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# Sustainability Status of Gillnet Fisheries Based on Ecological, Social, and Economic Dimensions in the Riau Province Fisheries Port Technical Unit

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**ABSTRACT**

Gillnet fishing gear is an environmentally friendly fishing gear but in 2018-2020 the catch was reduced. The purpose of this study was to determine the sustainability status of gillnet fisheries based on ecological, social, and economic aspects at the Riau Province Fisheries Port Technical Unit. Data analysis in this study used Rapfish (Rapid Appraisal for Fisheries) technique. The rapfish technique is a multidisciplinary ordination technique used to evaluate/determine/compare the status of fisheries in terms of their sustainability. This study shows that in general, the sustainability index of gillnet fisheries in the Riau Province Fisheries Port Technical Unit is between the index values of 25.01-50 which is classified as less sustainable. Monte Carlo simulation results show that the distribution of sustainability index plots is at a distance that is not far and coincides with the position of the sustainability index ordination, supporting the accuracy of determining the ordination of the sustainability status examined. Sensitivity analysis showed that the attributes of changes in fish weight in the last 5 years, family participation in the utilization of fishery resources, and alternative employment and income are attributes that greatly affect the sustainability of gillnet fisheries in the Riau Province Fisheries Port Technical Unit.

**Keywords:** Fisheries Sustainability, Gillnet, Rapfish

## 1. INTRODUCTION

Dumai City is a coastal area located in Riau Province that has a major role in advancing the marine fisheries sector. Marine fisheries resources in Dumai City have considerable potential. One of the villages in Dumai City that has good marine potential is Pangkalan Sesai Village. Pangkalan Sesai Village is located in the West Dumai sub-district which is directly opposite the Malacca Strait so the source of fishery commodities is often utilized by coastal communities around Dumai City and the Malacca Strait (Megawati et al., 2016).

Capture fisheries in the UPT Pelabuhan Perikanan Riau Province are still dominated by small-scale capture fisheries. One of the dominant fishing gear in the UPT Pelabuhan Perikanan Riau Province is gillnet fishing gear. In addition, there are also several other fishing gears such as sondong and splints.

According to Subehi et al. (2015), gillnet is an environmentally friendly fishing gear because it has high selectivity, does not damage the habitat, does not endanger fishermen, the product does not harm consumers, and is acceptable to the community.

Although gillnet fishing gear is classified as environmentally friendly fishing gear, the catch is decreasing, therefore it is necessary to conduct research related to the sustainability of gillnet fishing based on ecological, social, and economic aspects at the Riau Provincial Fishing Port UPT. This is done to see the extent of the sustainability of gillnet fishing gear seen from these three aspects. In this study, the sustainability of capture fisheries was evaluated using a multi-variable method called multidimensional scaling (MDS). This method is known as Rapfish (Rapid Appraisal for Fisheries).

## 2. RESEARCH METHODS

### Time and Place of Research

This research was conducted from 27 July - 31 August 2022 at UPT Pelabuhan Perikanan Riau Province.

**Methods**

This research was conducted using a survey method, namely direct observation of the field at the Riau Province Fishery Port Technical Implementation Unit (UPT). The sampling technique in this study used purposive sampling technique. Primary data collection was obtained through interviews with respondents using a questionnaire. While for secondary data collection is done through a literature study by collecting all information related to this research, both from the library and from the relevant agencies.

**Data Analysis**

Data analysis in this study used the Rapfish (Rapid Appraisal for Fisheries) technique. This technique was developed by the University of British Columbia Canada and is used to evaluate the sustainability of fisheries in a multidisciplinary manner. Rapfish is based on an ordination technique that places things in order of measurable attributes using multidimensional scaling (MDS).

Sustainability analysis using the RAPFISH technique begins by reviewing, identifying, and defining the fishery attributes used. After that, scoring of the analyzed fishery is carried out. The scoring is based on the provisions set out in the RAPFISH technique. The scoring data is then processed using RAPFISH software facilities that are linked (add-ins) to MS Excel. Following the input of attribute score results arranged in the 'RapScores' matrix in the form of MS-Excel software worksheets, further data processing takes place in the software. In the RAPFISH software, processing occurs in each VBA (Visual Basic Applications) module linked to "g77ALSCAL.dll" for multidimensional scaling (MDS) operations, leverage analysis (Jackknife), and Monte Carlo analysis.

