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Formulation of Grouper Fish Resource Management Using Ecosystem Approach in Spermonde Archipelagic Waters of Makassar

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Abstract

Development of Makassar are more expansive toward the sea coupled with the practice of fishing gears which are not environmentally friendly, the condition of the coastal and marine environment. Grouper fish resources become under pressure and increasingly difficult to be caught by fishermen. This condition is one of the background formulate alternative management as an effort towards sustainable management. Management of fish resources can not be separated from the ecosystem as a habitat resource management [1, 2]. Management of the resource that is not only fisheries and coral reef resources, but overall are included in the existing ecosystem (biotic and abiotic interactions in ecosystem) and balance the utilization of economically valuable resources.

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Ecosystem Approach for Fisheries Management (EAFM) later became the basis of formulation options as expected. By using indicators in EAFM as measured by techniques Multi Attribute Decision Making (MADM) - Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), resulting formulation strategic move that is expected to management in accordance with the conditions of existence resources, the expectations of stakeholders, and as well in line with the national development of marine and fisheries. This research resulted in the formulation of management measures, as follows: On the indicators of habitat, management measures can be prioritized perform a search option providing alternative and coral transplantation. In indicator of fish resources and the provision of alternative livelihoods can be used as a step restocking strategic management. Technical of fishing indicators more focus on measures to increase supervision and law enforcement of fishing gear that is not environmentally friendly. Social indicators oriented mentoring and counseling and community capacity building in- management of fish resources. economic indicators can prioritize diversification of fishermen society. As for the institutional indicators can put Assistance and Law enforcement, as well as law enforcement strong and consistent.

Keywords: Grouper fisheries, EAFM, MADM-TOPSIS, Spermonde

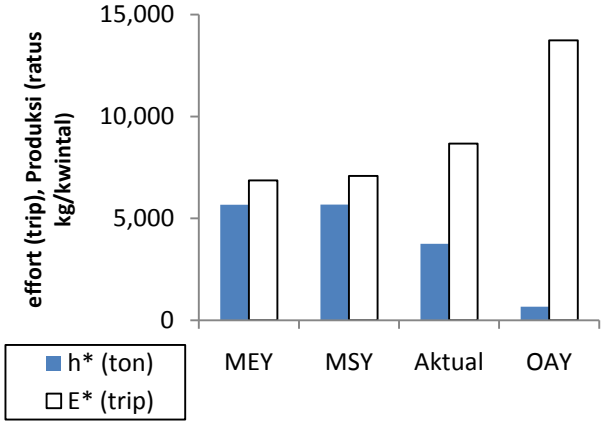
1. Introduction

Coastal and marine development in Makassar started launched in 2003 trying to implement a system of integrated coastal and ocean management (integrated coastal zone management) on the beach with the revitalization of the city, but in 2009, Project Central Point of Indonesia built various facilities along the beach town that decreases ecological functions of the area. Reclamation activities in the coastal city of Makassar in addition to providing the benefits of the availability of space for development will also lead to the negative side in the form of changes to habitats and ecosystems such as environmental degradation, changes in flow patterns, erosion and sedimentation will damage coastal ecosystems including coral reefs and seagrass beds. Therefore, revitalization approach should be able to recognize and exploit the potential of the environment [3].

Grouper, one of fish resources in Spermonde Islands, Makassar, have indicated decreased production and environmental quality. The value of the optimal biomass at MEY regime is 96.60 tons, the optimal production rate is 56.72 tons and the amount of effort (trips) are allowed there any optimal 6.867 trips. In the regime of MSY biomass, production and optimal effort is successively 93.77 tons, 56.77 tons and 7.081 trips. While the optimal biomass OA regime only 5.67 tons, the production of which can be 6.66 tons and the number of trips that allowed 13.735 trips. Economic rent is allowed if applying MEY regime is 32,545,574,509 rupiah and MSY regime is 32,513,953,839 rupiah. The research results are shown in Figure 1, note that the actual condition that decreases with increasing effort than conditions of the Maximum Sustainable Yield (MSY) and Maximum Economic Yield (MEY).

