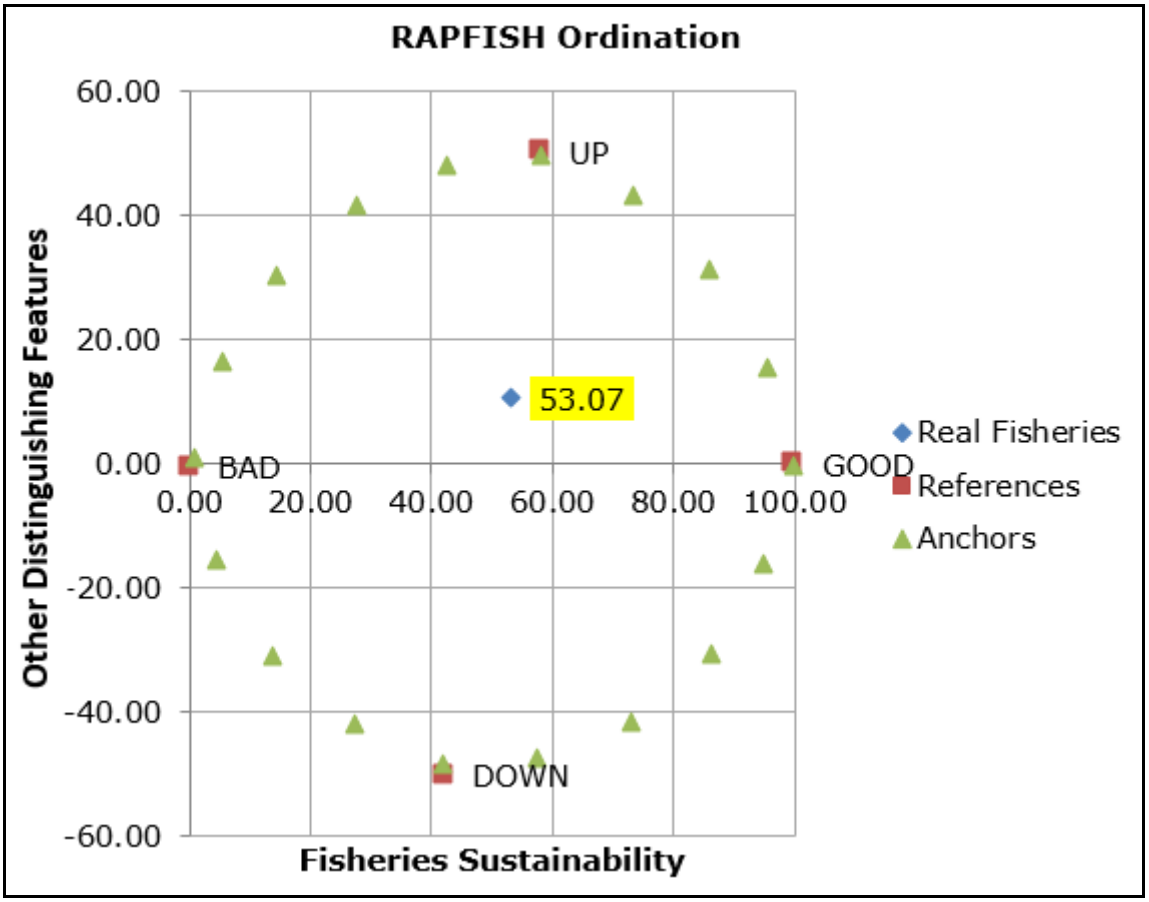

Figure 1. The skipjack tuna (*Katsuwonus pelamis*) fishery sustainability index on Buhung Pitoe Island, Indonesia, based on economic aspects.

The results of the analysis of the leveraging attributes of the skipjack fishery business in Buhung Pitoe Island are detailed in Figure 2. The measure of accessibility includes the ease of time, cost, and effort in moving from one point to another point. The level of economic accessibility is related to the ease of access to economic facilities and information, which engage the skipjack fishery business on Buhung Pitoe Island. This business includes market facilities, equipment and machine parts stores, fishing gear stores, building materials stores, loan-saving cooperatives, banking units, and other economic information. Therefore, it can be concluded that the economic accessibility factor is a major factor in the skipjack fishery business on Buhung Pitoe Island. Buhung Pitoe Island is a small island, where access to economic facilities is the main obstacle in the fishery business. This is different from the situation of fishermen who live on mainland, with better access to goods and information. Consequently, the level of accessibility for both goods and information becomes the main limitation factor in the island.

