Review of European Studies; Vol. 9, No. 2; 2017
ISSN 1918-7173 E-ISSN 1918-7181
Published by Canadian Center of Science and Education

The Management Model of Fishery Environment in Bengkalis District, Riau Province

Pareng Rengi[1], Marnis[2] & Fitri[2]

[1] Faculty of Fisheries and Marine Sciences, University of Riau, Riau, Indonesia

[2] Faculty of Economics, State University of Riau, Riau, Indonesia

Correspondence: Priyono, Graduate Program Master of Management, Universitas of Bina Darma, Palembang, Indonesia. Tel: 81-21-697-4878. E-mail: priyono.unu_sidoarjo@yahoo.com

Received: October 12, 2016 Accepted: October 24, 2016 Online Published: May 7, 2017

doi:10.5539/res.v9n2p222 URL: http://doi.org/10.5539/res.v9n2p222

Abstract

Research purposes are to design management of fisheries environment sustainable in Bengkalis district. This study was conducted in Bengkalis district, in Riau province. This location is situated in a strategic area of the Malacca Strait.

This research used survey method. Types of data collected in the form of primary and secondary data. Data analysis techniques used in this research is descriptive analysis, sustainability analysis (Rapfish), stakeholder needs analysis and prospective analysis.

The analysis showed the management of fisheries environmental in Bengkalis district is in the bad category level or less sustainable with MDS value of 39.59 overall. Implementation of management strategies to fisheries environmental in Bengkalis district (P) with the interaction scenario between the migration distance (j), Pressure mangrove land (m), level of education relative coastal communities (r), fisheryenvironmental policy (k), cooperation among stakeholders (s).

Keywords: model management, overfishing, sustainability analysis, MDS

1. Introduction

1.1 Background

Coastal waters and marine Bengkalis district is part of the Malacca Strait linking the inland waters of Indonesia by the Andaman Sea and the Indian Ocean. Results of research Marine and Fisheries Agency Bengkalis district (2008), the analysis of the fishery potential in Bengkalis Sea waters and refers to the potential of the waters of the Malacca Strait and then extrapolated based on the vast waters, pelagic fish that the sustainable potential of up to 55 meters water depth between 3350-5900 tons. The production is estimated at 7767 tons, thus the level of utilization has exceeded its potential. Overall Bengkalis coastal waters have been exploited beyond water potential is equal to 257.5%, or has exceeded 2.5 times of the sustainable potential waters. Utilization of fishery resources with multiple capture methods developed in the coastal waters Bengkalis district had caused overfishing.

The research location is spread through five locations, i.e., Fish Auction Place (FAP) Tanjung Medang Sub-district of North Rupat represent Rupat as Station I, Meskom Villagein Bengkalis District as the station II, New StraitVillage in Bantan Sub-district as station III, Pambang Village in Bantan Sub-district as station IV, Muntai Villagein Bantan Sub-district as station V. The fifth point of the station an area that represented the area of fisheries in Bengkalis District. Primary data were collected using a survey method, which is carried out by field observations and measurements and in-depth interviews and Focus Group Discussions (FGD). While secondary data was obtained from the documentation reports from various relevant agencies. Data analysis included; Analysis RATFEN (Rapid Appraisal Technique for Sustainable Fishery Environment) which is a modification of Rapfish, Stakeholder Needs Analysis (PRA) and Prospective Analysis.

1.2 Research Purpose

This research is aimed to find a managementmodel of fisheries environmental in Bengkalis District. This objective will be achieved through the determination of the essential factors of fisheries environmental managementin Bengkalis District.

2. Methodology

2.1 Location and Research Time

This study uses the case study methodis in Bengkalis District, collection of field data held on May to September 2015 as well as modeling in January 2016.

2.2 Methods/Data Collection Procedures

This research used survey method. Stages of this research is: 1) Preparation, 2) Survey/data collection phase, 3) compilation/analysis phase, and 4) Modeling stage. The data used in this study are primary and secondary data. Primary data includes of patterns management and utilization fisheries and socioeconomic communities obtained by interview to the fishermen. Descriptive analysis includes data for policy review and sustainability benefits. In the analysis phase Rapfish, primary data obtained through interviews with experts guided questionnaires. Secondary data in this study a fishery statistical data, literature studies related studies, as well as existing policy data obtained from various sources related.

3. Data Analysis

The descriptive analysis in this study performed by interpreting the existing data, describe the problems of situation was experienced, a relationship, an activity with other activities, views, attitudes to appearance, or about a process that is ongoing. Analysis of the environmental sustainability of fisheries management in Bengkalis District conducted by RAPFISH approach (Rapid Assessment Technique for Fisheries) which developed by Fisheries Center, University of British Columbia (Kavanagh, 2001). The MDS method is a computer-based statistical analysis techniques by using Rapfish software, with the transformation of any dimension and multidimensional the fishery environmental sustainability. Analysis of the fishery environmental sustainability through several steps, among others: (1) determining the attributes of management of environmental fisheriessustainable for each dimension (ecological, economic, social, cultural, technological, legal and institutional); (2) an assessment of the attributes in an ordinal scale based on sustainability criteria for each factor and ordination analysis methods based multi-dimensional scaling (The MDS); (3) indexing and sustainability status to management of fisheries environmental of in the Bengkalis District. Attributes determination in every dimension of ecological, economic, social, cultural, technological, legal and institutional refer to the indicators of FAO 2007.

The MDS on Rapfish performed by calculating the shortest distance from the *Euclidean distance* in equation 1:

$$d_{1,2} = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + \cdots} \quad (1)$$

Multidimensional *Euclidean* distance between the two points (d_{12}) then in The MDS is projected onto a two-dimensional *Euclidean* distance (D_{12}) based on the regression formula according to Fauzi and Anna (2005) in the following equation:

$$d_{1,2} = a + bD_{12} + \text{elsterror} \quad (2)$$

The regression process in Ratfen using algorithms ALSCAL (Fauzi & Anna, 2005) which in principle makes iterative the regression processes such that above so is obtained *e* the smallest value. ALSCAL algorithms were used in RATFEN according to Kavanagh (2001) also attempted to force in order to *intercept* in the equation equal to zero (a=0) so that the equation (2) into the following equation:

$$d_{1,2} = bD_{12} + e \quad (3)$$

Stakeholder's needs analysis was conducted to obtain the components that influential and have the important role in management of fisheries environmental from all stakeholders involved. After getting the supporting data for the determination of the basic necessities obtained based on the analysis of stakeholders' needs, then estimated the needs of each stakeholder. *Prospective analysis* is used to determine the important factors in the management of fisheries environmental sustainable. Prospective analysis is not the same as the forecasting for prospective analysis can predict alternatives that will happen in the future either be positive (desirable) or negative (undesirable). The usefulness of prospective analysis is to prepare a strategic action that needs to be done and see if changes are needed in the future (Bourgeois & Jesus, 2004).

