



Analysis sustainability of Patin Kualo (*Pangasius kunyit*) capture fisheries in Teluk Meranti Village of Teluk Meranti District Pelalawan Regency Riau Province

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Abstract

Analysis Sustainability of Patin Kualo (*Pangasius kunyit*) Capture Fisheries in Teluk Meranti Village of Teluk Meranti district Pelalawan Regency Riau Province based on five dimensions, namely ecology, economy, social, technology, and institutional. The approach used is *Multi-Dimensional Scaling* (MDS) with the Rapfish technique, as well as leverage and Pareto analysis to identify sensitive attributes. The method used in this study is a survey method with direct interviews in the field using questionnaires. The results of the study show that the overall sustainability status is in the "moderately sustainable" category with a multidimensional index value of 54.16. The index values for each dimension are as follows: ecological dimension 47.76 (less sustainable), economic dimension 54.75 (moderately sustainable), social dimension 43.55 (less sustainable), technological dimension 64.22 (moderately sustainable), and institutional dimension 60.55 (moderately sustainable). Attributes that are sensitive to the sustainability of Kualo Catfish (*Pangasius kunyit*) fishing in Teluk Meranti Village, Teluk Meranti District, Pelalawan Regency, Riau Province, include the attributes of range of capture area, size of the patin caught, marketing distribution, average income, alternative jobs, community welfare programs, fishermen's insurance, level of education, socialization of fisheries regulations, government policy, benefits of fisheries regulations for the welfare of fishermen, fishing vessel size, pre-sale processes, and engine type.

Keywords: Sustainability, capture fisheries, Patin Kualo, Rapfish, Teluk Meranti District

Introduction

Fisheries is one of the sectors relied upon for Indonesia's future development because it can have an economic impact on a large portion of the Indonesian population. In addition, fishery products are also an important food source for the community in general, making the fisheries sector one of the sources of state revenue as well as a source of livelihood for most people in river areas, especially fishermen. Capture fisheries in Indonesia require planned management so that capture fishing activities can be sustainable [1].

One of the coastal areas in Riau Province that has capture fishery resources is Pelalawan Regency. Pelalawan Regency consists of 12 sub-districts, with the largest sub-district being Teluk Meranti Sub-district, which covers an area of 4,321.64 Km². Teluk Meranti Village is one of the areas with potential fishery resources in public waters. The types of fish found in this area include patin (*Pangasius sp*), selincah (*Belontia hasselti*), tapah (*Wallago leeri*), baung (*Mystus nemerus*), toman (*Channa micropeltes*), dan selais (*Ompok hypophthalmus*) [2]. Among these species, patin is the main commodity most sought after by the local community.

Based on data from the Pelalawan Regency Central Statistics Agency in 2024, public water fisheries production in Teluk Meranti Village reached 1,407.72 tons, which is the highest in Pelalawan Regency. Catfish production has shown significant growth from year to year. In 2017, production was recorded at 206.28 tons, in 2018 at 197.48 tons, in 2019 at 197.64 tons, and in 2020 it increased to 1,093.91 tons in 2020, 1,279.17 tons in 2021, 1,295.57 tons in 2022, and increased again to 1,407.72 tons in 2023. These data show a consistent upward trend in catfish production in recent years.

Capture fisheries in Teluk Meranti Village, Pelalawan Regency, are still dominated by small-scale fisheries. The fishing gear used includes 865 gillnets, 430 longlines, and 11 fishing rods. Gillnets are nets that are placed vertically in the water to block the direction of fish swimming. Fish are caught by getting entangled in the mesh or wrapped around the body of the net [3]. This fishing gear is one of the most environmentally friendly and selective fishing methods. In terms of selectivity, this fishing gear only catches fish of a certain size depending on the size of the mesh used by the fishing gear, so it is very unlikely that fish that are too small will be caught [4].

Patin fish production tends to increase rapidly every year, which could cause new problems in the future if the utilization of patin fish resources does not take into account the carrying capacity of existing fish resources, raising concerns about overfishing. On the one hand, the local government continues to make efforts to increase the capacity of catfish fishing, such as providing assistance in the form of fleets and fishing gear, so that the number of catfish fishermen increases every year. Based on this, it is necessary to conduct an analysis of the sustainability of catfish fishing in the waters of Teluk Meranti Village.