The existence of economic institutions represents the presence or absence of institutions engaged in the economic field, such as fishermen cooperatives, the existence of savings and loan units and banking units. According to Baskara (2013), an economic institution carries out an activity in an economic field for the fulfillment of the economic needs of society. An economic institution is born as a human effort in adapting itself to nature in order to meet the needs of life related to an arrangement of economic fields (Rahardja & Manurung 2004). In our case, it relates to the fishing life and business of skipjack. Based on the survey results, economic institutions on Buhung Pitoe Island were still very limited. Moreover, the Fish Landing Place (FLP/TPI Lappa) in North Sinjai, Sinjai Regency, economic institutions can only be accessed well on the mainland. In the FLP located on the mainland, economic institutions are relatively complete and well

accessible, so that generally all fishermen on Buhung Pitoe Island carry out economic activities.

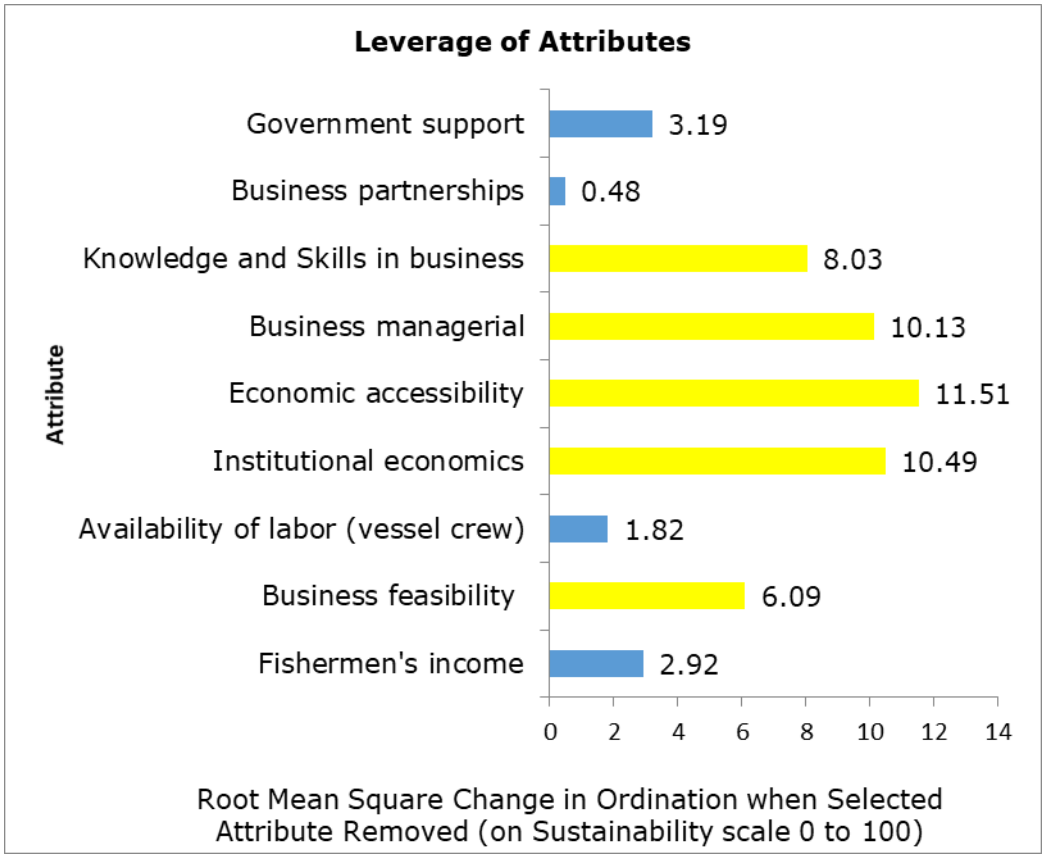

Figure 2. The leveraging attribute of the skipjack fishery business sustainability in Buhung Pitoe Island from an economic aspect.