The attributes obtained were analyzed in multidimensional. This analysis was used to determine the points in the Rapfish studied relative to two reference points. The sustainability criteria rating scale used was 0-25 (poor), 25.01-50 (poor), 50.01-75 (fair), and 75.01-100 (good) (Yusuf et al., 2021).

Monte Carlo analysis to take into account the dimension of uncertainty. The Monte Carlo procedure is useful to find out the effects of misjudgment caused by incomplete knowledge of the case under study or misunderstanding of Rapfish attributes and assessment guidelines, the effects of variation in judgments due to differences in opinion or judgments by different people, the stability of the MDS method for successive successes (quality and stabilization), incomplete convergence (high-stress value), data entry errors or missing data, and ambiguous solutions (reversed or rotated). Each dimension and multidimensional has a "stress" value that indicates the analysis is good enough when a value of 25% or 0.25 is obtained. Because the smaller the "stress" value obtained means the more accurate the results of the analysis carried out.

According to Kavanagh & Pitcher (2004), Monte Carlo analysis can be used as a simulation method to evaluate the impact of random errors in the statistical analysis performed. Fauzi & Anna (2005) also stated that Monte Carlo analysis can be an indicator of errors caused by scoring each attribute, multidimensional scoring variations due to different opinions, data analysis processes that are carried out repeatedly, and errors in inputting data or missing data

## 3. RESULT AND DISCUSSION

**Ecological Dimension Sustainability Analysis**

The ecological dimension in this study focused on aspects of the level of fisheries exploitation, the level of collapse/reduction in the location of the fishing area, changes in the type of fish caught in the last 5 years, changes in the weight of fish caught in the last 5 years, the use of marine tourism waters, the pressure of water use and environmental changes and the quality of critical habitats in coastal areas. The results of the *scoring* value analysis on the ecological dimension that has been processed using the Rapfish method can be seen in Figure 1.

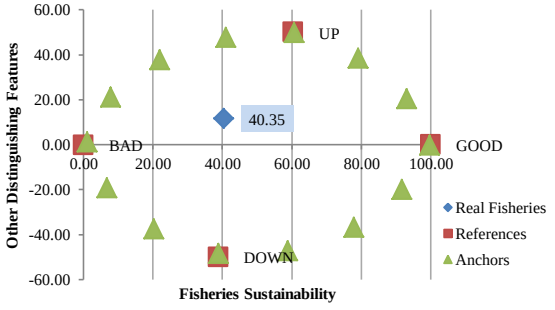


**Figure 1. Results of the analysis of the sustainability status of the ecological dimension**

The ecological aspect sustainability index obtained an ordination value of 40.35% which is categorized as less sustainable, based on Leverage analysis the attributes that become leverage factors and are considered sensitive to the level of sustainability of the ecological dimension change in fish weight within the last 5 years, changes in the type of fish caught in the last 5 years and the level of collapse/reduction in the location of the fishing area.

Changes to these leverage factors will easily affect the increase or decrease in the value of the ecological dimension sustainability index. The results of the *leverage* analysis are presented in (Figure 2).