Considering the characteristics of fisheries in Teluk Meranti Village, particularly the fishing activities targeting patin fish, and the concept of sustainable fisheries assessment, it is necessary to examine the sustainability of fishing from several dimensions of sustainability, namely ecology, economy, society, technology, and institutions. Several aspects of sustainability can be used as a basis for assessing the sustainability status of a fishery area, which can then be used as a reference in formulating policies for fisheries resource management or the sustainability of capture fisheries in the area. Therefore, this research is necessary

and very important considering that the sustainability of patin kualo (*Pangasius kunyit*) fishing can reflect the direction of national fisheries development in the future.

Research Methodology

Time and Place

This research was conducted in January 2025 in Teluk Meranti Village, Teluk Meranti District, Pelalawan Regency, Riau Province.

Research Method

The method used in this study was the survey method. The method used in the implementation of the study was the survey method. The survey method is direct observation of objects in the field and collecting data related to the research being conducted. The survey method aims to collect data from a number of variables in a community group through interviews and literature studies [5].

Determination of Respondents

Respondents in this study were determined using the probability sampling technique, which is a sampling method that gives equal opportunity to each member of the population to be selected as a sample. The sample of respondents was taken using the purposive sampling technique. The population in this study consisted of 110 fishermen in Teluk Meranti Village. To determine the sample size, the researcher used the Slovin method as follows:

$$n = \frac{N}{1 + Ne^2}$$

dimana : n = sample size
 N = population size
 e = (error tolerance)

The sample size that can be taken from the Slovin method is 10–20% of the research population, which consists of 110 catfish fishermen. The margin of error used is 20%, and the calculation results can be rounded to achieve consistency. So, to determine the research sample, the calculation is as follows:

$$n = \frac{N}{1 + Ne^2} = \frac{110}{1 + 110(0,20)^2} = 20,37$$

Based on the calculations, the number of catfish fishermen sampled in this study was 20, fishermen who met the criteria of catching kualo catfish with 3.5-inch gillnets and using 1 GT motorboats – 2 GT operating in the waters of Teluk Meranti Village, as well as stakeholders who have a relationship with the management of kualo catfish resources at the research location. The number of respondents included 20 fishermen and stakeholders selected to fulfill the primary and secondary data, namely the capture fisheries data/information section, which consisted of the head of the fishermen's group (1 person), community leaders (1 person), fisheries extension workers (1 person), village officials (2 people), the Fisheries Service (1 person), and a fisher cooperative (1 person), bringing the total number of respondents in this study to 27 people.

Data Collection

The data collected in this study consisted of primary and secondary data. The primary data used in this study was sourced from fishermen who catch kualo catfish and related parties, obtained through direct observation in the field and interviews using questionnaires. Meanwhile, secondary data was obtained through literature studies by collecting all information related to the research objectives, both from libraries and various related agencies (agencies, institutions, offices within the government), and various other information relevant to the research objectives.

Data Analysis

The analyseis used in this study were Multi-Dimensional Scalling (MDS), Leverage analysis, and Pareto analysis.

1. Multi-Dimensional Scalling (MDS) Analysis

Rapfish is a method used to analyze fisheries sustainability and is included in the application of multidimensional scaling in the field of fisheries [1]. Seluruh atribut yang diperoleh dari hasil penelitian ini dianalisis secara multidimensi. All attributes obtained from the results of this study were analyzed multidimensionally. Multidimensional analysis was used to determine the points in Rapfish that were examined relative to two reference points. The reference points are good and bad, where there are extreme good and extreme bad points. In addition, by using MDS analysis, the stress value and coefficient of determination (R²) can be seen. The sustainability index for each dimension does not fully reflect the overall sustainability status of the activity. Therefore, the index values for each dimension need to be combined to determine the multidimensional sustainability status value [15].

Stress values (S) and the coefficient of determination (R²) are used to measure goodnes of fit. Stress values can measure how close two-dimensional values are to multidimensional values. A good analysis is indicated by low stress values (S<0,25) and R² values above 95% confidence or close to 1 (100%) which means that the selected attributes can explain nearly 100% of the existing model, so that the quality of the Multi-Dimensional Scalling (MDS) analysis can be accounted for [6].

