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Models of Fisheries Management Policy in the Thousand Islands

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ABSTRACT

Purpose of this Paper is to discuss a model of fisheries management in the Thousand Islands for community economic development while improving the environmental condition of a thousand islands. Particular purpose are analyzing the causes of damage in and determine alternative policies, to identify and determine the key elements of the model is applied to improve the marine ecosystem in a thousand islands, especially coral reefs and fishing areas, priorities that support the achievement of the goals of sustainable management of fisheries resources. Comparative Performance Indeks (CPI) Fisheries resources management model designed and can be used to assist decision-making with Interpretative Structural Modelling (ISM) become a key element of fisheries resource management objectives embodied the skills and education sub-elements of fishing (T3) is the key that drives the achievement of objectives in the management of coral reefs and islands seribu. done with support elements which need Elemen needs is a sub element of enforcement of fishing rules (E1), incentive element in fish and reef bomb Prohibition (E3), the active role of government and elements of society (E11). Alternative management measures taken to manage fisheries resources with Analytical Hierarchy Process (AHP). Such alternative based on environmental benefit factor. The most influential actors in the management of Thousand Islands Fishery Resources is the government / local authority supporting the creation of Fisheries Resource Conservation. Further development is needed to help support models that can access the knowledge base directly with the use of these criteria more specific in the conduct of fisheries resource management in the Thousand Islands. Keep the fish stock data in order to predict the availability of fishery resources in the present and the days to come. Thus the settings and can be implemented.

Keywords: Management, marine fishery, fishing gear, authority, Fish stock.

1. Introduction

1.1. Background

Coastal and marine areas are highly vulnerable areas of a variety of problems, be it related to the problems of physical and biological aspects and issues related to social, economic and cultural. Problems of degradation and depletion of natural resources and the environment in the coastal and marine areas that have a lot going on for example. The two issues are inseparable issues and postharvest fisheries conservation (Bjorndal, et.all, 2002). Issues, particularly regarding the use of natural resources that are not according to the rules that lead to ecosystem sustainability are important to the sustainability of both human life itself, as well as natural resources and the environment as a whole become damaged and can not provide sustainable benefits. In the future biodiversity marine fisheries in particular will play an important role in development. A shift in global economic activity and the concentration of free trade create wealth resource 2020 fishery has comparative advantage into competitive
primacy nation. Fish resources in some areas in Indonesia waters. Until recently that the potential of marine fishery resources sustainably Indonesia is about 6.4 million tons / year, and only used by the arrest of about 4.7 million tons / year or 73.4%. If the use is allowed is 80% of the sustainable potential, then the utilization can be improved by 17% sustainable potential or 1.2 million tons / year. (Department of Marine and Fisheries, 2006).

The application of the theory of decision-making in the post-harvest management and in this case the catch including regulatory and resource allocation also includes regulation and allocation of the catch, including fishermen and their fishing gear (Bjorndal, et.all, 2002). Selectivity of fishing gear and mesh sizes are very determine the amount of the catch. The size of the illegal causes small number of fish caught is also great, it is a measure of the fisheries management (Alejandra, et.all., 2009) In addition to fishing gear is also very influential time arrest (Buscaino, et.all, 2009). Table 1 illustrates the reduction escalation and shellfish stock of all models based on the improved management and the impact of fishing gear efficiency. (Buscaino, et.all, 2009)

This is where the importance of policies to manage fish resources so sustainable management of fish resources currently available to meet the needs of present and future generations, which includes aspects of ecological sustainability, social and economic, community and institutions.

Tabel 1. Prediction Number of cockles (x10⁶) modelled from 2002 to 2007 from the data for the preceding year (year n = 1) compared with the numbers obtained (year n)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fishable stock prediction</th>
<th>Estimated number of individuals (&gt; 30 mm SL) from data the preceding year (x10⁶)</th>
<th>Fishable Stock Obtained numbers (x10⁶)</th>
<th>Difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2002</td>
<td>129</td>
<td>115</td>
<td>-12</td>
</tr>
<tr>
<td>2.</td>
<td>2003</td>
<td>124</td>
<td>101</td>
<td>-22</td>
</tr>
<tr>
<td>3.</td>
<td>2004</td>
<td>169</td>
<td>188</td>
<td>+10</td>
</tr>
<tr>
<td>4.</td>
<td>2005</td>
<td>105</td>
<td>132</td>
<td>+20</td>
</tr>
<tr>
<td>5.</td>
<td>2006</td>
<td>138</td>
<td>132</td>
<td>-4</td>
</tr>
<tr>
<td>6.</td>
<td>2007</td>
<td>316</td>
<td>310</td>
<td>-2</td>
</tr>
</tbody>
</table>


1.2. Objective
The purpose of this paper is to formulate a model of fisheries management for the improvement of the economy of the district administration thousand islands and improve environmental conditions.