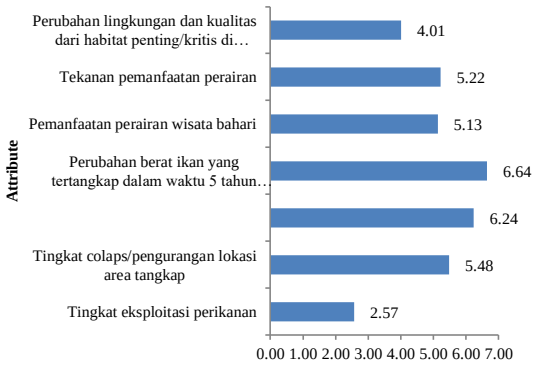


**Figure 2. Leverage analysis results of the ecological dimension**

The decline in catches caused by dwindling fish stocks has caused fishermen to reduce fishing locations. This is because in some locations the available fish are already relatively small. In addition, the reduction of locations is also caused by the occurrence of water pressure caused by ship traffic lanes and also the disposal of garbage waste into the waters and it greatly interferes with fishermen catching. The fishing process in the Riau Provincial Fishing Port UPT has generally exceeded the limit of overfishing. Reducing the spatial space of marine ecosystems or reducing fishing locations due to overfishing can affect fish stocks in a body of water so that fish will move to other places (Salmarika et al., 2018).

**Social Dimension Sustainability Analysis**

Social conditions are very influential on the sustainability of capture fisheries in the Riau Provincial Fishing Port UPT. The social dimension describes the social conditions of coastal communities and fishermen related to capture fisheries activities. Some attributes in the social dimension are knowledge of the fisheries environment, education level of fishermen, status and frequency of conflict, family participation in the utilization of fisheries resources, frequency of meetings between residents related to fisheries resource management, implementation of work (individual) / group, counseling, and training for fishermen. The results of the scoring value analysis on the ecological dimension that has been processed using the Rapfish method can be seen in Figure 3.

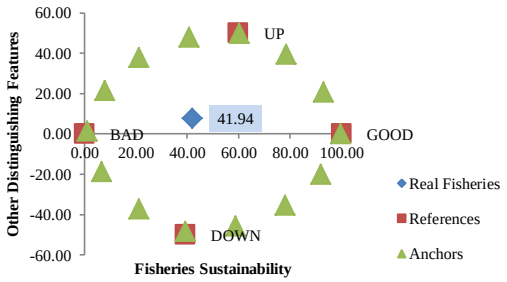


**Figure 3. Results of the analysis of the sustainability status of the social dimension**

The results of the analysis using Rapfish (Figure 3) show a social dimension index value of 41.94. This condition explains the index sustainability index of *gillnet* fisheries is in the less sustainable category.

There are 3 leverage factors in the social dimension, namely family participation in the utilization of fishery resources, the frequency of meetings between residents related to fishery resource management, and the level of education of fishermen. The results of the *leverage* analysis are presented in (Figure 4).

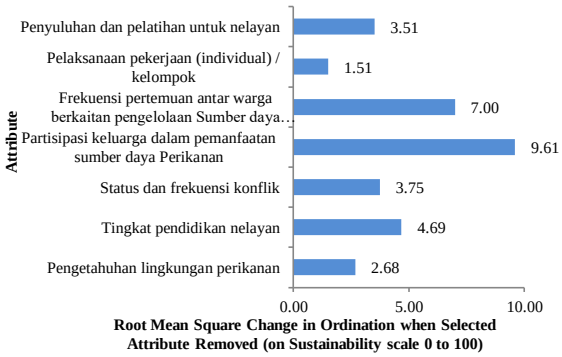


**Figure 4. Leverage analysis results of the social dimension**

The high value of *leverage* analysis in the social dimension is due to the low level of education of fishermen in the Riau Province Fishery Port UPT, resulting in limited knowledge and insight into fisheries resource management. In addition, there is still a lack of awareness among fishermen about the importance of counseling on fisheries resource management and the lack of family interest and participation in capture fisheries management activities. The government must improve counseling and skills use so that fisheries resources remain sustainable (Putri et al., 2017).

Family participation needs to be increased so that fishermen do not only rely on family income sources from the fishing process alone but also from other forms such as value-added fishery products.

**Economic Dimension Sustainability Analysis**

Economic conditions are an important factor in the survival of coastal communities. The economic dimension describes the economic conditions associated with capturing fisheries resources. The linkage is described based on several attributes in the study, namely fishing business profit, fisheries contribution to gross regional domestic product (GRDP), per capita income, ownership (beneficiaries of ownership), subsidy level to fisheries, alternative employment, and income, destination location or marketing orientation, fishermen's relative acceptance of each fishing gear to working time, labor absorption, profit transfer between fishermen and local economic actors/local economic outsiders.