Based on data from the condition of coral reef ecosystems as a common habitat of the grouper, known conditions of living coral below 50% with a downward trend, both overall and in the waters Spermonde Islands located in the administrative area of the city of Makassar.Conditions grouper resource management requires an alternative approach as an effort towards sustainable management [4, 5]. Grouper resource management can not

be separated from the management of ecosystem resources as habitat. Management of the resource that is not only fisheries and coral reef resources, but overall are included in the existing ecosystems and balance the utilization of the resources that have economic value [6, 7].



sources: primary data 2013, processed

Figure 1. Comparison of production and grouper fishing effort in condition MEY, MSY, open access yield (OAY) and actual in Spermonde archipelagic waters of Makassar.

Ecosystem Approach for Fisheries Management (EAFM) is a new approach to international attention. EAFM can be understood as an attempt to balance the concept of socio-economic objectives in fisheries management (fishermen's welfare, justice utilization of fish resources) by considering the knowledge, information and uncertainty about biotic components, abiotic and human interactions in aquatic ecosystems through an integrated fisheries management, comprehensive and sustainable [8, 9, 10].

Ministry of Marine and Fisheries Affairs - Directorate General of Capture Fisheries – Directorate of Fish Resources, WWF-Indonesia and the Center for Coastal and Marine Resource Studies - Bogor Agricultural University in 2011 has made the Ecosystem Approach Performance of Fisheries Management (Ecosystem Approach to Fisheries Management) in Regional Fisheries Management Indonesia . This study also uses the performance indicators contained in it to be used as a criterion in finding grouper resource management strategies in the study area. Thus the study with the aim of formulating management resources management formulation grouper with the ecosystem approach to fisheries management approach in Makassar city Spermonde archipelagic waters can be generated.

2. Methodology

The study was conducted in the Spermonde archipelagic waters of Makassar include three coastal district, the District Ujung Pandang, District Mariso, and Tamalate District starting from Losari to Barombong Beach. Research in the field was conducted from August 2013 to January 2014. The primary data was collected using a

questionnaire with structured interview technique in which a list of questions has been prepared as the characteristics of the stakeholders. Furthermore, the determination of the respondents in this data collection is determined by purposive sampling [11]. Grouping of stakeholders who play a role in fisheries management to be: 1) a group manager / administrator; 2) fishers group; 3) institutions/organizations concerned with coastal resources; 4) group of scientists/marketing [12].