The specific objective is:
1. Anayze the causes of damage in a thousand islands and determine alternative policies.
2. To identify and define the key elements of the model are applied to improve the marine ecosystems in the thousand islands, especially coral reefs and fishing area.
3. Assign to priorities that support the achievement of sustainable management of fishery resources
1.3. Convenience
1. For science is the discovery model for fishery resource management in the thousand islands
2. recommendation for policy makers in determining policies that remain in the management of fisheries in the thousand islands

1.4. Scope of Research
The scope of the study area is bounded by the thousand islands development model of sustainable management of fishery resources.

2. THEORY
2.1 Management of Fisheries Resources
Fisheries management is all efforts including the integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of fish resources and the implementation and enforcement of laws and regulations by government or other authorities that aimed to achieve continuity and productivity of aquatic biological resources agreed objectives.
Integrated management to attain a sustainable development and the protection of habitats and natural resources. In a sense, the scheme requires the management of the union in terms of dimensions of ecological, socio-economic and cultural, social, political and institutional.

2.2. Systems Approach
The systems approach is a way of solving the problems that began with the identification of a number of needs, so as to bring out an effective operation is considered. Stages of a systems approach method includes needs analysis, problem formulation, system identification, modeling, verification and validation, and implementation.
Therefore the steps being taken are as follows:
a. Goal setting
b. Needs Analysis
c. Formulation of the problem
d. Identification system

2.3. Performance Comparison of Techniques Index
Comparison of the performance index technique (Comparative Performance Index, CPI) is a composite index that can be used to determine the assessment or ranking of the various alternatives.
Composite Index which can be used to determine the assessment or ranking of the alternatives (i) based on some criteria (j).
The formula used in CPI techniques:
\[ A_{ij} = \frac{X_{ij}(\text{min}) \times 100}{X_{ij}(\text{min})} \]
\[ A_{i+1,j} = \frac{X_{i+1,j}}{X_{ij}(\text{min}) \times 100} \]
\[ l_{ij} = A_{ij} \times P_{j} \]
\[ L_{j} = \sum l_{ij} \]
\[ J = 1 \]

Description:
\[ A_{ij} \] = the value of the -i alternative on criteria to - j
\[ X_{ij}(\text{min}) \] = the value of the i alternative minimum initial criteria to-j
\[ A_{i+1,j} \] = value alternative to-i + 1 on the criteria to – j
2.4. Interpretative Structural Modeling Methods (ISM)

Interpretative Structural Modeling (ISM) methodology is a good one to identify the relationship between specific matters relating to the problem or a complex issue. The opinion of the expert group are used to develop normally used to develop a matrix of relationships used in developing the model ISM (Marimin, 2008). ISM analyze a system of elements and presenting them in a graphical overview of all direct relationships and hierarchy levels. Element may be the object of the policy, the purpose of an organization, assessment factors, and others. Direct relationship can be varied within a context (referring to contextual relationships), such as the element (i) is better than, is success through, will help the success, more important than the element (j).

The steps in the use of Interpretive Structural Modeling (ISM) is as follows:

1. Identify elements: each element of the system will be identified and registered. This may be the overall success of the research, brainstorming, and others.
2. Contextual relationships: a contextual relationship between certain elements are, depending on the object of the exercise models.
3. Structural Self-Interaction Matrix (SSIM): This matrix presents the respondents' perception of the elements to a direct relationship between the elements. Four symbols are used to present the types of relationship can exist between two elements of a system with a consideration. The symbols are:
   - V: to the relation of the elements Ei to Ej, but does not apply to the reverse.
   - A: for the relation of Ej to Ei, but does not apply to the reverse.
   - X: for the interrelation between Ei and Ej (applies to both directions).
   - O: to represent that Ei and Ej are not related.
4. Reachability Matrix (RM): This matrix provides a symbolic change SSIM into a binary matrix. Use conversion rules are as follows:
   - If the relation Ei to Ej = V in SSIM, then element Eij = 1 and Eji = 0 in RM
   - If the relation Ei to Ej = A in SSIM, then element Eij = 0 and Eji = 1 in RM
   - If the relation Ei to Ej = X in SSIM, then element Eij = 1 and Eji = 1 in RM.
   - If the relation Ei to Ej = 0 in SSIM, then element Eij and Eji = 0 = 0 in RM.