4. Results and Discussion

4.1 Results

Analysis of sustainability status to Management of Fishery Environmental in Bengkalis district Riau province iscarried out through the Multi-Dimensional Scaling approach (The MDS) is a technique Rapfish approach. The dimensions are analyzed to determine the status of sustainability covering ecological, economic, social, institutional and technological. Status of sustainability for each of these dimensions is used to make improvements in the future of the factors or attributes that are sensitive or levers to increase the sustainability of fisheries environmental management Bengkalis district Riau province.

4.1.1 Sustainability Ecological Dimensions

The MDS analysis results for the ecological dimensions of sustainability index shows that the Management of Fisheries Environmental in Bengkalis District Riau Province amounted to 32.71 (Figure 1).

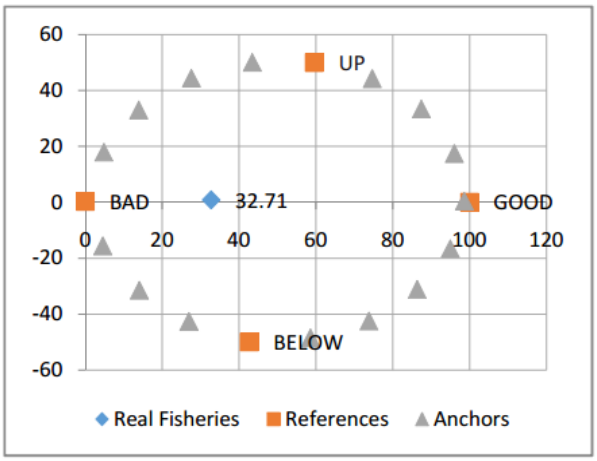

Figure 1a. Sustainability indexof ecological dimension

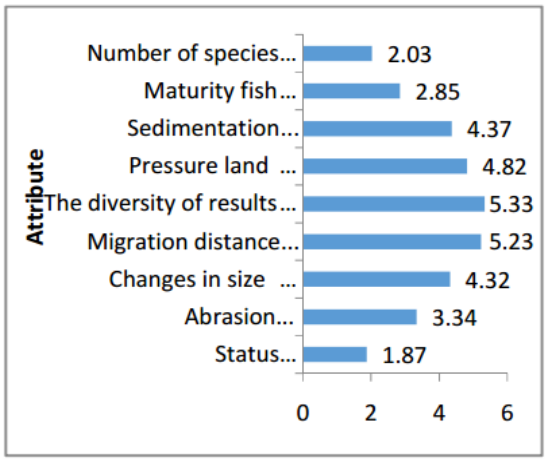

Figure 1b. Leverage ecological dimension factors

Leverage analysis used to determine the attributes that are sensitive or give effect to an index value of sustainability. Leverage analysis results (Figure 1b) shows that the ecological dimension is a factor key leverages are: (1) the diversity of catches.

Mangrove land pressure have a dominant influence in the sustainability of fishery resources because it serves as a spawning ground and a place to live fish, so it will affect the ability of fish to recover naturally. It can be seen from the size of the fish are getting smaller because the fish do not have time to grow up or diminishing fish species for fish to reproduce opportunity to recover its carrying capacity decreases. So, we need a policy in the mangrove management.

4.1.2 Economic Dimension

The MDS analysis results to the economic dimension shows that magnitude of sustainability index of the fisheries environmental management in Bengkalis District is amounted of 40.53 (Figure 2). Based on the scores of sustainability, the economic dimension classified as less sustainable.

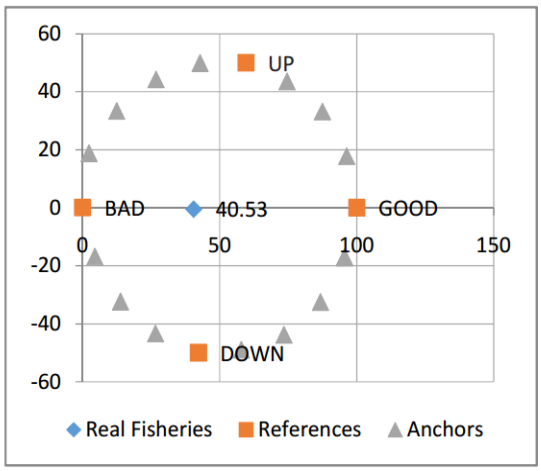

Figure 2a. Sustainability index of the economic dimension

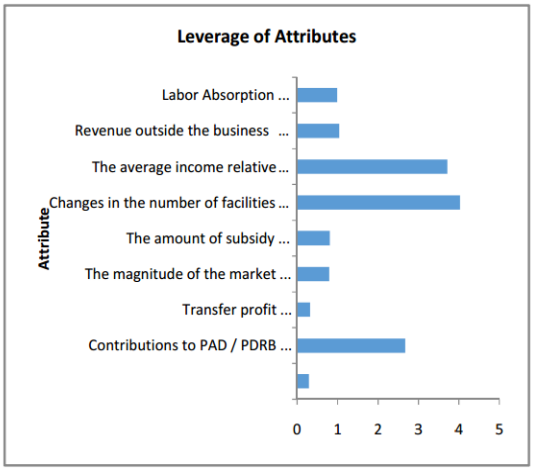

Figure 2b. Leverage economic dimension factors

The results of the factor analysis/attribute leverage (leverage attributes) as shown in Figure 2b, shows that there are three main leverages factor in the economic dimension of sustainability aspectsis; changes in the number of economic facilities (the last 5 years), the amount of subsidies and market size. The emergence of the main leverage of factors explains that these attributes are very sensitive to sustainability status of fisheries environmental on the economic dimension.

Changes in the economy means Bengkalis District over the last 5 years quite rapidly and therefore contributes to the management of fisheries environmental. The amount of government subsidies in the form of fuel as one of the largest input operational costs fishermen become an important attribute in the management of fisheries environmentally sustainable. This can affect the level of effort/fishing effort, which in turn can lead to over-fishing.

However, factors other than key levers above, the percentage of the labor absorption capacity of fisheries must be limited as Allahyari (2010) explains that when 50% of the proportion of the population absorbed in Fishing Sub-Sector is a condition with a poor economic sustainability. The proportion indicate lack of alternatives to find another job in the area where the fisherman usually work is the only option available.

4.1.3 Social Aspects

MDS analysis results to the economic dimension indicates that the magnitude of sustainability indexes of the fisheries environmental management at 48.38 (Figure 3a). Based on the scores of sustainability, the social dimension relatively less sustainable.