Table 1. Sustainability Status Index Categories

Indekx	Category
0-25	Poor (non sustainable)
26-50	Less (less sustainable)
51-75	Sufficient (sustainable enough)
76-100	Good (very sustainable)

Source: [7]

2. Leverage Analysis and Pareto Analysis

Determination of sensitive attributes that affect sustainability using a combination of leverage analysis and Pareto analysis. Leverage analysis aims to determine the relationship between each attribute and the sustainability status of capture fisheries. This analysis can show which attributes are considered to have the most positive/negative impact on sustainability status. The determination of sensitive attributes is based on priority order by looking at the Root Mean Square (RMS) ordinal value on the X-axis.

The greater the RMS value, the greater the role of the attribute in sustainability [8].

The Pareto concept, known as the 80-20 rule, states that 80% of activities are caused by 20% of factors. By focusing on the 20% of factors, 80% of the problems can be overcome. The use of Pareto analysis in this study will be adjusted to the research needs and will still refer to the sustainability index values in Table 1. The adoption of Pareto's Law in this study is not based on the 80-20 rule, but on the 75-25 rule, namely attributes with a cumulative value limit of <75% are the most sensitive attributes affecting the sustainability index value [9].

Result and Discussion

Overview of the Research Location

Geographically, Teluk Meranti Village is located on the banks of the Kampar River, where the area is still affected by the tides of the Kampar River. This area is about 135 km from the capital of Pelalawan Regency and can now be reached by road, whereas previously it could only be reached by river transportation such as *speed boats* or motorboats from Pangkalan Kerinci. Teluk Meranti Village covers an area of 1.470,67 km² of the Teluk Meranti Subdistrict. Teluk Meranti Village has the following boundaries: to the north it borders Sungai Apit Subdistrict, to the south it borders Rumbai Jaya Subdistrict, to the west it borders Teluk Binjai Village, and to the east it borders Pulau Muda Village.

The Teluk Meranti Village area is drained by the Kampar River as the main river with several tributaries such as the Serkap River, Turip River, Merawang River, Bilah River, and Kerumutan River, with a total area of 24.628,9 ha that has the potential to be developed for capture fisheries, while 82,22 ha has the potential for cage aquaculture and has its own potential for both biological resources and as a source of livelihood for the local community to be developed.

Analysis Sustainability of Patin Kualo (*Pangasius Kuyit*) In The Village of Teluk Meranti

Ecological Dimension

The ecological dimension in the sustainability index indicates that the capture fishery of Kualo catfish in Teluk Meranti Village utilizes fishery resources using effective fishing gear. This means that the attributes used contribute positively to future sustainability. The attributes of the ecological dimension focus on factors that are considered to influence the level of sustainability of patin kualo fishing, both directly and indirectly.

The results of the ecological dimension analysis obtained a sustainability index value of 47,76 which can be said to be in a less sustainable position, as indicated by two main factors, namely water conditions and fishing intensity. Fishing that is carried out too often without considering the season and the amount of catch has the potential to cause *overfishing*, reduce the catfish population, and disrupt the balance of the of the aquatic ecosystem.

Research [8] also confirms that irregular fishing times without considering the fish reproduction cycle can significantly reduce fish stocks and trigger ecosystem imbalance.

