

# Coastal Restoration Based on Institutional Approach: A Case Study in the City of Probolinggo, East Java Province, Indonesia

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## ABSTRACT

The coastal area in Indonesia is currently experiencing a very heavy pressure, whether caused by human activities, or caused by natural processes. Damage to coastal ecosystems like mangroves, coral reefs, sea grass beds, estuaries and the region has reached at an alarming rate. It is estimated that more than 41 percent of the coastal area in Indonesia is experiencing environmental degradation. This leads to the coastal region can no longer support the region's ecological system. Associated with more severe coastal damage, it is necessary efforts to save the coast through the people residing in coastal areas as a subject of coastal development. In this regard, more comprehensive studies are needed to determine the institutional aspects as an effective solution for dealing with coastal restoration. The aim of this research is to handle of coastal environmental damage by coastal restoration based on institutional aspect, and to formulate institutional models in accordance with local wisdom. Therefore, it is needed a statistical approach with assumption that there is relationship between restoration of mangrove with institutional aspect. Partial Least Square (PLS) is used to examine such relationship. To analyse priority of institutional strategy, it is used SWOT analysis. The result of this research is that to overcome the damage of mangroves, it is necessary to formulate activities synergy among local government, private and local people. Therefore, Co-management approach is needed to strengthen mangrove Community Working Group. (CWS).

**Keywords:** coastal restoration, Partial Least Square, Strength Weakness Opportunity and Threats, mangrove community working group.