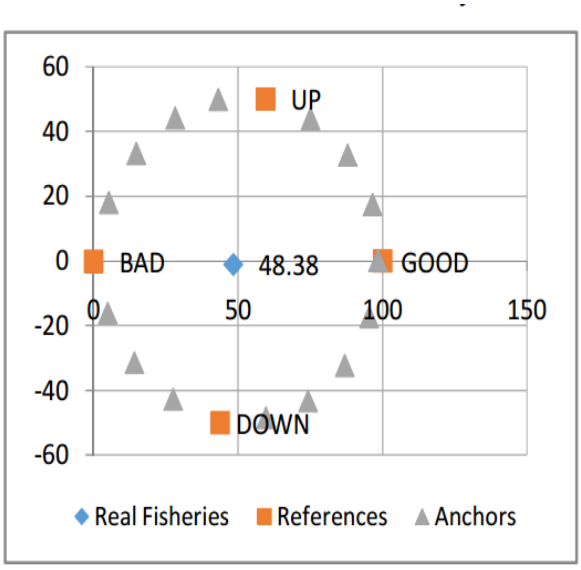

Figure 3a. Sustainability index of social dimensions

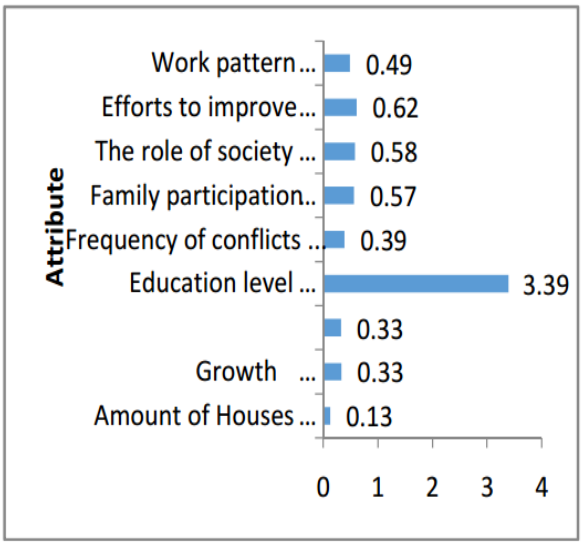

Figure 3b. Factors Leverage social dimension

Based on Figure 3b, the result that there is one attribute of the most dominant influence on the environmental sustainability of fisheries overfished territorial waters of the social dimension of the Bengkalis District, i.e., relative education level of coastal communities. Based on primary data in the field and literature studies, there was information that the education level of coastal communities are generally low. The level of education has a significant impact on the management of fisheries environmental, because it will affect how viewing habits and patterns of society in managing and utilizing natural resources and the environment. This attribute is one of the important instruments that need to be driven government in an effort to improve the level of education and knowledge of fishing communities in order to create management of fisheries environmentally sustainable.

The next influential attributes that the community's role in the management of fisheries resources. Community participation through group work patterns will increase the opportunities for sharing resources in carrying out fisheries management activities. In addition to the fishing groups could share experiences to improve their capacity. With a group of fishermen will be easier to find consensus on the existing problems. Berkes (2003) stated that the ability to improve the condition of a fishing activity is also influenced by the extent to which stakeholders can hold a consensus on a common goal.

4.1.4 Institutional Aspects

The results of the institutional analysis shows institutional function of both formal and non-formal in management of fisheries environmental in Bengkalis district is not run well. It is characterized by the vulnerability of the environmental conditions of the fishery due to human activities. Stakeholders who have influence and a strong interest in management of fisheries environmental sustainable in Bengkalis, among others DKP, Parliament, the Forest Service and BLH.

MDS analysis results for the institutional aspects shows that the sustainability index of the fisheries environmental management at 45.46 (Figure 4a). Based on the sustainability scores, so the legal and institutional dimensions relatively less sustainable.

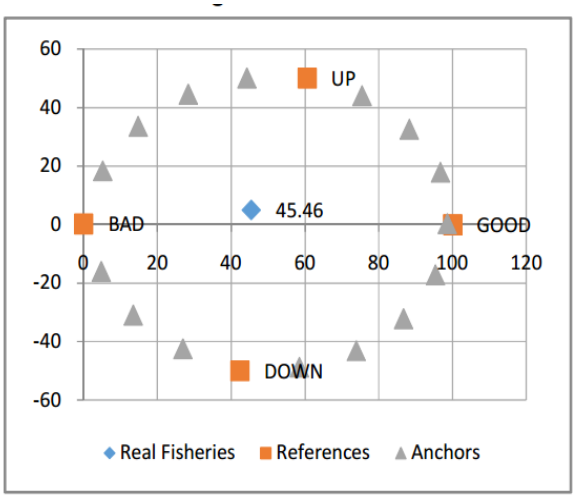

Figure 4a. The sustainability index of institutional dimensions

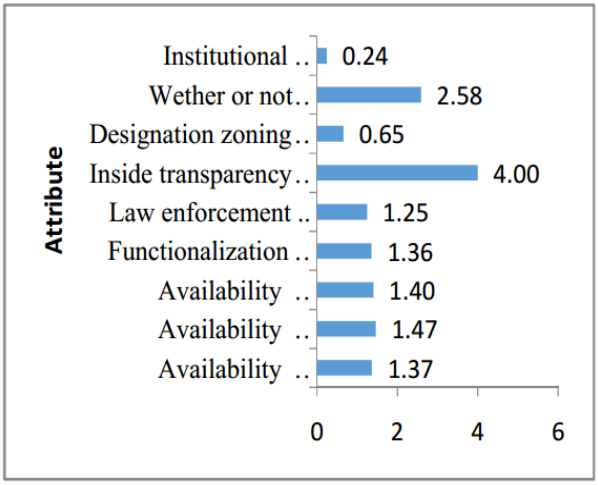

Figure 4b. Factors Leverage institutional dimension

Index value of fisheries environmental sustainability in Bengkalis district on institutional dimension obtained by techniques Ratfen is 45.46. Based on the sustainability criteria so the sustainability status in this institutional dimension is at less sustainable status. Stress values obtained on the social dimensions are 0.1475 (14.75 percent) or still below 25 percent so analysis Ratfen already meets the conditions good of fit. R^2 value obtained was 94.80 percent, which means the model was using the variables are now explained 94.80 percent of the existing models.

Based on Figure 4b is known that there is one attribute of the most dominant influence on the environmental sustainability of fisheries Bengkalis of the institutional dimension of transparency policy. Based on the findings of primary data through discussion fishermen, PPP (Policies, Plans and Programs) made relevant government fisheries management has not been optimal to involve the participation of fishing communities in the formulation. The participation of fishing communities in this regard, information on the needs, issues and so forth. Berkes (2003) stated that the formulation of policy and resource management objectives that involve issues related to the factual conditions of fishermen using participatory management approach is adaptive strategy that will involve knowledge, capacity, and independence of resource users, thereby enhancing the sustainability of resource use within the community.