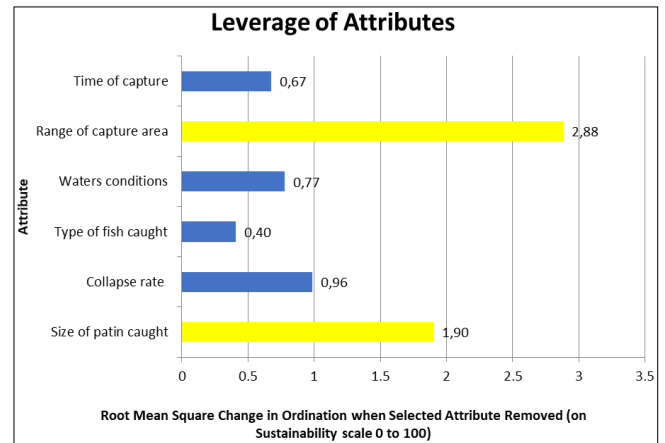


Fig 1: Sensitivity of Ecological Dimension

To identify sensitive attributes, *leverage* analysis and Pareto analysis were used. The RMS values in the leverage analysis results were sorted from largest to smallest, then accumulated by looking at the cumulative percentage results < 75%. Thus, it can be seen that the sensitive attributes for the sustainability of patin kualo fishing in Teluk Meranti Village are the range of capture area and the size of the patin caught. The fishing area coverage attribute serves as an initial indicator in assessing the ecological condition of fish stocks in river waters.

Attribute values can be categorized as sustainable if the fishing area remains limited and does not experience significant expansion, while values that show an unsustainable trend occur if there is continuous and significant expansion of the range. This is in line with the results of research [10] which states that fishing area management can be carried out through the establishment of fishing zoning. The establishment of these zones serves to prevent the extinction of fishery resources and ensure the sustainability of fisheries. Zoning is carried out by compiling maps of permitted fishing areas and maps of areas designated as no-fishing zones so that the distribution of fishing efforts can be managed more effectively and sustainably.

Changes in fish catch size can be influenced by several factors, including fish age, environmental conditions (water quality), fishing season, and fishing technique characteristics such as mesh size. The results of this study are in line with research [11] which shows that differences in the size of fish caught can be caused by different fishing activities, such as the fishing gear used, the fishing season, environmental conditions, and the level of exploitation in a water area.

Economic Dimension

The economic dimension refers to economic aspects that can be maintained in the long term without damaging natural resources and the environment. Economic factors are important indicators for assessing the welfare and stability of a community, especially those whose livelihoods depend on the fisheries sector.

The results of the economic dimension analysis obtained a sustainability index value of 54.75, which can be said to be quite sustainable, as indicated by two main indicators, namely relatively stable fishermen income and marketing distributions that reaches local, district, and provincial markets. Adequate income enables fishermen to meet their

basic needs, invest in fishing equipment, and maintain their fishing businesses. Additionally, a fairly equitable marketing system ensures that catches are absorbed well, thereby strengthening the economic resilience of fishermen's households.

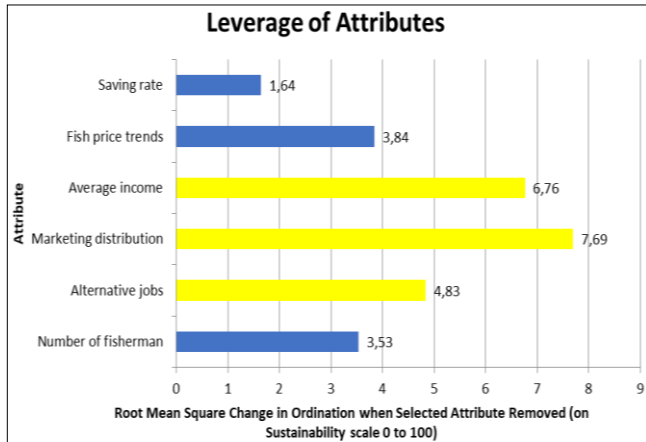


Fig 2: Sensitivity of Economic Dimension

To identify sensitive attributes, leverage analysis and Pareto analysis were used. The RMS values in the leverage analysis results were sorted from largest to smallest, then accumulated by looking at the cumulative percentage < 75%. Thus, it can be seen that the sensitive attributes in the sustainability of patin kualo fishing in Teluk Meranti Village in the economic dimension are the attributes of marketing distributions, average income, and alternative jobs.

The marketing of fish catches is an important link that determines the amount of fishermen's income. Direct sales through local markets give fishermen the opportunity to obtain better prices because there are no intermediary margins. However, limited storage facilities, daily fluctuations in demand, and consumer reach mean that most fishermen remain dependent on collectors and large traders as their main distribution channels. This dependence often puts fishermen in a weak bargaining position because prices are determined unilaterally by collectors, especially when the catch must be sold immediately to avoid spoilage. The establishment of fishermen's cooperatives is an important strategy to overcome this problem. Cooperatives can act as collective institutions that collect, weigh, and market catches collectively so that fishermen receive more competitive prices. Cooperative membership also provides access to cold storage facilities, business financing, and more transparent market price information.