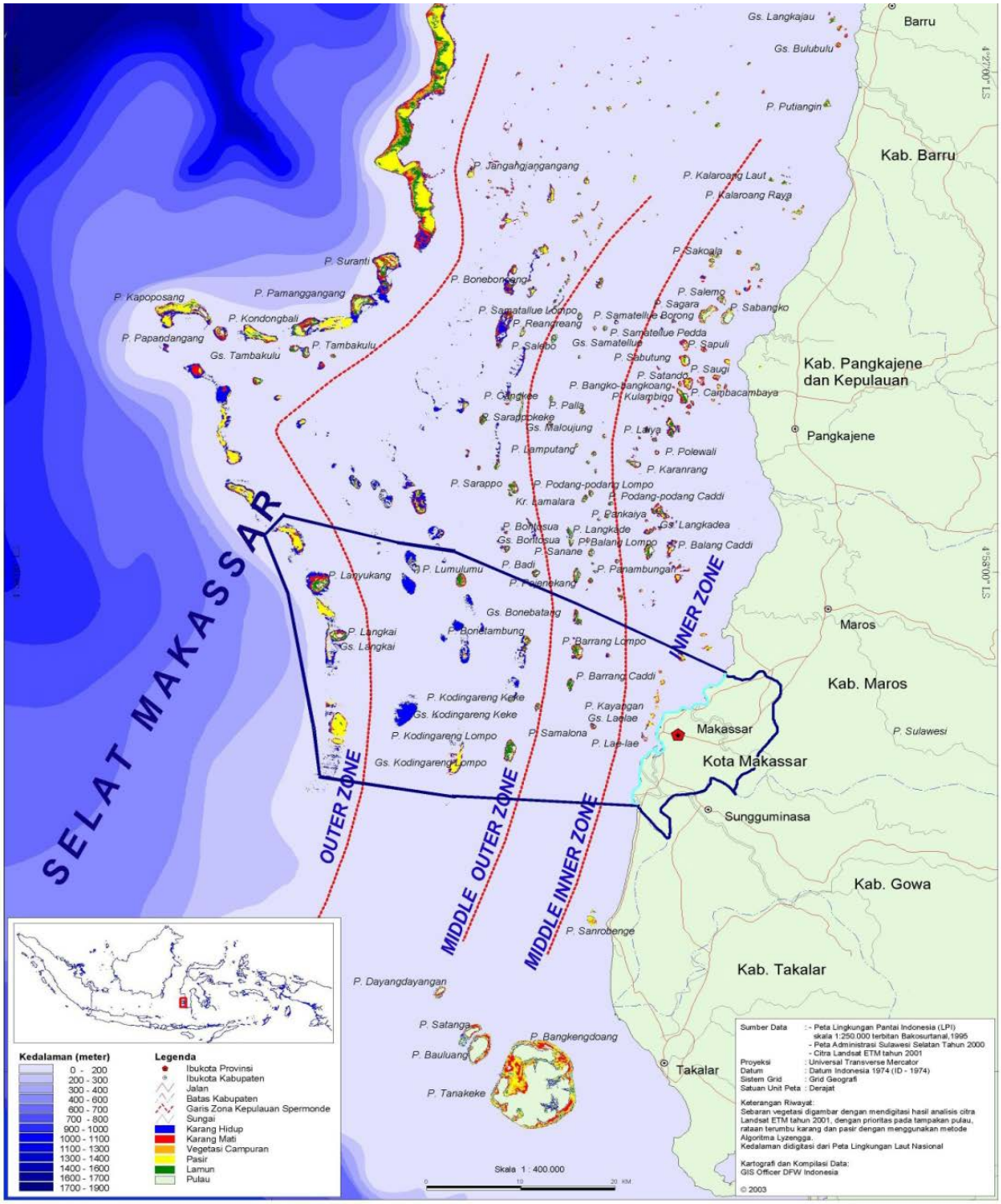


Figure 2. Map location of research

At this stage of the analysis by the method of Multi-Attribute Decision Making (MADM) -Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to determine the best alternative formulations grouper resource management.

The steps taken for this purpose are as follows:

Step 1: determination of a fishery management alternatives grouper

Step 2: establish criteria for selecting models grouper fishery management and specifies weights and scores for each criterion.

Step 3: make a selection of alternative models grouper fishery management based on calculations using the Excel program.

Stages in TOPSIS method

1. Build normalized decision matrix. Elements r_{ij} result of the normalization of decision matrix R by the method of Euclidean length of a vector.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

2. Build weighted normalized decision matrix, the weights W = (w1, w2, ..., wn),

$$V = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} \cdots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} \cdots & w_n r_{1n} \\ \vdots & \vdots & \vdots \\ w_1 r_{m1} & w_2 r_{m2} \cdots & w_n r_{mn} \end{bmatrix}$$

3. Determine the ideal solution and negative ideal solution,

A^* = {(max v_{ij} | j € J).(min v_{ij}| j € J'}.
i = 1,2,3, ….m} = { v_{1^*} , v_{2^*} , …. v_{n^*} }
A - = {(min vij | j € J).(max vij| j € J'}.
i = 1,2,3, ….m} = { v_{1-} , v_{2-} , …. v_{n-} }

4. Calculate separation, K_i * is the distance (in view of Euclidean) alternative to the ideal solution

$$\boldsymbol{S_{i*}} = \sqrt{\sum_{j=1}^{n} (Vij - Vj*)^2} \quad , with\ 1 = 1,2,3, \dots m$$

and furthest to the negative-ideal solution.