4.1.5 Technology Aspects

Fishing gear for the fisheries resource is analyzed Kurau nets, longlines and gillnets. Based on the number of trips (effort) in fishing gear, it can be concluded that most fishermen fishing using gear operated drift and settle. Of the total effort is also known that the addition of fishing gear occurred sizable effort. Based on the results of interviews with selected respondents found the fact that:

1) Old fishing trip operate their fishing gear is one day to one week.

2) Most of the fishermen sell their catch shortly after arriving in TPI, and the fish is fresh fish sold without going through any treatment.

3) The use of fishing gear that is destructive aid is rarely encountered.

Value index of environmental sustainability of fisheries Bengkalis on the dimensions of the technology acquired with the technique Ratfen is 48.85. Based on the status of the sustainability criteria of sustainability dimension of this technology is at less sustainable status. Stress value obtained in the technological dimension is 0.1473 (14.73 percent) is still below 25 percent or so of analysis Ratfen already meets the conditions good of fit. R^2 value obtained was 94.81 percent, which means the model using the variables are now explained 94.81 percent of the existing models.

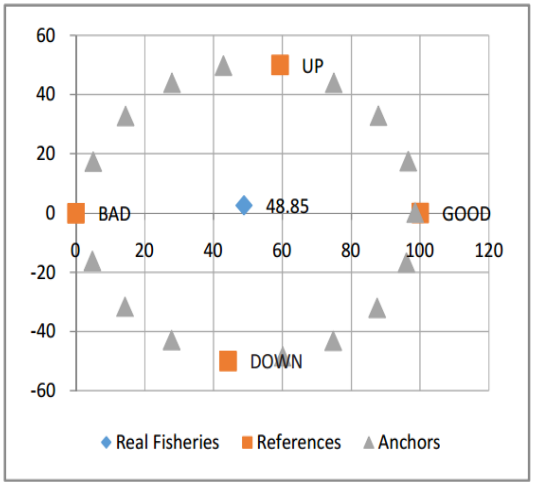

Figure 5a. Sustainable index of technology dimension

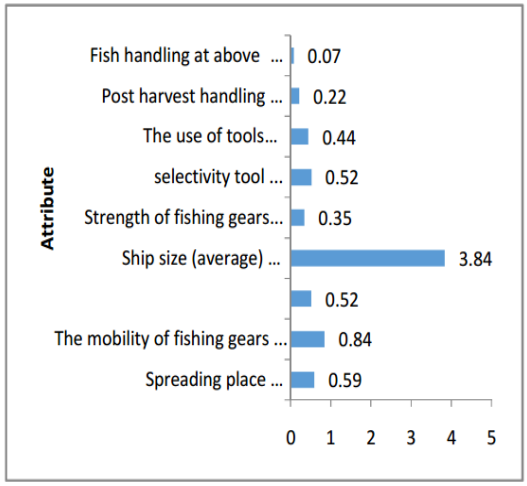

Figure 5b. Factor leverage technology dimension

The results of this analysis provide management strategies for local governments in the form of means of capture fisheries development program. According Gullestad et al. (2014) required settings that restrict the focus of ownership and transfer of fishing rights between geographical regions and between the fleet (GT high and low). This will cause the effect of lowering the number of vessels and fishermen in the region overfishing.

4.1.6 Status Multidimensional Sustainability

Prediction environmental sustainability status catch fisheries portrayed through 45 attributes. The whole of this attribute consists of nine attributes in the dimensions of ecology, nine attributes in the economic dimension, nine attributes in the social dimension, nine attributes in the institutional dimension and nine attributes in the technological dimension. By analyzing the MDS it is known the position or status of environmental sustainability catch fisheries on good or bad ordinate. The results of the analysis using techniques Ratfen expected to be a common reference in the proposed improvement of the sustainability status of the catch fisheries environmental (Figure 6).

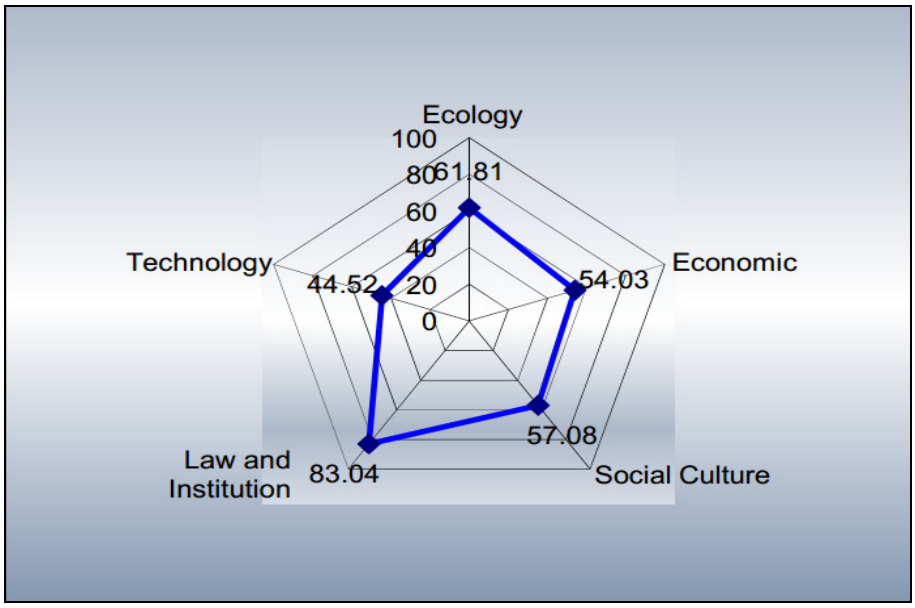

Figure 6. Kite chart MDS analysis results

Results of weighting puts ecological dimension at the top followed by the economic dimension, social, institutional and technological. Based on the number of these values are obtained 39.59 multidimensional index value which indicates that the sustainability status of the fisheries environmental management multidimensional in Bengkalis district are in the bad category/less sustainable status. This indicates that to improve the overall sustainability of status is required arrangement of the various high sensitivity attributes to the ecological dimension in particularly.

4.2 Discussion

4.2.1 Essential Factors of Fisheries Environmental Sustainable

Based on the sustainability analysis by using MDS, obtained sensitive attributes that affect fisheries environmental sustainability. These attributes, among others: (1) The distance migration, (2) Pressure mangrove lands, (3) The amount of subsidy, (4) The educational attainment relative coastal communities, (5) Transparency in policy, and (6) The size of the ship.

The results showed that the stakeholders had link directly or indirectly in the management of fisheries environmental in Bengkalis district broadly can be grouped in four categories, namely: (1) community, consist of fishermen, universities and NGOs, (2) government group, comprising on services/agencies related to the management of fisheries and marine environment, transportation, development planners, cooperatives/SMEs and financial institutions, (3) private group consists of the fishery, and (4) consumer groups, namely public.