Initial RM is then modified to show all achievements directly or indirectly, all of them if Eij = 1 and then Eik Ejk-1 = 1.
5. Level partitioning: partitioning level do command to classify elements into a structure of the ISM. That is two sets associated with each element of the system Ei: Reachability Set (Ri), which is a set of all elements can be accomplished from the elements Ei, and antecedent set (Ai), which is the set of all elements that can be achieved Ei.
6. Canonical matrix: Grouping together elements in the same level developed in this matrix. Generated from this matrix almost the top of the triangle element is 0, and the triangle bottom element is 1. This matrix is then used to prepare a digraph.
7. Digraph. Digraph is a pattern obtained from the directional and reference graph is a graphical representation of the elements, direct and hierarchical level relations. Initial graph provided in the canonical basis matrix. It then shortened through a transfer of all transitivities digraph final form.

8. Structural models: the model ISM is generated through the transfer of all the number of elements with the actual description of the element. ISM therefore gives a very clear picture about an element of the system, and the flow relation.

2.5. Analithycal Hierarchy Process Method (AHP)

According Marimin 2008 that the principle of the AHP is a prioritization system to obtain the components / sub-components in accordance with the hierarchy and significance level, as follows:

1. Decomposition principle
   a. Used to structure a complex problem into a hierarchy of clusters / level, sub-klastier/sub-level and so on.
   b. Hierarchy: a special type of depiction of a system, which is based on the assumption that the system entities that have been identified can be grouped into separate sets.
   c. Used to explain how changes in priorities at higher levels affect the priority of the element underneath

2. Principle of Comparative Judgment
   a. Used to represent the perception or expression of the relationship between one element with another element, based on a certain criteria (such as interest rate or level of excellence).
   b. Carried out through pairwise comparisons (pairwise comparisons), the elements that exist in the cluster / same level compared to one another, based on or refer to one of the elements in the cluster / level one level above it (cluster / parent level)
   c. Pairwise comparisons were used to determine the priority of the elements in the cluster / level with respect to the cluster / level above ("local priorities").

3. Principles of synthesis
   a. Which is used to obtain the elements in each cluster / level that has the highest priority ("global priorities"), as well as
   b. Elements where the largest effect on the results or the system as a whole.

4. Logical Consistency Principle
   a. Relationships between objects or between the mind set so that coherent, ie objects or ideas relate to one another well.
   b. Intensity of relationships between objects or ideas that are based on certain criteria each logically justify.

3. METHODOLOGY

3.1. Framework

Thousand islands are a source of native ecosystems are widely used by the various parties who helped build and the increasing pressure environmental of population growth. Thus the question arises

1. How alternative management policies that effectively and efficiently?
2. How to shape a policy for dealing with changing environmental conditions where fishing activity takes place mainly fishing areas and the location of aquaculture?
3. How to determine the policies and priorities of the strategy that can be applied in a thousand islands?
3.2. Types and Sources of Data

Necessary data in this study is primary data and secondary data. Primary data was collected through field observations, interviews with questionnaires, and focus group discussions (focus group discussion). Secondary data was collected through the study of literature books, previous research studies related to the object of research, archives, newsletters, and report status and water quality monitoring. Data collection of expert opinion which was acquired by means of focused group discussions of experts.

4. RESULTS AND DISCUSSION

4.1 Analysis of Fisheries Resources Management Policy in the Thousand Islands

Policy and management program is expected to be a mutual agreement and as a guide in organizing, directing, controlling various activity communities in resource use in the thousand islands region in an integrated (integrated) and sustainable, thus the existing fishery resources will be able to support the sustainable community. Comparison of selected composite index to determine the best policy alternative in the management of Fishery Resources in the Thousand Islands.

Results of the identification of several policy alternatives that are used in the management of Fishery Resources in the Thousand Islands are:

1. Make arrangements gear and Season Arrest
2. Fishery Resources surveillance.
3. To increase public education / fishing
4. Doing Increased aquaculture.

The need for time series data so that the data generated can be estimated due to the existing results can be described temporal and spatial data is particularly in view of the development of the ecosystem (Polovina and Evan, 2005)

From the results of the comparison of the expert opinion is based on the CPI method is as following Table 2.