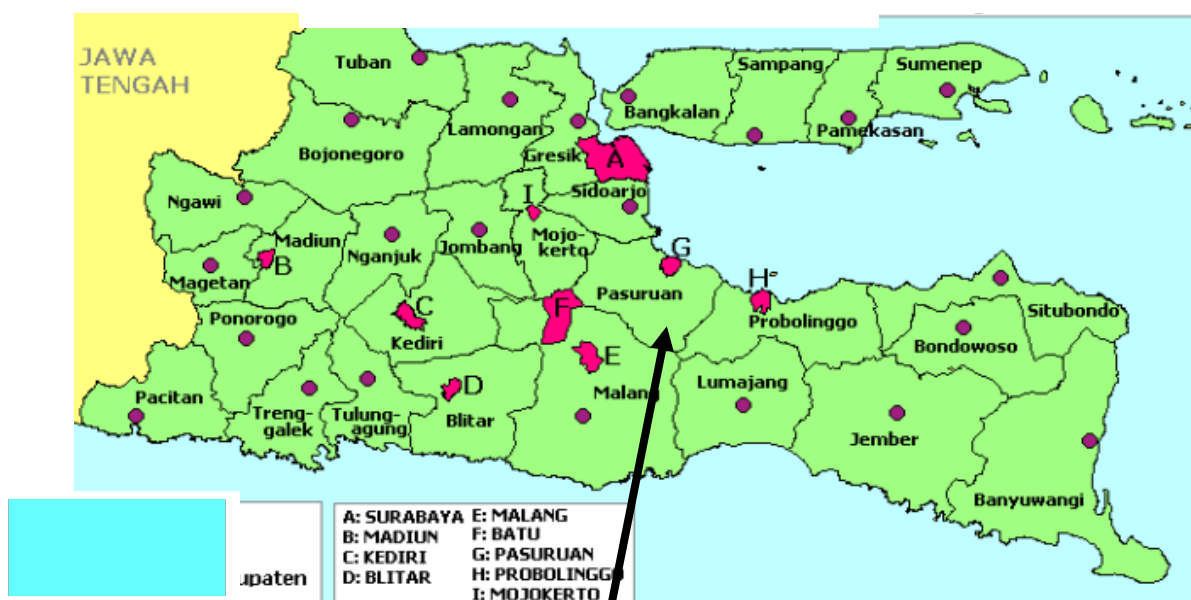
## INTRODUCTION

The coastal area in Indonesia is currently experiencing environmental degradation due to irrational utilization rates without regard to sustainability. Ecological losses suffer is caused mainly by human activities. This problem is mainly concerns the trade off coastal resource use, for example between economic interests and the preservation of ecological functions (Fauzi, 2010). Coastal ecosystems degradation should be solved with more integrated and more comprehensive way. The relationship among ecosystems in coastal area is taking place in certain one unit of space. Therefore, among ecosystems has a mutual relationship and interdependence. According to Rudianto (2014) to deal with coastal damage, it is needed integrated manner with taking into account mangrove restoration is the first priority. Then the coral reefs and further the third priority is sea grass restoration. In order to be successfully to restore coastal area, it is needed to be supported by institution aspects. Wibowo (2009) mentioned that to realize integrated between government agencies with private and local people through the process of institutional based management. In its implementation the Institution that should be effective and efficient must have authority. In order to get authority, institution should have attribution and delegation. Attribution is the formation of a certain authority and administration to specific organs. While, delegates is defined as the delegation of authority by government officials to the other party and the authority are the responsibility of the other part.

Coastal damage problem is not only how to do the restoration, but the capability and institutional capacity to carry out the restoration. The Failure of coastal restoration comes to handling damage technically regardless of the institutional aspects.

Based on the above reasoning, the restoration is done by rehabilitating of coastal mangroves as a top priority by strengthening community institutions as the main prerequisite of success of coastal restoration. Based on these ideas, the study was conducted in the district of Mayangan in Probolinggo. The argument is that such region is an area of mangrove restoration in urban areas with very high levels of damage vulnerability, because it is considering population growth and demand of land for various needs.

There are three objectives of this research that should be achieved. Firstly, it deals with damage of coastal environment based on the technical and institutional aspects. Secondly, it formulates institutional models in accordance with local wisdom. Thirdly, it describes the model in the form of coping strategies based on institutional mangrove restoration.



Location of Research

Fig 1. Map of Mangunharjo Village coastal area in Probolinggo, East Java, Indonesia

Mangunharjo village is located on the coastal areas along one kilometre of Probolinggo city shorelines. It has an area of 19.34 ha of mangrove forests with a height of land approximately four meters above sea level. (Wiyono, 2009). Condition of mangrove forest is the result of the restoration of mangrove forests conducted by Probolinggo government since the 1990s. People who are involved in restoring mangrove forest called Community Working Group (CWG) named Arum Jaya. CWG played in active role to restore mangrove in 2008 with a land area of 8 hectares.

Table 1: Sample location for Mangrove observations

No	Region	Village	Types of Research	Sample size
1.	Probolinggo City	Mangunhardjo	Interview	30 respondents
			Measurement of Mangrove condition by using sampling plot	5 stations in coastal area

### MATERIALS AND METHODS

This research is focus on aspects of coastal biophysical environment to determine whether Mangunhardjo of coastal habitats is suitable for mangrove growth. It is also examine mangrove land suitability and it is also needed institutional analysis as the key to success for mangrove restoration including preparing model and treatment strategies.

Measurement of water quality parameters included: temperature, dissolved oxygen (DO), acidity (pH), salinity, tides, substrate texture and organic C. Whereas, to determine the condition of mangrove needs measurement of mangrove density, environmental carrying capacity and mangrove species dominance.

**Table 2: Measurement of mangrove condition and water quality parameter**

Parameter	St1	St2	St3	St4	St5
Tree level	RM	RM AB	RM AB	RM AB	AB
• Di	700 1	767 433 1 1	700 300 1 1	834 700 1 1	600 1
• Fi	0,1 300	0,3 0,4 155 144	0,2 0,6 155 144	0,3 0,7 174 125	0,7 300
• Ci	1100	600 300	1300 900	900 1700	1100
• INP	1 0,1 300	1 0,7 0,3 0,4 167 131	1 1 0,8 0,8 167 132	1 1 0,9 0,6 130 169	1 0,3 300
Belta stage					
• Di	3333 1	2000 2000 1 1	2000 100 0,7 0,7	1000 2667 1 1	1667 1
• Fi	0,9 300	0,6 0,4 160 140	0,2 0,3 153 146	0,1 0,25 130 169	0,5 300
• Ci	30,5	29,4	29,5	28,9	30,2
• INP	5,8 7,5 29,7	6,7 7,8 31,3	6,3 7,7 31,5	6,8 8,03 30,7	6 8 31,9
Seedling stage					
• Di	Semi diurnal	Semi diurnal	Semi diurnal	Semi diurnal	Semi diurnal
• Fi	Sandy Loam	Sandy Loam	Clay	Sandy Loam	Sandy loam
• Ci					
• INP					
Temperature					
DO					
pH					
Salinity					
Tides					
substrate texture and organic C					