Through the needs analysis results are analyzed, there are four attributes as a key factor in the management of fisheries environmental which are the driving factors and have a strong influence in the system being studied. These factors, among others: (1) government policy, (2) the quality of human resources, (3) cooperation among stakeholders, and (4) fishermen income Factor. Calculation of prospective analysis stakeholders needs (the direct influence).

The scenario of fisheries environmental management strategies in Bengkalis district obtained based on key sustainability factor analysis results by Ratfen which the drawing current conditions (existing) and the stakeholders' needs analysis that describes the conditions expected in the future. The key factors were obtained by integration (merging) between MDS sustainability analysis and analysis of stakeholders' needs.

The combined factors of MDS prospective analysis result and stakeholder needs analysis further analyzed again with a combined prospective techniques as shown in Figure 7.

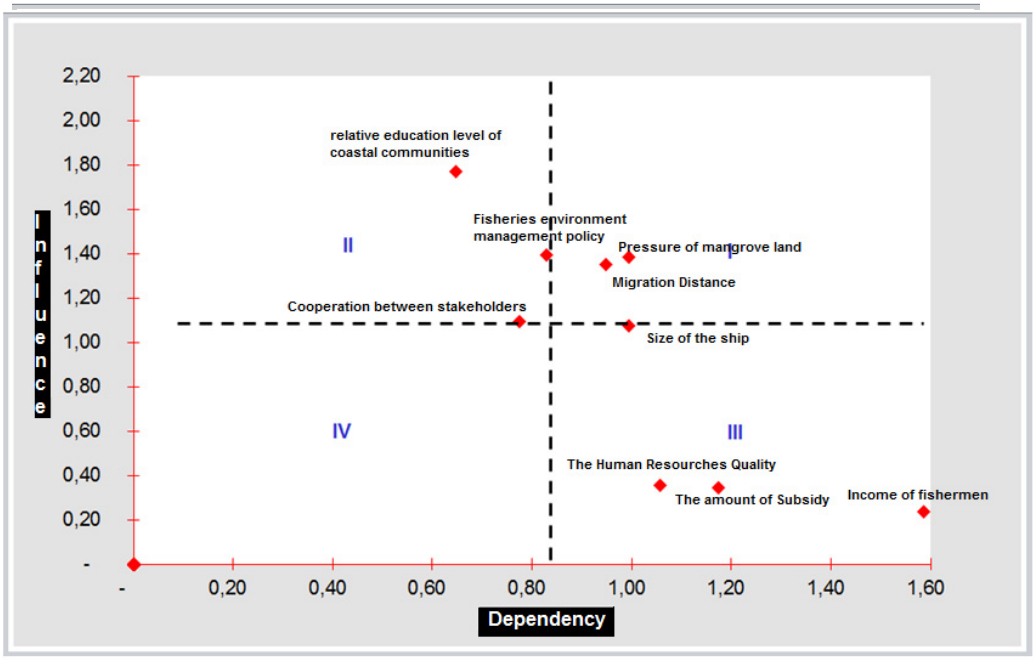

Figure 7. The key factors of the combined analysis

Based on the combined results of the analysis found five the dominant factors are affecting environmental management in Bengkalis district. Model of management of fisheries environmental in Bengkalis district (P) is an interaction between; Distance migration (j), Pressure mangrove land (m), level of education relative coastal communities (r), environmental policy fishery (k), cooperation among stakeholders (s). In order to realize a model of environmental management of fisheries sustainable carried out by repairing and improving important factors contained in the model formulation.

4.2.2 Management Model of Fisheries Environmental Sustainable

Management strategies of fisheries environmental in Bengkalis district is conducted by the approach of sustainability analysis by existing conditions and analysis of stakeholders' needs. Finding out the status of sustainability index and used methods of multidimensional scaling (MDS) is called the Ratfen. Indicators that are analyzed include the five sustainability dimensions namely the ecological, economic, social, institutional and technological.

Analysis by Ratfen obtained index and sustainability status of each dimension and the leverage factors or key attributes. The results are then followed by a prospective analysis to determine the key factors or dominant. These factors would have a considerable influence on the system to be built in an effort to fisheries environmental management in Bengkalis district.

Stakeholders needs analysis is performed to determine the factors based on the preferences of the needs in the future. Factors or attributes of stakeholders' needs are conducted a prospective analysis to obtain the key factors or dominant towards the achievement of environmentally sustainable fisheries management. The results of the analysis of sustainability is integrated with stakeholders needs analysis using prospective analysis. The results are used to develop strategies for sustainable fisheries environmentally management. The result of the integration will be obtained dominant factor that will be used as the basis for the preparation of environmental management strategies scenario fisheries in Bengkalis district.

The scenario is a picture of the future of each and every dimension of sustainability a key factor. The specified scenario then simulated to assess the sustainability index and status in the future. Changes in the condition (state) of each dominant factor in the future have a number of different possibilities, as described in Table 1.

Table 1. The description of each scenario fisheries environmental management strategies

Scenario	Description (captions)
I (Minimal)	Make improvements to the management of fisheries environmental by increasing the scoring on several sensitive attributes to the unsustainable dimensions in minimally
II (Optimal)	Make improvements to the management of fisheries environmental by increasing the scoring on some sensitive attributes to the all dimensions in optimally
III (Maximum)	Make improvements to the management of fisheries environmental by increasing the scoring to the all sensitive attributes in maximally

Scenario of fisheries environmental management strategies Bengkalis district is prepared by 3 (three) scenarios, the minimum scenario, the optimal scenario and maximum scenario. Each of these scenarios in the policy application is highly dependent variables of time, costs and resources. Model environmental management of fisheries is based on strategies compiled in Scenario I (minimal), II (optimal) and III (maximum). Management model (P) to the management of fisheries environmental in Bengkalis district is an interaction between distance migration (j), Pressure land mangrove (m), level of education relative coastal communities (r), environmental policy fishery (k), cooperation among stakeholders (s) can be described in relation function as follows:

$$\mathbf{P=f\ (j,\ m,\ r,\ k,\ s)}$$

In order to realize these functions carried out by repairing and improving the management of the key factors in management of fisheries environmental in Bengkalis district. Management model of fisheries environmental is based on strategies compiled in Scenario I (minimal), II (optimal) and III (maximum). The integrated approach factor Distance migration (j), Pressure land mangrove (m), level of education relative coastal communities (r), environmental policy fishery (k), cooperation among stakeholders (s) in relation to the function **P=f (j, m, r , k, s)** into consideration in determining the management of fisheries environmental in the waters over exploitation

(overfishing) in Bengkalis district. Management model of fisheries environmental by the function **P=f (j, m, r, k, s)** is the novelty of this study is described through scenarios and strategic management direction of fisheries environmental in the waters over exploitation (overfishing) in Bengkalis district.

If the migration distance (j), mangrove land pressure (m), is a constant (c), it is based on the assumption that the two factors are variables that are fixed (constant) and required in the management of fisheries environmental.