This is in line with research [12] stating that the marketing of fish catches generally takes place through a multi-stage supply chain involving fishermen, collectors, wholesalers, retailers, and consumers. This chain structure results in significant transaction costs and distribution margins, so that the proportion of income received directly by fishermen is relatively small compared to the final value in the market. Several factors affect the amount of fishermen's income, including operational costs such as fuel, boat maintenance, and fishing equipment, as well as fluctuating fish prices in the market. Changes in fuel prices directly impact operational costs and are an important factor affecting fishermen's profit margins. To increase income, especially during the lean season, diversification of fishing businesses

and the provision of business capital assistance from the government or related institutions need to be considered [7]. The availability of alternative employment for fishermen is an important indicator in assessing their economic conditions. Fishermen who have additional sources of income, such as working as construction workers, traders, or farmers, have a stronger economic safety net so they are not entirely dependent on fish catches. This is also mentioned by [13], who found that diversification efforts such as working in other sectors (construction workers, farmers, small traders) have a positive impact on the income of fishing families and help them cope with times when sea conditions or catch are favorable.

Social Dimension

The social dimension reflects how the social life of fishing communities engaged in fishing activities is mutually supportive and integrated for the development of the capture fisheries sector and the maintenance of the social welfare of fishing communities. The analysis of the social dimension yielded a sustainability index value of 43.55, which can be considered unsustainable due to the low level of education among fishermen, the uneven distribution of training and extension services, and conflicts between fishing groups that trigger competition in the utilization of aquatic resources.

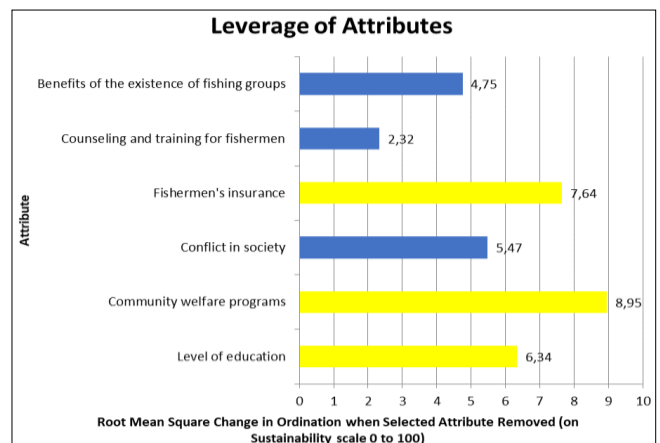


Fig 3: Sensitivity of Social Dimension

To identify sensitive attributes, leverage analysis and Pareto analysis were used. The RMS values in the leverage analysis results were sorted from largest to smallest, then accumulated by looking at the cumulative percentage < 75%. Thus, it can be seen that the sensitive attributes in the sustainability of patin kualo fishing in Teluk Meranti Village in the social dimension are the attributes of community welfare programs, fishermen's insurance, and level of education.

The welfare program for fishermen aims to strengthen their skills, improve their economic capacity, and improve their social conditions. In the social aspect, there are programs such as fish funding (fish on), scholarships, and subsidies provided to fishermen's families, especially children, so that they can continue their higher education. In addition, fisher welfare programs can provide access to microfinance and production assistance, provide fuel sales at low prices, build supply chains such as cold storage and cooperative-based fish auction sites (TPI), and help fishermen switch from destructive fishing gear to environmentally friendly gear.

The availability and accessibility of fishermen’s insurance is one of the key factors in improving the welfare and sense of security of fishermen. Fishermen who have access to insurance programs are better able to manage the economic risks of crop failure or losses at sea, allowing them to focus on preserving fish resources without having to resort to over- exploitation to cover their losses.

Education is one of the social attributes that influence the sustainability of capture fisheries. Education plays an important role in shaping fishermen's behavior, understanding, and awareness of the importance of maintaining the sustainability of fishery resources, as well as their ability to implement environmentally friendly and economical fishing practices.