$$S_{i^-} = \sqrt{\sum_{j=1}^{n} (Vij - Vj^-)^2} \ , with\ 1 = 1,2,3, \dots m$$

5. Calculate the relative closeness to the ideal solution

$$C_{i*} = \frac{S_{i^-}}{S_{i*} + S_{i^-}} \ , with\ 0 < C_{i*} < 1\ and\ i = 1,2,3, \dots m$$

6. Alternative rank, alternatives can be ranked based on the sequence S_i *. Therefore, the best alternative is the one that is the shortest of the ideal solution

The variables used in this study is a step in the action of the management of each indicator on the Performance of the Ecosystem Approach to Fisheries Management in Fisheries Management Area of Indonesia. In the development of the indicator above it also contained administrative actions. Management action is then used as a variable/criteria in MADM- TOPSIS analysis. Coralreef ecosystems as habitat for grouper commodity chosen as the object of ecosystems, while the description of the indicators and actions that management is used as a variable/criteria, namely; indicators of habitat, indicators of fish resources, indicators of fishing technique, indicators of social, indicators of economic, indicators of institutional.

Table 1. The criteria used in the analysis of data [14]

Criteria	Sub-criteria	Code	Criteria	Sub-Criteria	Code
Habitat	Designation of conservation areas (ecosystems, species, genetic).	C1	Economic	diversification, *Alternative livelihood*	C19
	coral transplantation	C2		Catch quality improvement /*on board handling, ecolabelling*	C20
	Strengthening local wisdom	C3		counseling about the importance of saving	C21
	Coordination across sectors based on the cause of sedimentation / run off	C4		asset management extension and counseling	C22
	The provision of alternative livelihoods	C5	Institutional	Institutional Performance Monitoring	C23
Fish Resources	Setting the minimum size of fish allowable cacth	C6		Monitoring and mentoring capacity fisheries stakeholders	C24

	Setting selectivity of fishing gear	C7		Institutional monitoring fishery management	C25
	restocking	C8		Strong law enforcement and consistent	C26
	The timing and location: season closing and closing area	C9		Monitoring and mentoring of fisheries management planning	C27
	The provision of alternative livelihoods	C10		Assistance and Law enforcement.	C28
	Reducing the rate of exploitation	C11	General Indicators	Indicators of Habitat	C29
	Setting fishing effort	C12		Indicators of Fish Resources	C30
Fishing Technique	Control input (the utilization of fish resources)	C13		Indicators of Fishing Technique	C31
	fishing quotas (*Target, Gear, Area, Time*)	C14		Indicators of social	C32
	Improved monitoring and enforcement of the fishing gear that is not environmentally friendly.	C15		Indicators of Economic	C33
Social	mentoring (*public awareness)*	C16		Indicator of Institutional	C34
	counseling and community capacity building in the management of fish Resources	C17			
	conflict resolution (*preventive*, conflict mitigation)	C18			

3. Results

3.1 Priority Weight Criteria Analysis

Determination of criteria for priority ranking is done by taking the weight of each criterion recapitulation each respondent questionnaire data, which is done by counting the number of opinions of respondents [13]. The number of respondents as many as 31 people, namely: Marine Police, Department of Tourism in Provincial and Makassar City, Department of Marine and Fisheries in Provincial and Makassar City, Government of Makassar City, Grouper Fisherman Group, Other Fisherman Group, Enterprise Trade and Grocery Materials, Group of

Investors, Environmentalist Groups, NGOs, Marine Tourism Operator, Seafood Restaurant, Seafood Shop Tent, Grouper Collectors, Grouper Traders, and Universities.

The analysis is done by using the priority weights priority weighting criteria [15, 16, 17], each component of the criteria by analyzing quantitative data from the respondents [18].

3.2 Grouper Fishery Management Formulation Analysis

In the analysis of the identification of these grouper fishery management respondents were asked to assess the importance of management actions on EAFM approach. The assessment levels are 1 = Not Important, 2 = Not Quite Important, 3 = Quite important, 4 = Important, 5 = Very Important

While alternatives / solutions in the form:

S1 = Relegated; is an alternative / solution assess management measures have intensity, treatment of the criteria is too high so that needs to be lowered

S2 = Defended; is an alternative / solution assess management measures have intensity, treatment of the criteria are quite good

S3 = Optimized; an alternative / solution that assesses the need for management measures with intensity, treatment of criteria aligned / balanced with other criteria.