Thus the formulation of management is:

$$P_j = \sum_{i=1} c\ r_{ij}.\ k_{ij.}\ s_{ij}$$

Description: i=1, 2, 3, 4, 5 (function to i)

j=1, 2, 3 (scenario to j)

So, the management formulation of fisheries environmental in various scenarios is:

$P_1=c\ (r_{1.1}\ k_{1.1}\ s_{1.1}+...+r_{5.1}\ k_{5.1}\ s_{5.1})$; minimal scenario

$P_2=c\ (r_{1.2}\ k_{1.2}\ s_{1.2}+...+r_{5.2}\ k_{5.2}\ s_{5.2})$; optimal scenario

$P_3=c\ (r_{1.3}\ k_{1.3}\ s_{1.3}+...+r_{5.3}\ k_{5.3}\ s_{5.3})$; maximum scenario

Implementation of environmental management model in Bengkalis district is undertaken to achieve an optimum condition with regard to the costs required and the exercise period.

4.2.3 Scenario of Fisheries Environmental Management

Based on MDS analysis result, laverage, needs (need analysis) and prospective analysis of environmental management strategies can be formulated fisheries in Bengkalis district in Riau province. Implementation of environmental management strategies of fisheries (P) with the scenario I (minimal) to do with the interaction between distance migration (j), Pressure land mangrove (m), level of education relative coastal communities (r), environmental policy fishery (k), cooperation among stakeholders (s) with the relationship functions: $\mathbf{P_{(1)}=f\ (j, m, r, k, s)}$. In the first scenario the environmental management of fisheries to be improved through increased scoring on several attributes sensitive to the dimensions unsustainable. Implementation of the strategy with the scenario I improve the sustainability index by 5.88. So the value of a combination of existing sustainability index 41.61 increased to 47.49. So the management status on this scenario is less sustainable.

In the second scenario (optimal) efforts is the management of fisheries environmental carried out improvements on all dimensions, with relations function $\mathbf{P_{(2)}=f\ (j, m, r, k, s)}$. Increasing the value of sustainability index of 13.75. So the value of a combination of existing sustainability index 41.61 increased to 55.36. Thus the management status of fisheries environmental in scenario II is already sustainable.

In the third scenario (maximum) efforts is the management of fisheries environmental to do repairs on all dimensions maximally, with the relationship function $\mathbf{P_{(3)}=f\ (j, m, r, k, s)}$. Increasing the value of sustainability index of 24.82. So the value of a combination of existing sustainability index 41.61 increased to 66.43.

Sustainability level of fisheries environmental management can be increased from the current existing conditions. Repairs on a key attribute (sensitive) in each dimension, is able to increase the value of sustainability index. Through a management strategy with the scenario II and III application will be obtained a management level of fishing environmental is sustainable from each dimension. Increasing the value of sustainability index on scenario II and III provide a significant change in the level of fisheries environmental sustainability is marked by the index value of all sustainability dimensions that has been good. Increasing the value of sustainability index on each scenario in every sustainability dimension is shown in the kite chart Figure 8.

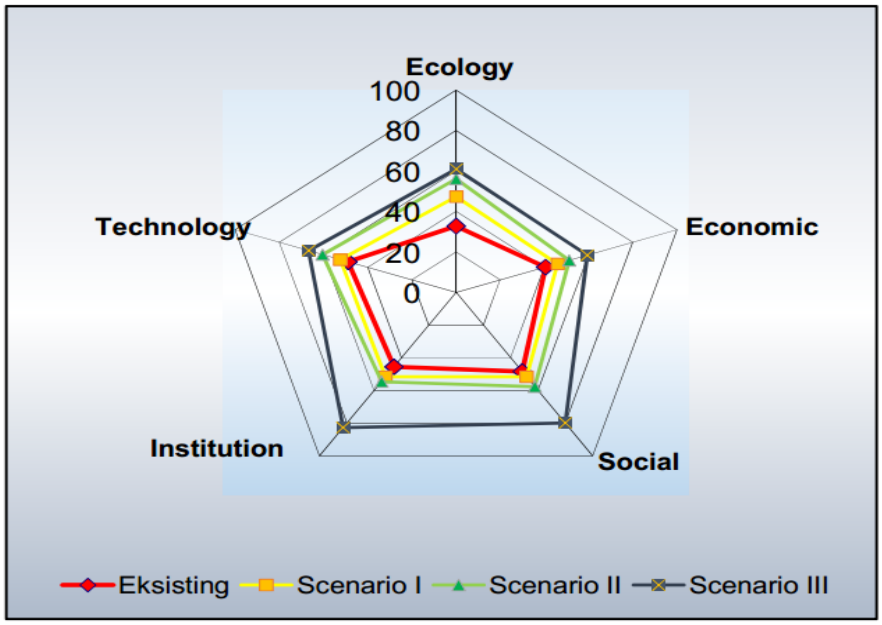

Figure 8. The five sustainability dimensions of sustainability index on existing conditions, Scenario I, II and III on fisheries environment

Environmental management strategies of fisheries in Bengkalis district performed based on strategies compiled in Scenario I, II and III. In the scenario I do like the existing conditions and a slight improvement in some sensitive attributes on dimension that is unsustainable. In the second scenario, the increase in scoring on several sensitive attributes on all dimensions is not optimal. In the third scenario, the increase in scoring on all the attributes of a sensitive after scenario II. Thus the strategy management of fisheries environmental in the future to do with the implementation of such a dominant factor.

Fisheries environmental management strategies are determined by the role of the dominant factors that provide increased value of sustainability index. Interaction between the dominant factor will be taken into consideration in determining management strategies in the future. Preparation of management models of fisheries environmental done by looking at the interaction between the components of the ecological, economic, social, institutional and technological. The model was built based on an integrative approach to all key attributes that affect the management of fisheries environmental. Management efforts was using strategies in scenario II (optimal) is a condition that can be achieved at this time. By using correlation function $\mathbf{P_{(2)}=f(j, m, r, k, s)}$ the value of a combination of existing sustainability index 41.61 increased to 55.36. Availability of human resources, cost, time and policies that can support the achievement of the optimum strategy, a consideration for the successful management conducted.

4.2.4 Management Strategy

Operational steps that can be taken to obtain the results of the environmental management of fisheries at its optimum in Bengkalis district, among others by undertaking the repair and programs on key factors. Repair of the key factors as the operational stages to gain optimum management of fisheries environmental in Bengkalis District described as follows:

Migration Distance

Data related to the pattern of the fish house, either through primary and secondary data as well as some of the results of the analysis in this study suggests that fish migration distance in Bengkalis district quite far mainly pelagic fish, the condition is generally caused by environmental factors waters. In the framework of sustainable environmental management of fisheries, then some strategies to follow up the conditions of the migration distance which is making the fish house reinforced with the establishment of the institution as a management group.