Institutional Dimension

The institutional dimension describes the extent to which the role of institutions, including the level of enforcement and compliance with regulations, can support the sustainability of patin fishing. The attributes of this dimension focus on aspects that directly or indirectly contribute to the achievement of sustainable fishing.

The results of the institutional dimension analysis obtained a sustainability index value of 60.55, which can be said to be quite sustainable, as this value is influenced by government policies and the intensity of socialization of fishing regulations. Policies such as fishing regulations, quota setting, and habitat protection play an important role in maintaining the sustainability of fisheries. However, the effectiveness of these policies is highly dependent on the dissemination of information to fishermen and other stakeholders. Without adequate understanding, policies have the potential to not be implemented optimally, thereby hindering the achievement of sustainability.

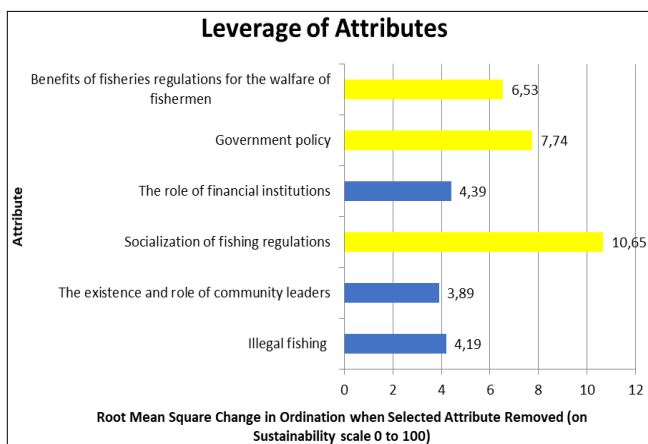


Fig 4: Sensitivity of Institutional Dimension

To identify sensitive attributes, *leverage* analysis and Pareto analysis were used. The RMS values in the *leverage* analysis results were sorted from largest to smallest, then accumulated by looking at the cumulative percentage < 75%. Thus, it can be seen that the sensitive attributes in the sustainability of patin kuala fishing in Teluk Meranti Village in the institutional dimension are the attributes of socialization of fishing regulations, government policy, and the benefits of fisheries regulations for the welfare of fishermen.

The dissemination of fisheries regulations is an effort to convey information about fisheries resource management

policies and regulations to fishermen and related parties. Optimal dissemination is expected to encourage fishermen to change their behavior towards sustainable fishing practices, reduce violations, and increase their involvement in the monitoring and management of fisheries resources.

Government policies on fisheries management include various regulations aimed at maintaining the sustainability of fish resources and the preservation of aquatic ecosystems. These regulations cover the setting of catch quotas, the protection of important habitat areas, and the application of environmentally friendly fishing technologies. These policies are designed to prevent overfishing, minimize negative impacts on ecosystems, and ensure that fishing activities do not damage the environment.

Good fisheries regulations not only provide ecological benefits, but also have a significant socio-economic impact on fishermen. The existence of regulations helps ensure the long-term availability of fish resources so that fishermen have a guarantee of the sustainability of their businesses.

Technological Dimension

The technological dimension shows how effectively capture fisheries resources are used for specific fishing activities. Good technology can help the capture fisheries sector in the long term and sustainably.

The results of the technological dimension analysis obtained a sustainability index value of 64.22, which can be said to be quite sustainable, influenced by the attributes of the fishing gear used and the size of the fishing vessels. *Gillnets* are a very efficient and environmentally friendly fishing gear, and the size of the vessels is also a factor that influences the technological dimension. Larger vessels may be able to produce more catches, but if not managed properly, this can lead to overfishing and damage to the ecosystem. Conversely, smaller and more efficient vessels can help maintain a balance between catch yields and resource sustainability.