**Source: Sri Rahayu (2014)**

**Remarks:**

St: Station

INP: Important Value Index Fi: Frequency Type AB: *Avecenia Alba*

Di: density type RM : *Rhizophora Mucronata*

Ci : Relative Closure Type Semi-Diurnal tides occur twice

In order to analyse local institutional capacity called arum jaya as key to success to restore coastal damage, it needs latent variable consisting of the role of local government (X), the role of CWS (Y1), the role of private (Y2) and effort to mangrove restoration (Y3).

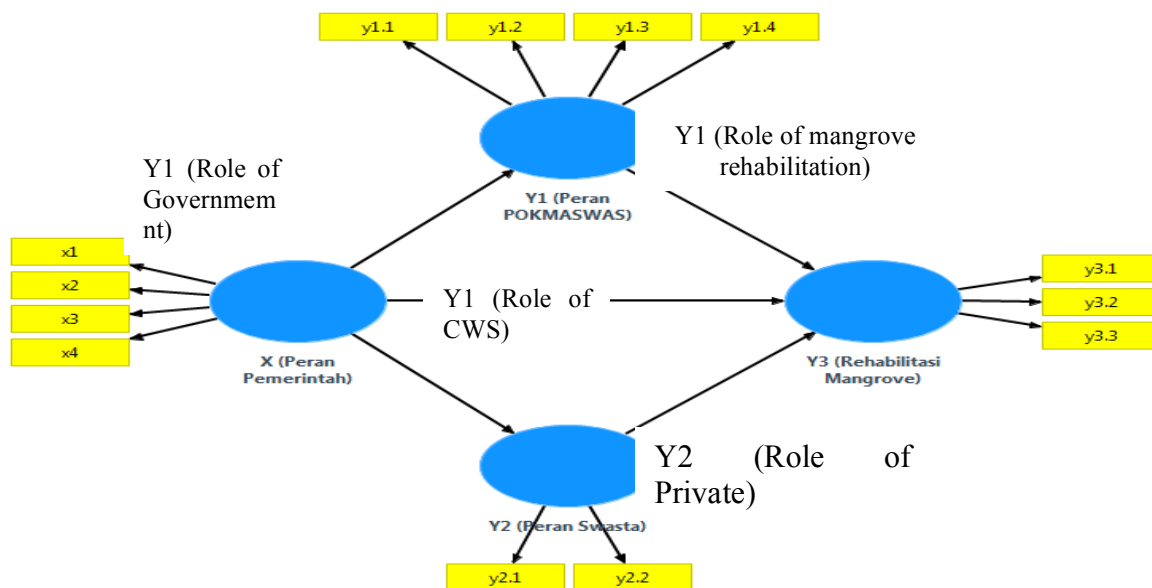
**Table 3. Validity and Reliability Testing of Latent Variables**

Variable	AVE	Composite Reliability
X (Role of government)	0.717	0.910
Y1 (Role of CWS)	0.686	0.897
Y2 (Role of private)	0.714	0.831
Y3 (Restoration of Mangrove)	0.543	0.781

**AVE: Average variance extraction**

Based on table 3 above, the convergent validity outer model has met requirements. whereas, the value of composite reliability in each variables is more than 0.6, so it conclude that indicators of latent variable constituent has validity and internal consistency was good.

After testing validity of latent variables, it is prepared structural model conceptual image below and it can be explained that the conceptual model can be divided into three models based endogen variables, namely: Model 1, which is a model that describes the direct influence of the Role of Government (X) on the Role CWS (Y1). Model 2, which is a model that describes the direct influence of the Role of Government (X) on the Role of Private (Y2). Model 3, which is a model that describes the direct influence of the Role of Government (X), Role CWS (Y1) and Private Roles (Y2) of the Restoration of Mangrove (Y3).