Management model of fisheries environmental can be done through the construction area of the fish house/fish apartment reinforced with the establishment of the institution as a group manager, and equipped with local regulations pertaining to the management. Management strategies such as this can be one of the instruments of empowerment. Governments and private companies through the CSR funds work with the community to build a number of fish house/fish apartment area, and then performed of seeding sea fish periodically.

The fish apartments (fish house) is a building hollow composed of construction plastic partition, shelter, and ballast were placed in the bottom waters serves as a spawning site for adult fish (spawning ground) and or area protection, care and rearing for eggs, larvae and juveniles (nursery grounds) that aims to restore the availability (stock) of fish resources (Bambang et al., 2011).

Form of fish house/fish apartment can be prepared patterned with a particular structure. Material from the fish house is made of concrete, the shape can be like a garbage can upside down whose sides made certain diameter holes or rectangular or like a pipe. Each unit of the concrete is arranged on the seabed have been surveyed and not far away from land so as to form a region called the home of fish. Besides the fish house/fish apartment can also be made with plastic materials, the main raw material used to manufacture fish skeleton apartment is a type of plastic materials Polyprophylene (pp). Chosen plastic material because it is easy to obtain and can be produced in a suitable amount desired, relatively safe (non-toxic), do not dissolve in water, durable, safe for humans and the environment (Life *Cycle Assessment of PVC European Commission*; in Bambang et al., 2011).

Construction of fish houses/fish apartments in this strategy is not geared as FADs, or fish traps, but in order to secure fish stocks. As the study of Lim et al. (2014), who studied complex systems at the University of the Philippines Diliman in Quezon City, have modeled the effects of FADs in the western Pacific, the results showed that "when the fishery has been overfishing, using FADs can only accelerate the collapse of the fishery". However, modeling also shows that on the other hand the use of FADs (fads) can be used to protect fish stocks, by building these FADs and then banned or severely regulate fishing effort. This will change to the Fed FADs (fish stock enhancement device). So the feds can protect highly mobile species (migratory) which tend to swim out of the conservation area, or has a function as part of the reef system. So the feds based fishing system can serve as a shelter various areas of fishery resources.

Construction of fish houses/fish apartments effectively aims to maintain fish stocks will have an impact on the increase in the volume of fish caught without interrupting the continuity of its life cycle and save on mileage while cruising at sea. Placement of the house/apartment and analysis of fish require special consideration so getting the right decisions based on the best option.

The Pressure of Mangrove Land

Mangrove forests as an ecosystem in coastal areas have ecological functions that play an important role in coastal protection and survival of fishery resources. As one of the ecosystems in coastal areas, mangrove forests is a unique and fragile ecosystem with ecological and economic functions. Ecological function of mangrove forests to fish resources, among others as a habitat (the residence), feeding (feeding ground), where the care and rearing (nursery grounds), and the breeding (spawning ground).

Based on the results of the previous analysis, there was information that the condition of mangrove forests Bengkalis district under pressure, which causes degradation and result in abrasion and other coastal disasters. This condition is of course also impact on the fisheries sector. It required a series of policies in order to maintain and repair the mangrove area that also serves as an area/fisheries environmental.

Technically, the government issued a policy regarding Technical Guidelines for Forest and Land Rehabilitation through the Minister of Forestry No. 70 Year 2008 which was renewed by No. 26 in 2010. The regulation states that the rehabilitation of mangrove forests can be done on land with stands of mangrove degradation/deforestation so disturbed ecological functions, social and economic. The rehabilitation activities performed as a form of protection against the region to conserve mangrove forests.

Referring to the condition of Bengkalis district and existing government regulations, the strategy to overcome the pressure of mangrove land can be an optimal scenario, namely the protection of the area and conservation efforts as well as mangrove planting. This step involves the local government in this case related SKPD through a series of policies and environmental management program (strategy 4).

Level of Education Relative Coastal Communities

Interactions between humans and the environment is the interplay directly or indirectly. human role in the ecosystem is very broad, because the human environment is not confined to the physical, biological and chemical, but including also economic problems therein, cultural, social and religious. All sorts of changes in the

human environment will affect the human beings themselves. Man with the ability of science and technology can make changes to the environment. The change came because of the increasing needs of human life that causes the interaction between man and his environment has intensified. Similarly, the coastal communities that have a strong interaction with the environment fishery.

The level of education relative coastal communities have close links with the perspectives and attitudes towards environmental fishery. The role of coastal communities is an important factor in determining the success sustainable management of fisheries environmental. The strategy for improving the role of coastal communities performed with improving the quality of human resources through increased formal education and non-formal education (awareness programs and community development) as well as coastal communities to develop local wisdom.

Increased coastal community education conducted through formal and non formal education. Formal education of coastal communities in Bengkalis district through government programs in order to provide facilities for children of school age in Bengkalis coast which is the next generation of coastal communities. Non-formal education such as training and counseling intended for fishermen or coastal communities in general in order to provide the knowledge and awareness of the environment fishery. Strategi can be poured in the form of the following programs:

a. Awareness programs and law enforcement in the utilization of marine resources.
b. Community empowerment program in the supervision and control of marine resources.

Local wisdom in Bengkalis related to environmental management is still limited. However, the concept of local knowledge can be developed through participatory management Pokwasmas realized in synergy with traditional elders and village administration. So that might be expected to be born local community agencies that regulate life based on noble values that are believed capable of providing a harmonious life, prosperity, dignity and personality in establishing various public relations into their own community or out society.

With the local institutions by customs, then there is a clear social rules, limits of rights and powers is happening within the rules, including the management and members of traditional institutions, coordination and decision-making arrangements to meet the needs of internal and for external purposes. All these organizational functions into tasks and functions of traditional institutions in synergy with the task of village head. So that starting from the management, supervision, coordination, sanctions existing in the traditional elders and head of government village.

Fisheries Environmental Policy

Bengkalis district government has a strategic function in environmental management for sustainable fisheries. The environmental policy of fisheries on the choice of optimal strategy in the form of a series of planning policy and environmental protection and integrated sustainable fisheries. Besides the necessary policies related to the development of Alternative Livelihoods (MPA) for the fishermen's fisheries Bengkalis District.

Policy related to the environmental management of fisheries done by involving community participation. As stated by Froese (2004); One of the causes of overfishing is the lack of clarity on community involvement in fisheries issues. The complexity of fisheries models have made it possible for people to bring their influence to control the use responsible for aquatic resources. There are three simple and understandable indicators that enable effective assessment of all stakeholders including the general public. Indicators that can be monitored or controlled, among others: (I) the percentage of mature fish catches (consumption), with 100% as the target; (Ii) the percentage of species with the length/size is optimal, with 100% as the target; and (iii) the percentage of "mega-spawners" catches, with 0% as a target, and 30-40% as a representative of a reasonable stock structure if there are no limits of the existing measures. This strategy can also be applied in Bengkalis through formal and non-formal regulation with community involvement.