Managerial ability is a set of technical skills in carrying out a task as a manager, to utilize all available resources to achieve business objectives effectively and efficiently (Karweti 2010). The managerial capability referred to in this case is the managerial ability in the fishery business of skipjack. Ability is defined as the individual's capacity to perform various tasks in a job (Kirch 2008). According to Yuniarsih et al (2018), managerial ability is the skill to organize, coordinate and move subordinates towards achieving the goals set by the organization. This ability is born from a long process that occurs slowly through observation and learning. The managerial ability can be obtained through years of business experience, or from educational institutions, especially informal education, such as entrepreneurial training or counseling (Hasibuan 2001). Therefore, managerial capability is very important, because the large investment capital in the skipjack fishery business reaches large sums, so it has a high business risk. On the other hand, the high business capital required causes the business to be sustainable, especially in the financial aspects. It also important to consider the personnel that exists in a business unit, where generally there are 8-9 crew members. A leader could face various personal traits/characteristics of its crewmembers. Therefore, a good leader is required to have good emotional management when facing unique personal characteristics or situations. With good managerial skills in human resource management, a business can run systematically, and can be organized so that the work process is more oriented towards reaching targets (Dessler 2015). In addition to the ability to manage conflict and human resources, the leader must also be able to inspire and positively encourage his team, and should be involved and responsible in solving problems and take risks (Satria 2002).

According to Mulyadi & Irawan (2016), skills require training and basic abilities, so that people are able to help produce more value more quickly. Furthermore, skills represent the ability to use reason, thoughts, ideas and creativity in doing, changing or

making something more meaningful (Semiawan 1985). In addition, it can also be interpreted as the ability to translate knowledge into practice, so that the desired performance will be created (Hikosaka et al 2002). The possessed knowledge and skills of fishermen are generally obtained from experience, or obtained from training or by attending counseling (Kusnadi 2004). According to Subagyo (2008), skills are the practice of knowledge that are influenced by the level of education, which facilitates the acceptance and absorption of new situations and solving the issues in these new situations; by age, which brings physical and psychological changes, and a higher age brings more maturity; by experience. The experience that a person has will be influenced by the person's maturity in thinking and acting (Soemarjadi et al 1991).

Feasibility analysis. A description of the analysis for the eligibility criteria for the skipjack fishery based on financial aspects could be seen in Table 3, as follows:

Table 3

The results of the feasibility analysis

No	*Parameter*	*Analysis results*	*Indicator*	*Decision*
1	Net Present Value	1.23	>0 (+)	worth it
2	Net Benefit-Cost	3.79	>1	worth it
3	Internal Rate of Return	38.81%	>Minimum Attractive Rate of Return (MARR=18%)	worth it
4	Payback Period	3rd year	No (-)	worth it

The NPV was 1.23, meaning that the skipjack fishery business on Buhung Pitoe Island is feasible. Therefore, skipjack fishery business can be done and is currently being pursued by the community in Buhung Pitoe. With the business forecast in the next 10 years assuming a capital interest of 15%, the business can provide a high profit of 4250.02 USD per year. In other words, with an initial capital of 34020.65 USD, a skipjack fishery business will earn 4250.02 USD per year.

The net B/C was 3.79, which means that the skipjack fishery business on Buhung Pitoe Island was feasible. If the skipjack fishery business is carried out (in the form of business investment), there will be a profit of 3.79 times the invested capital.

IRR had a value of 38.81%, greater than the MARR value of 18% (IRR>MARR). Consequently, the skipjack fishery business on Buhung Pitoe Island is very feasible and very attractive to investors. The IRR value reached twice the MARR value. This condition will attract investments in the skipjack fishery business on Buhung Pitoe Island.

The results of the PBP analysis show that the fishery business can achieve a positive profit in the third year, 9361.84 USD. It is claimed that the skipjack business in Buhung Pitoe represents a prospect from the business side. Thus, the PBP on capital is relatively short, so the skipjack fishery business is able to benefit from the invested capital. For this reason, the skipjack fishery business on Buhung Pitoe Island is relatively good and very feasible. In addition to the feasibility of the business, there are also other considerations in the business of skipjack fisheries, such as relatively high business risks, which generally characterize businesses in the field of fisheries (Yard 2000). Therefore, given the relatively high business risk, the skipjack fishery business in Buhung Pitoe Island requires a relatively fast rate of return on capital).

Conclusions. Based on the results of the economic analysis, the following can be concluded: 1) the level of sustainability of the skipjack fishery business on Buhung Pitoe Island, from an economic aspect, was classified as quite sustainable, with a sustainability index value of 53.07%, with five leveraging attributes; 2) the feasibility was classified as feasible from a financial perspective, with an NPV of 1.23, net B/C value of 3.79, IRR value of 38.81%, and a PP of approximately 3 years.

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Conflict of Interest. The authors declare that there is no conflict of interest.

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