**Figure 2: Structural Conceptual Model**

CWS Role variable (Y1), it can be explained that all of the items making up the variable of CWS role (Y1) has a p-value less than 0.05. Thus, it can be said that all indicators are significant. Public Awareness Indicators (y1.2) has a value of outer loading greatest. This indicates that the greatest contribution to the variable of CWS role (Y1) is measured by indicators Awareness (y1.2)

Private Role variable (Y2), it can be explained that all of the items making up the variable Private Role (Y2) has had a p-value less than 0.05. Thus, it can be said that all indicators are significant. Indicator of personnel (y2.2) has a value of outer loading greatest. This indicates that the greatest contribution to the Private Role variable (Y2) is measured by indicators of Personnel (y2.2).

Mangrove Restoration variables (Y3), it can be explained that all the variables making up the indicator of Mangrove forest restoration (Y3) has had a p-value less than 0.05. Thus, it can be said that all indicators are significant. Compliance Indicators for growth area mangrove (y1.3) has the greatest outer loading. This suggests that the suitability Land for growth of mangrove (y1.3) has the most contribution to the mangrove forest restoration variables (Y3) than other indicators.

**Table 4: Direct Impact Testing Results Inner Model**

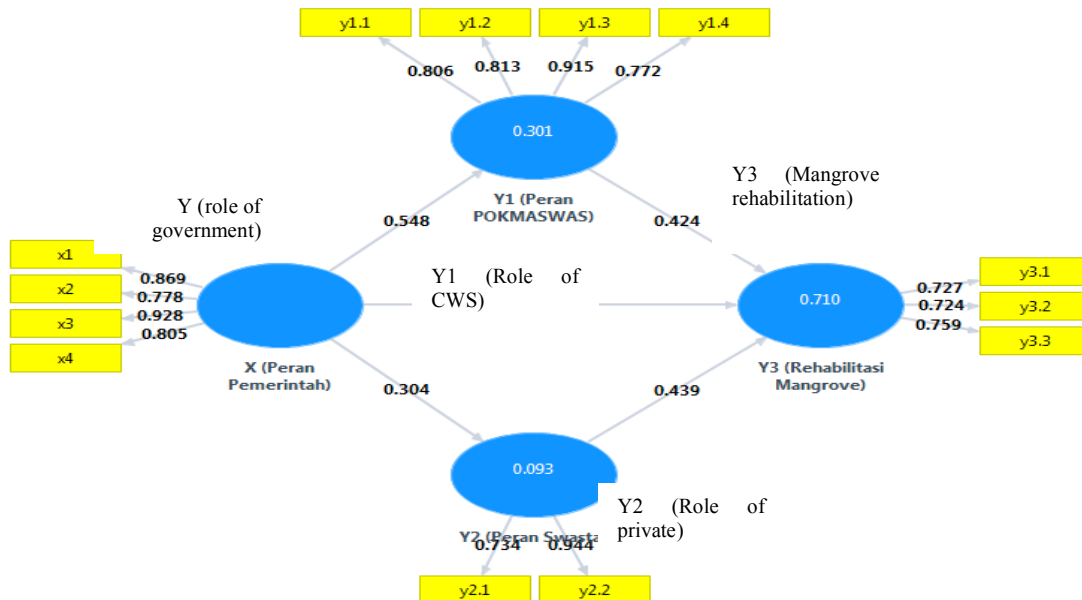
Exogen Variabel	Endogen Variable	Coefficients Path	T-Statistic	p-value
Government role (X)	CWS role (Y1)	0.548	3.267	0.001*
Government role (X)	Private role (Y2)	0.304	2.254	0.025*
Government role (X)	Mangrove restoration (Y3)	0.191	1.439	0.151 <sup>ns</sup>
CWS role (Y1)		0.424	3.179	0.002*
Private role (Y2)		0.439	3.188	0.002*

**Remarks :**

\* : significant at the level of errors 5

ns: not significant

The results of hypothesis testing pathways direct influence can be seen in the following image path diagram.