Policy environment management of fisheries by the regional government in the form of set limits coastal border tailored to the characteristics of topography, biophysical, hydro-oseonografi coastal, economic and cultural needs, as well as other provisions. Other policies are the rules relating to the management of domestic and industrial waste that can pollute waters.

Environmental protection policies in the form of fisheries protection regulations on coastal ecosystems, such as wetlands, mangroves, coral reefs, seagrass beds, sand dunes, estuaries and deltas. Environmental safeguard fisheries policy fishing gear selectivity. The use of environmentally friendly fishing gear will give a good impact on the sustainability of fisheries resources. It also calls for a series of measures against the restrictions on fishing effort and fleets. Based on the results of the two commodities economical bioeconomy fisheries Bengkalis

district. The Parang-parang fish necessary to reduce the trip amounted to 82,168 trips per year per 423,334 of the total trip the Kurau fish while the effort needs to be reduced by 14.749 trips per year. So through this policy generated rents optimal and environmental sustainable fisheries.

Policy gear restrictions also with a large set mesh sizes. It is intended to improve the selectivity of fishing gear, so that only the target species caught alone, while other species can escape out through the net. For example, on gill net fishing gear and drift gill net. Diversify their fishing gear, it is intended that the fishermen do not rely on one type of fishing gear only, but can choose other gear types with different target species.

Cooperation between Stakeholders

Successful management of fishery environment is largely determined by the cooperation among stakeholders, this is caused by the environmental characteristics of cross-sectoral fisheries. Patterns will affect the management of cooperation among the stakeholders. Bodhanya and Cecile (2014) revealed the main points of the findings of their study results that the importance of balancing the needs of stakeholders when implementing the new policy, as well as the need to improve cooperation between the various stakeholders. Institutional concerning aspects of the employment relationship, the source of funds, payment systems, land allocation, and organizational. Parties associated with an interest in environmental management of fisheries in the waters overexploitation (overfishing) Bengkalis, among others: Bappeda, Department of Marine and Fisheries, the Environment Agency, Banking, Large Corporate Private/State Research Agency, NGOs, cooperatives of fishermen. On future attempts to do is cooperation among stakeholders runs with good coordination and supported by their duties and functions are clear of each institution.

The formation of a cross-sectoral institutions to support cooperation between stakeholders can be done by forming a "working group of fisheries environment" that is facilitated by the Department of Marine and Fisheries. It is based on the consideration that the Marine and Fisheries Agency has duties and functions as the sectoral institutions are responsible for the success of fisheries programs. Forum or institutional consisting of various stakeholders from backgrounds different would be beneficial in order to optimize the management of fisheries resources. This is in line with the assessment of Stohr (2014) which states that the dialogue/discussion forums and knowledge sharing among different stakeholder groups will increase and useful to achieve certain goals that are relevant to stakeholders, including government officials. The obvious benefits have been achieved in the social and institutional as well as for the economic and ecological effects.

5. Closure

5.1 Conclusion

Important factors that influence the environmental sustainability of fisheries in Design management (P) on the environmental management of fisheries waters overexploitation (overfishing) in Bengkalis an interaction between distance migration (j), Pressure land mangrove (m), level of education is relatively communities coastal (r), environmental policy fishery (k), cooperation among stakeholder (s) that can be described in relation function P=f (j, m, r, k, s). Management strategies that can be done through an optimal scenario, among others; (1) Making fish house reinforced with the establishment of the institution in the village as the management group; (2) Area protection and conservation efforts as well as mangrove planting; (3) Promote formal and non-formal education (training and education) as well as coastal communities to develop local wisdom; (4) A series of planning policy and environmental protection and integrated sustainable fisheries; (5) Environmental management of fisheries carried out cooperation between fishermen (businesses) government, academia and investors.

5.2 Suggestions/Recommendations

5.2.1 Government

Improved environmental sustainability of fisheries performed by the government through a series of policies by focusing on improving the key attributes that affect the dimensions of the ecological, economic, social, institutional and technological.

5.2.2 Private/Investor

The private sector and investor opportunities of business cooperation and investment to environmental management of fisheries. Patterns of cooperation may include community development, conservation, grants and CSR.

5.2.3 People and Businesses

Fishing communities and businesses together with the relevant stakeholders to maintain, organize and manage the fisheries environmental in accordance with its role.

References

Allahyari, M. S. (2010). Social sustainability assessment of fisheries cooperative in guilan province, Iran. *Journal of Fisheries and Aquatic Science*, *5*(3), 216-222. https://doi.org/10.3923/jfas.2010.216.222

Bambang et al. (2011). *Apartment Fish (Fish apartment) As Pilar Fish Resources Conservation*. The Center for Development of Fishing (BBPPI), Directorate General of Capture Fisheries, the Ministry of Maritime and Fisheries, Semarang.

Berkes, F. (2003). Alternatives to conventional management: Lessons from smallscale fisheries. *Journal Environments*, *31*(1), 1-19.

Bodhanya, S., & Cecile, G. P. (2014). Using a Change Management Framework to Examine the Effect of a Marine Resource Policy on the Stakeholders in the Fisheries Sector, South Africa. *Journal of Human Ecology*, *46*(2), 235-247.

Bourgeois, R., & Jesus, F. (2004). *Participatory Prospective Analysis, Exploring and Anticipating Challenges with Stakeholders*. Center for Alleviation of Poverly throught Secondary Crops Development in Asia and The Pasific and French Agricultural Research Centre for International Development.

Fauzi, A. S. A. (2005). *Modeling of Fisheries and Marine Resources*. PT. Gramedia Pustaka Utama, Jakarta.

Froese, R. (2004). Keep it Simple: Three Indicators to Deal with Overfishing. *Journal Fish and Fisheries*, *5*, 86-91. https://doi.org/10.1111/j.1467-2979.2004.00144.x

Gullestad et al. (2014). Changing Attitudes 1970-2012: Evolution of The Norwegian Management Framework to Prevent Overfishing and to Secure Long-Term Sustainability. *Journal of Marine Science*, *71*(2), 173-182. https://doi.org/10.1093/icesjms/fst094

Kavanagh, P. (2001). *RAPFISH software description (for Microsoft Excel)*. Rapid apraisal for fisheries project, Fisheries Centre UBC, Vancouver.

Lim, M. T., Porfirio, M. A., & Raniel, B. C. (2014). Modelling the impacts of Fish Aggregating Devices (FADs) and Fish Enhancing Devices (FEDs) and their implications for managing small-scale fishery. *Journal of Marine Science*.

Stohr, C. (2014). From Shouting Matches to Productive Dialogue-Establishing Stakeholder Participation in Polish Fisheries Governance. *Journal of Sustainable Development*, *7*(4). https://doi.org/10.1504/IJSD.2014.065328

Copyrights