S4 = Enhanced; is an alternative/solution assess management measures have intensity, treatment of the criteria is low and needs to be improved

3.2.1 Habitat indicators

Table 1. Rating suitability of each alternative on criteria habitat indicators

Alternative/Solution	Criteria/Attribute				
	C1	C2	C3	C4	C5
Relegated (**S1**)	1	1	2	1	1
Defended (**S2**)	3	3	3	3	4
Optimized (**S3**)	4	4	4	4	4
Enhanced (**S4**)	4	5	4	5	5

Weight value that indicates the relative importance (W) of each attribute in the General Criteria and alternative solutions (S) are as follows:

W = {0.03 0.08 0.21 0.05 0.62}
S3 = optimized

Management actions in habitat indicators criteria by establishing protected areas, coral transplantation, cross-sector coordination, strengthening of local knowledge, providing an alternative search, needs to be optimized. The emphasis of management can be an alternative search site preparation, and optimize the site. Then step is followed by strengthening the management of local wisdom, because the people at the site can access all sea areas around the islands spermonde to catch fish that are a potential source of conflict area utilization.

3.2.2 Fish resources

Table 2 Rating suitability of each alternative on criteria Fish resources indicators

Alternative/Solution	Criteria/Attribute						
	C6	C7	C8	C9	C10	C11	C12
Relegated (**S1**)	1	3	1	1	1	5	3
Defended (**S2**)	3	3	2	2	3	3	2
Optimized (**S3**)	3	4	3	3	3	4	2
Enhanced (**S4**)	5	5	5	3	5	2	1

Weight value that indicates the relative importance (W) of each attribute in the General Criteria and alternative solutions (S) are as follows:

W = {0.03 0.05 0.18 0.06 0.54 0.06 0.08}
S4 = enhanced

Fisheries management on the criteria included in the indicator fish resources must all be improved. Fishing communities who derive their living by catching grouper in Spermonde Islands are expecting conditions can catch grouper fish resources, according to fishing community, with the improvement of the condition of the resource, will increase revenue for the fish caught will increase. Balance between utilization and conservation is needed in the management of resource enhancement [19]. It is also supported by the high weight of the criteria on the provision of alternative livelihood resource indicators grouper. Expected with the availability of alternative livelihoods to reduce the concentration of fishing effort so that the pressure grouper grouper pressure on resources around the islands Spermonde can be reduced and eventually this resource can be increased.

3.2.3 Fishing Technique

Table 1 Rating suitability of each alternative on Fishing Technique criteria

Alternative/Solution	Criteria/Attribute		
	C13	C14	C15
Relegated (**S1**)	3	4	1
Defended (**S2**)	3	3	3
Optimized (**S3**)	4	4	4
Enhanced (**S4**)	2	1	3

Weight value that indicates the relative importance (W) of each attribute in the General Criteria and alternative solutions (S) are as follows:

W = {0.11 0.11 0.78}
S2 = Defended

On criteria including of the fishing Technique indicators, resulting management options be maintained. Step of management is improving monitoring and enforcement of the fishing gear that is not environmentally friendly. The results of the field review also found the fact that many of the fishermen who use fishing gear that is not environmentally friendly.

3.2.4 Social

Table 2 Rating suitability of each alternative on social criteria

Alternative/Solution	Criteria/Attribute		
	C16	C17	C18
Relegated (**S1**)	1	1	1
Defended (**S2**)	3	4	3
Optimized (**S3**)	4	4	4
Enhanced (**S4**)	4	5	4

Weight value that indicates the relative importance (W) of each attribute in the General Criteria and alternative solutions (S) are as follows:

W = {0.45 0.45 0.09}
S3 = Optimized

Fisheries management based on this EAFM on social indicators need to be optimized, this results in solutions obtained from analysis of MADM. Social indicators in which there are management measures such as mentoring, counseling and management of fish resources capacity building and conflict resolution needs to be optimized solution. Based on the highest weight of the sub-criteria, the optimal effort in question is the sub-criteria assistance (public awareness) and sub-criteria for extension and improvement of the capacity of management of fish resources.