Table 2. Proportion Some Alternatives to the CPI Method

<table>
<thead>
<tr>
<th>Alternatif</th>
<th>Criteria</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Environmen tal Benefits</td>
<td>Economic</td>
</tr>
<tr>
<td>Capture Device Settings</td>
<td>5=250</td>
<td>4=133.33</td>
</tr>
<tr>
<td>Education Improvement society fisherman</td>
<td>4=200</td>
<td>3=100</td>
</tr>
<tr>
<td>Fishery Resources Surveillance</td>
<td>3=150</td>
<td>5=166.67</td>
</tr>
<tr>
<td>Increased aquaculture</td>
<td>2=100</td>
<td>3=100</td>
</tr>
<tr>
<td>The interest rate</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 3. Analysis of the results of the model calculations Priority Water Resource Management

<table>
<thead>
<tr>
<th>Selected Alternative</th>
<th>CPI value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management 1 Management Settings gear</td>
<td>1974.99(1)</td>
</tr>
<tr>
<td>Management 2 Management of Fishery Resources Monitoring</td>
<td>1808.35(2)</td>
</tr>
<tr>
<td>Management 3 Increasing society should management Education / fisherman</td>
<td>1666.67(3)</td>
</tr>
<tr>
<td>Management 4 Improved management of marine aquaculture</td>
<td>1333.34(4)</td>
</tr>
</tbody>
</table>

With regard Tables 2 and 3 above the gear setting policy alternatives to address the problems of fisheries resource management in Thousand Island. This option would be optimal if accompanied by an alternative monitoring of fishery resources and increasing public education / fishing. Need for setting the proper gear models are used because it is associated with the catch obtained. Moreover attention associated with aquatic ecosystems and coral reefs are also the coastal environment. According (Roeroe, et. All, 2009) method for improving environmental reproduce existing around this coastal and marine environmental. Economically Policy has a very high value because the costs are not so great in practice. Management policies and also have a social impact and benefits of very high value. Indirect economic effect on the community as well as to improve the quality of the environment.

4.2 Determination of Key Elements of Fisheries Resources Management Policy in the Thousand Islands.

1 Results Identification Element / Sub Elements
a. Sub goal Element
T1: Increase the area of environmental sustainability of fisheries catches.
T2: Creating artificial reef / fish shelter
T3: Improving skills and education of fishermen
T4: Improving Community Income / fishing
T5: Increasing surveillance of fisheries resources
T6: Implement Government Policy
T7: Improvement environmentally friendly aquaculture
T8: Develop marketing of fishery products.

Fishing skills and education is the key that drives the achievement of objectives in the management of coral reefs and Thousand islands. Sheter construction aquatic resource ecosystems that foster increased regional environmental sustainability fishery product. Arrests creation will increase the income of fishermen fish in addition to the implementation of government policies implemented one of the goals expected to develop the marketing of fishery resources. Surveillance will be accomplished with the support of elements other purpose. The result can be seen in the flow chart below.
Results Treatment with ISM

a. Sub-goal Element

level 4

Level 3

T1

Level 2

T2

Level 1

T3

b. Sub-Element Requirements
E1: Spatial Enforcement in the Thousand Islands
E2: The existence of qualified and skilled manpower in the field of fisheries
E3: The existence of incentive coral reef bom
E4: Making shelter coral reefs
E5: Ease of access to marketing of fishery products
E6: Technology arrest environmentally friendly
E7: fishing community empowerment program
E8: continuity of government programs
E9: government's active role in monitoring and supervision
E10: The utilization of the fishery with the appropriate technology

Facility of access to marketing of fishery products and the active role of the government in the conduct and supervision of an element monitoring needs that drive other elements. Utilization of fishery products and continuous appropriate government programs encourage environmentally friendly technologies and community development programs with incentives ban fishing reef bomb is an element that needs to encourage the establishment of spatial and creating skilled manpower in the field of fisheries.
c. Sub-Element Constraints (Based on the literature review):
K1: high population growth
K2: The low level of public education / fishing.
K3: The low level of social welfare
K4: Continuity program unsustainable
K5: Still the reef bomb
K6: The higher the level of the economic needs of the community
K7: The use of fishing gear that are not environmentally friendly
K8: The existence of environmental pollution
K9: The lack of effectiveness of the program between the government and relevant stakeholders
K10: lack of role of society to support government programs.
K11: Low knowledge society for marine aquaculture.
K12: Lack of funding community development incentives in the form of credit to the public / fishing
ISM processing results obtained by using elements that can support the Fisheries Resource Management strategies in the Thousand Islands as follows:

a. Key elements of the sub goals can be realized element Improving the skills and education of fishermen (T3) Sub sub element Besides realizing the elements that need to be met by carrying out sub elements other purpose.

b. The key element that needs to be met to achieve the objectives of fisheries management are the three key elements are sub elements enforcement of fishing rules (E1), the element Incentive Prohibition Bombing fish and coral (E3), and elements of the government's active role (E11).

c. Key elements of the obstacles that must be overcome to realize the objectives of fisheries management strategies Sumberdayam in the Thousand Islands is a sub-element of use of fishing gear that are not environmentally friendly (K7)

4.3 Priorities achievement of objectives and priorities of the role of the parties in an effort to sustainable management of Fishery Resources in the Thousand Islands.