**Figure 3: Hypothesis Testing Results of Line Diagram Inner Model**

From figure 3 and table 6 above shows that the five direct effect of three models between exogenous variables with endogenous variables, is indicated that not all path coefficients

significant at 5% error rate. In Model 1, the line between the roles of government influence (X) on the Role of CWS (Y1) has a path coefficient of 0.548 with a p-value of 0.001. Government's role variable (X) has significant impact on the role of CWS (Y1). Government's Role variable (X) gives a positive and significant effect on the Role of CWS (Y1). It means that more important the role of government, more positive direct impact to the role of CWS.

In Model 2, the line between the role of government influence (X) on the role of Private (Y2) is indicated that the Government's role of variable (X) has a path coefficient of 0.304 with a p-value of 0.025. Government's role variable (X) gives a positive and significant effect on the Role of Private (Y2). The better the role of government, the better direct positive impact on the private sector's role. In Model 2, the line between the role of government influence (X), role CWS and role of Private (Y2) of the Restoration of Mangrove (Y3), It is indicated that the Government's role variable (X) has a path coefficient of 0.191 with a p-value of 0.151. P-value is more than 0.05 that is indicates that the variable Role of Government (X) does not provide significant direct influence on mangrove restoration (Y). Variable role of CWS (Y1) has a path coefficient of 0.424 with a p-value of 0.002. P-value less than 0.05 is indicated that the variable role of CWS gives positive and significant direct effect on mangrove restoration (Y). Private role variable (Y2) has a path coefficient of 0.439 with a p-value of 0.002. P-value is less than 0.05 that is indicated that the variable role of private gives positive and significant direct effect on mangrove restoration (Y). Private Role influence lines (Y2) of the Restoration of Mangrove (Y3) has the highest coefficient. This indicates that the most dominant influence directly shown by the private sector's role (Y2).

## RESULTS AND DISCUSSION

In terms of testing indirect influence government variable (X) is related to rehabilitate mangrove (Y3) via a variable role of CWS (Y1) and the role of the private sector (Y2) as mediation. Testing the effect of mediation variables is done only if there is a direct effect which significant between predictor variables and the response variable, but there is a chance conceptually that there is a mediation variable between these two variables (Bennett, 2000).

**Table 5: The results of testing the effect of mediation role CWS (Y1) and the role of the private sector (Y2)**

Exogenous variable	Mediation variable	Endogen variable	Indirect influence	P-value
Government role (X)	CWS role(Y1) Private role (Y1)	Mangrove restoration (Y3)	0.233 0.134	0.023** 0.066*

### Remarks :

\*\* : Significant at the 5% error level

\* : Significant at the 10% error level

Indirect influence variable of Government role (X) of the restoration of mangrove (Y3) through private role (Y2) as mediation is equal to 0.134 and p-value of 0.066. P-value is less than 0.10. That it is indicated that the indirect effect is formed significantly in 10% error level. Therefore, it is proved from testing with test that the variable of private role (Y2) is link to mediation variable linking of government role (X) of the mangrove Restoration (Y3). Indirect influence of variable government role (X) of the Restoration of Mangrove (Y3) through CWS role (Y1) is higher than through the private role (Y2). It concludes that to improve Mangrove restoration, the government encourages CWS more than encourage the private sector.

The formulation of strategies for dealing with mangrove restoration in the village of mangunhardjo in this study used SWOT analysis. SWOT analysis is the identification of various factors systematically to formulate strategy. This analysis is based on the logic that maximize strengths and opportunities, but at the same time can minimize weaknesses and threats (Rangkuti, 2001).

There are many factors to be opportunities, threats, strengths and weaknesses of the process of handling the mangrove restoration in Mayangan.