3.2.5 Economy

Table 3 Rating suitability of each alternative on economic criteria

Alternative/Solution	Criteria/Attribute			
	C19	C20	C21	C22
Relegated (**S1**)	1	1	1	1
Defended (**S2**)	3	3	3	2
Optimized (**S3**)	5	4	5	4
Enhanced (**S4**)	5	4	4	4

Weight value that indicates the relative importance (W) of each attribute in the General Criteria and alternative solutions (S) are as follows:

W = {0.58 0.24 0.12 0.06}
S4 = Enhanced

Economic indicators are an important part and the attention and the outpouring of time sufficiently long interview when collecting field data. Economic indicators that includes the sub-criteria diversification, improved quality of the fish catch, counseling about the importance of saving, and asset management extension, as a whole needs to be improved. The highest weights of sub-criteria is diversification. Not only group grouper fishermen who need to diversify the business, entrepreneurs and exporters group is also noteworthy to look for other types of resources that sell high value which leads to the importance of efforts to diversify the business.

3.2.6 Institutional

Tabel 4 Rating suitability of each alternative on institutional criteria

Alternative/Solution	Criteria/Attribute					
	C23	C24	C25	C26	C27	C28
Relegated (**S1**)	1	1	1	1	1	1
Defended (**S2**)	3	2	3	3	3	3
Optimized (**S3**)	4	4	4	3	4	3
Enhanced (**S4**)	4	5	5	5	4	4

Weight value that indicates the relative importance (W) of each attribute in the General Criteria and alternative solutions (S) are as follows:

W = {0.03 0.06 0.09 0.37 0.07 0.38}
S3 = Optimized

The entire sub-criteria in institutional indicators resulting solution should be optimized. According to most respondents in the management of assistance and law enforcement (law enforcement) need to be optimized. In addition, sub-criteria strong law enforcement and consistent too much into the spotlight as part of grouper fishery management needs to be optimized. MADM analysis results also put the management by way of assistance and law enforcement is the first highest weight and strong law enforcement and consistent in the second with a 0.01% difference in weight so that the management measures will be very effective in improving the institutional indicators management uses EAFM approach.

3.2.7 Criteria Indicators of Ecosystem Approach to Fisheries Management

Tabel 5 Rating suitability of each alternative on general indicator criteria

Alternative/Solution	Criteria/Attribute					
	C29	C30	C31	C32	C33	C34
Relegated (**S1**)	1	3	1	1	1	1
Defended (**S2**)	3	3	3	3	3	3
Optimized (**S3**)	4	4	4	4	5	3
Enhanced (**S4**)	5	5	3	4	5	4

Weight value that indicates the relative importance (W) of each attribute in the General Criteria and alternative solutions (S) are as follows:

W = {0.28 0.15 0.07 0.28 0.18 0.05}
S4 = Enhanced

4. Conclusion

Step management indicator can be preferred habitat make a concerted effort to optimize the provision of alternative search options and coral transplantation. In fish resources indicator, the provision of alternative livelihoods and restocking can be used as a strategic management measures. On the technical indicators arrests, more focus on measures to increase supervision and law enforcement of fishing gear that is not environmentally friendly. As for the social indicators oriented mentoring and counseling and community capacity building in-management of fish resources. economic indicators can prioritize diversification of fishermen society. As for the institutional indicators can put Assistance and Law enforcement, as well as law enforcement strong and consistent. Overall criteria for the management indicators need to be improved, the effective management to improve social indicators and indicators of habitat. Fore expected to be able to reform the management focuses on the management of matters related to indicators of habitat and social indicators will recover grouper resources and sustainable management of coral reef ecosystems and fishing communities prosper. It is recommended that implementation of planned management, integrated and consistent need immediate catching grouper resources that overfishing can recover and give optimal results. And maintain coordination, engagement and desire take an active role among stakeholders is needed to maintain the sustainability of resource use grouper in Spermonde Islands waters of Makassar.

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