Alternative strategies used in the management of Fishery Resources in the Thousand
Islands are:
1. Make arrangements gear and Season Arrest
2. To increase public education / fishing
3. Fishery Resources surveillance
4. Increased aquaculture.

Factors affecting the selection criteria of the above alternatives are:
1. Environmental benefits in fisheries resource management system.
2. Effectiveness of fisheries resource management system.
3. Environmental impacts of fisheries resource management.
4. Cost model of fisheries resource management.

Criteria actor who plays a role in achieving the above objectives, namely:
2. Universities / research
3. People / fishermen
4. Private Parties.

Objective determination of fisheries resource management policy strategy is in order to:
1. Creating environmental sustainability of fisheries resources in the Thousand Islands.
2. Economy improving community
3. Applying technology
4. Improve human resources skills in managing fishery resources
5. Creating a good and healthy institutions in managing fishery resources in the Thousand Islands.

Results of identification using the AHP method Criterium Decision Plus application. is as follows:

Bobot Hierarchy
AHP final outcome data processing:

<table>
<thead>
<tr>
<th>Lowest Level</th>
<th>Arrangements fishing gear and fishing season</th>
<th>Improvements education of fishermen</th>
<th>Fishery Resources Surveillance</th>
<th>Improve ment aquaculture</th>
<th>Model Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Benefits</td>
<td>0.558</td>
<td>0.269</td>
<td>0.118</td>
<td>0.559</td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td>0.569</td>
<td>0.244</td>
<td>0.133</td>
<td>0.054</td>
<td>0.231</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>0.558</td>
<td>0.253</td>
<td>0.135</td>
<td>0.054</td>
<td>0.149</td>
</tr>
<tr>
<td>Cost</td>
<td>0.627</td>
<td>0.229</td>
<td>0.094</td>
<td>0.050</td>
<td>0.062</td>
</tr>
<tr>
<td>Results</td>
<td>0.565</td>
<td>0.259</td>
<td>0.123</td>
<td>0.054</td>
<td></td>
</tr>
</tbody>
</table>

Graph Results of treatment AHP

Based on calculations using the method of AHP with Criterium Decision Plus, it can be concluded that:
1. Alternative management made in the management of fishery resources in the Thousand Islands are Doing setting fishing gear and fishing season (0565)
2. The alternative selection factor based Environmental Benefits (0559).
3. Most influential actors in the management of the Thousand Islands Fishery Resources is the government / local government (0560).
4. The main purpose Thousand Islands Fisheries Resource management is Creating Sustainability of Fisheries Resources (0526).

5. CONCLUSION AND SUGGESTION
5.1. Conclusion
Fisheries resource management model is designed to be used to assist the decision making process in order to conserve water resources especially fisheries in the Thousand Islands.

Selection of policy alternatives to the CPI with several alternative is setting fishing gear. Verification of the model results using the existing data in the Thousand Islands in particular fisheries is a key element of fisheries management objectives are sub elements embodied skills and education of fishermen (T3) is the key that drives the achievement of objectives in the management of coral reefs and Thousand islands. sheter establishment aquatic resource ecosystems which encourages an increase in fishery products. Element that needs to be power driver is a sub element of fishing Enforcement (E1), the element Incentive Prohibition Bomb fish and coral (E3), and elements of the government's active role (E11). Besides realizing the sub elements it needs to be met by carrying out sub elements other purpose. While most elements of the constraints is the use of fishing gear that are not environmentally friendly.

Alternative management made in the management of fishery resources in the Thousand Islands are Performs fishing Season . Alternative gear and the alternative factor based Environmental Benefits. Most influential actors in the management of the Thousand Islands Fishery Resources is the government / government that supports the creation Sustainability of Fisheries Resources.

5.2. Suggestion
Further development is needed to help support models that can access the knowledge base directly with the use of criteria that are more specific in making fisheries management in the Thousand Islands.

Need for fish stock data in order to predict the availability of fishery resources in the present and future. Thus setting and implementation optimal policy can be implemented.

REFERENCES

Ponsero Alain, Dabouineau, Jeremy Allain.2009. Modelling of common European coke


Department of Marine and Fisheries, 2006. *Act NO 31 of 2004 on Fisheries*. Jakarta

-------------------------- 2006. *Act NO 45 of 2009 on Fisheries*. Jakarta


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