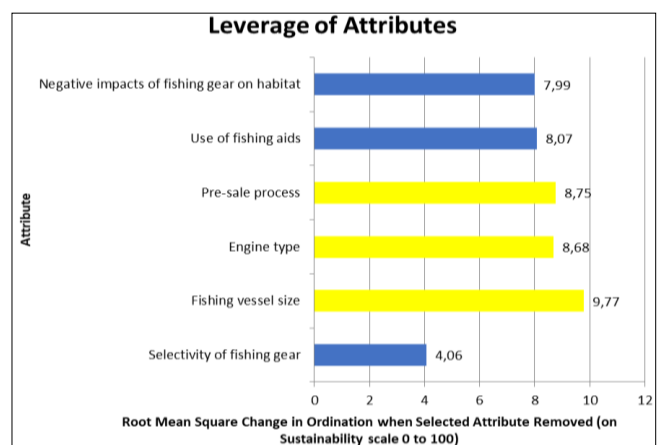


Fig 5: Sensitivity of Technological Dimension

To identify sensitive attributes, *leverage* analysis and Pareto analysis were used. The RMS values in the *leverage* analysis results were sorted from largest to smallest, then accumulated by looking at the cumulative percentage < 75%. Thus, it can be seen that the sensitive attributes for the sustainability of patin kuala fishing in Teluk Meranti Village in the technological dimension are the attributes of fishing vessel size, pre-sale processes, and engine type.

The size of a vessel plays an important role in determining the capacity and efficiency of fishing activities. Large vessels can carry more fishing gear and catch, but this comes at the cost of higher operational expenses. Choosing a vessel size that is appropriate for the type of fishing being carried out can support the sustainability of fishing businesses by reducing the potential negative impact on marine ecosystems. This is in line with the findings ^[14] which confirm that vessel size plays an important role in improving the technical efficiency of fishermen. This study also reveals that vessels that are too large can incur high operational costs and potentially increase pressure on fish stocks if not balanced with strict catch quotas. Therefore, selecting vessel sizes that are proportional to the type of fishery and ecosystem carrying capacity is key to maintaining a balance between economic productivity and resource sustainability.

The pre-sale stage of fish is an important part of the fisheries supply chain because it affects the quality, quantity, and sustainability of fish resources.

The type of engine used in fishing activities plays a major role in the operational efficiency of the fleet. Engines with more fuel-efficient consumption not only reduce operational costs but also reduce carbon emissions released into the atmosphere. In addition, the application of environmentally friendly engines, for example with low emission technology or the use of alternative fuels, can minimize negative impacts on aquatic ecosystems and support the achievement of sustainable fishing practices.

Goodness of Fit

Tabel 2: Stress Values and R-Square

No	Dimension	Stress Values	R ²
1	Ecological Dimension	0,14	0,94
2	Economic Dimension	0,16	0,94
3	Social Dimension	0,14	0,94
4	Institutional Dimension	0,15	0,94
5	Technological Dimension	0,15	0,94

In the Table 2: Stress values the *stress* values obtained from the five dimensions, namely ecological, economic, social, institutional, and technological dimensions, are less than 0,25. Meanwhile, the *R-Square* values of these five dimensions shows a value close to 1 atau > 90%. A good analysis is indicated by a low stress value ($S < 0,25$) and R^2 above the 95% confidence level or close to 1 (100%), which means that the selected attributes can explain nearly 100% of the existing model, thus the quality of the *Multi-Dimensional Scalling* (MDS) analysis can be justified ^[6].

Conclusion

Analysis Sustainability of Patin Kualo (*Pangasius kunyit*) Capture Fisheries in Teluk Meranti Village of Teluk Meranti district Pelalawan Regency Riau Province, is categorized as moderately sustainable at 54.16 (moderately sustainable). The ecological dimension is 47.76 (less sustainable), the economic dimension is 54.75 (moderately sustainable), the social dimension is 43.55 (less sustainable), the technological dimension is 64.22 (moderately sustainable), and the institutional dimension is 60.55 (moderately sustainable). Attributes that are sensitive to the sustainability of Patin Kualo (*Pangasius kunyit*) fishing in Teluk Meranti Village, Teluk Meranti District, Pelalawan

Regency, Riau Province, include the attributes of range of capture area, size of the patin caught, marketing distributions, average income, alternative jobs, community welfare programs, fishermen's insurance, level of education, socialization of fishing regulations, government policy, benefits of fisheries regulations for the welfare of fishermen, fishing vessel size, pre-sale processes, and engine type.

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