The results of the scoring value analysis on the ecological dimension that has been processed using the Rapfish method can be seen in Figure 5.

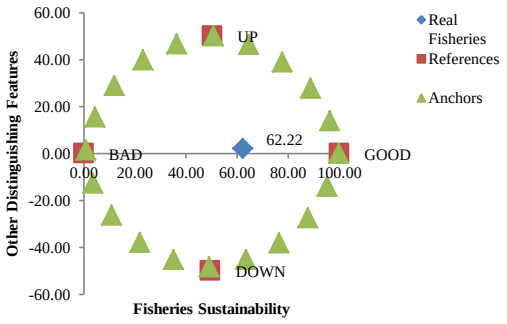


**Figure 5. Results of the analysis of the sustainability status of the economic dimension**

The results of the economic dimension sustainability analysis using Rapfish showed an index value of 62.22. This condition explains the sustainability index of gillnet capture fisheries is in the category of quite sustainable.

The influential attributes or the results of the leverage analysis in the economic dimension show that there are 3 sensitive attributes, namely alternative employment and income, destination location or marketing orientation, and ownership of fishing facilities. The results of the leverage analysis are presented in (Figure 6).

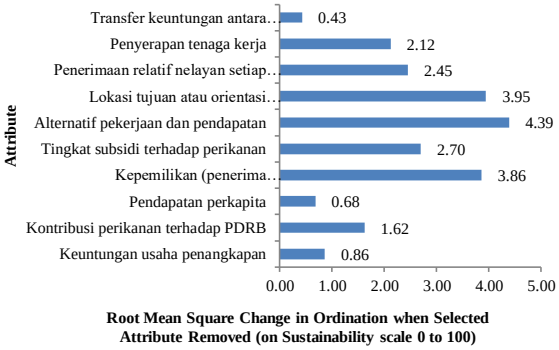


**Figure 6. Leverage analysis results of the economic dimension**

Marketing of fishery products in the UPT Pelabuhan Perikanan Riau Province is mostly controlled by residents. In general, the capital of fisheries businesses in the UPT Pelabuhan Perikanan Riau Province comes from local entrepreneurs and also migrants who invest in the business. Investment in the provision of fleets and fishing gear as well as the operational costs of catching the profit-sharing system related to this business between fishermen and entrepreneurs can be in the form of a sales/marketing chain or profit-sharing directly in the field. Based on the results of interviews with fishermen, to meet the needs of fishing and boat repair needs, gillnet fishermen in the UPT Pelabuhan Perikanan Riau Province borrow capital from agents or tauke. The reason fishermen prefer agents is that they need quick funds. The relationship between fishermen and middlemen at the UPT Pelabuhan Perikanan Riau Province is mutually beneficial. Because, with this cooperation, the work of fishermen becomes easier in selling their catches. Likewise, with the tauke, the more fishermen who work with the tauke, the more profit they get.

The parameters resulting from the

Rapfish analysis using the MDS method serve as a standard for determining the feasibility of the results of studies conducted in the study area. The presentation of stress values and $R^2$ (coefficient of determination) for each dimension and *multidimensional* can be seen in Table 2.

**Table 2. Rapfish analysis results**

| No. | Statistical attributes | Ecology | Social | Economics |
|---|---|---|---|---|
| 1. | *Stress* | 0.22928 | 0.22957 | 0.22086 |
| 2. | $R^2$ | 94.43 | 94.03 | 94.96 |
| 3. | Number of iterations | 2 | 2 | 2 |

## 4. CONCLUSIONS

Based on the results of the analysis in the research on the sustainability of gill net capture fisheries in the Technical Port Unit (UPT) of Riau Province Fisheries Port, it can be concluded that: The results of field observations and literature studies show that there are 24 (twenty-four) indicators that can reflect the sustainability index of gillnet fisheries. The results of the analysis of each dimension showed that the ecological dimension had an index value of 40.35 (less sustainable), the social dimension has an index value of 41.94 (less sustainable) and the economic dimension had an index value of 62.22 (moderately sustainable).

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