**Table 6. Factors of SWOT**

Strength	Weakness	Opportunity	Threats
1. Availability of funds for restoration	1. Lack of transparency of budget;	1. easily cooperative society;	1. Corruption in bureaucracy
2. Excellent CWS Performance	2. Lack of coordination among government, private and local people;	2. active role of community	2. overlapping authority
3. CSR fund from private sector	3. Lack of community awareness	3. Social culture change	3. restoration mangrove project is delayed because of bureaucracy factors
4. Rules and regulation	4. Lack of human resources		4. Illegal mangrove logging
	5. governments is less serious in mangrove restoration program		

To formulate strategy for mangrove restoration, it is rely on PLS analysis both internal and external environment that it has been stated in structural model as shown in figure 3. Analysis of the internal environment can be applied using IFAS analysis. From the analysis using IFAS matrix, it can be calculated weights, ratings and scores to determine the priority situation. By using the IFAS matrix scores, it will get that superior strength and greatest weakness should be solved. Analysis of the external environment can be applied using EFAS analysis. From the analysis using EFAS matrix, it can be calculated weights, ratings and scores to determine the priority situation. By using the matrix scores EFAS, it will get the greatest opportunities that can be applied and the biggest threat should be avoided.

**Table7: IFAS Matrix**

Internal Strategy Factors	Wegiht	Rating	Score
<b>Strength</b>			
1. Availability of funds for rahabilitation	0.11	3	0.33
2. Excellence CWS performance	0.18	4	0.71
3. CSR fund from private sector	0.07	3	0.20
4. Rules and Regulation	0.20	4	0.80
<b>Weakness:</b>			
1. Lack of budget transparency	0.13	4	0.53
2. Lack of coordination among government, private and local people	0.04	4	0.18
3. Lack of community awareness	0.09	1	0.09
4. Lack of human resources	0.02	3	0.07
5. Government is less serious in mangrove restoration program	0.16	4	0.62
Total	1.00		3.53

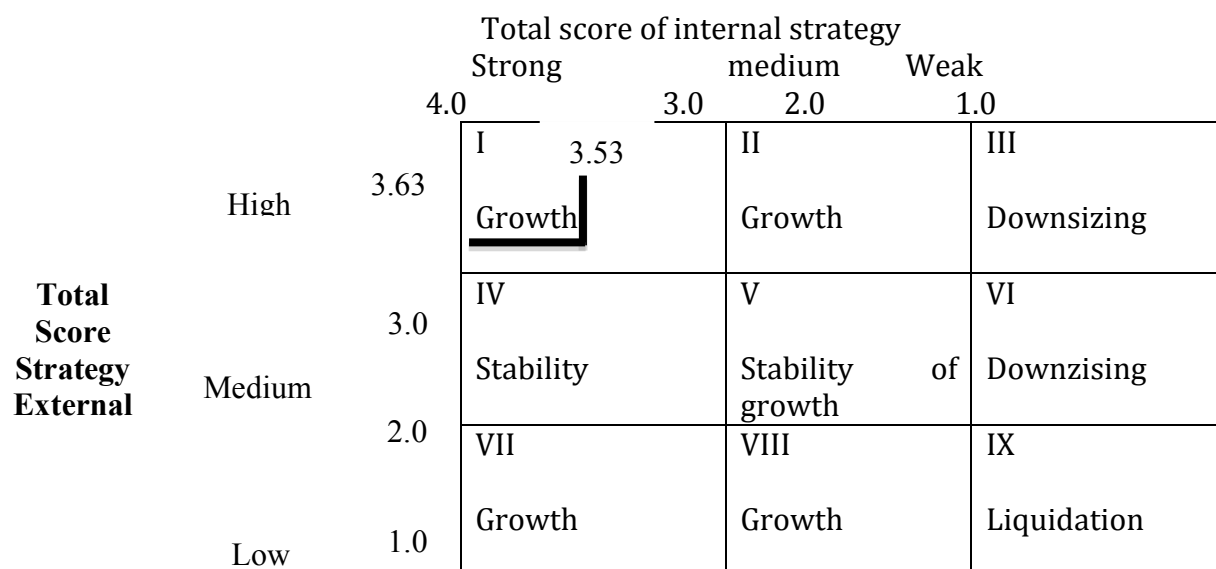
Based on Table 7 above, it can be explained that the highest scores of IFAS matrix is the rules and regulations which is equal to 0.80. This suggests that in dealing with mangrove restoration, rules and regulations are clearly a driving force. Both legal sanctions law and customary regulation is a key force in the process of mangrove restoration the village of Mayangan. In addition, CWS performance has the second highest score. It means that the government helps the CWS indirectly in overseeing the mangrove forest. Thus, CWS act as an agent of the government to the public. In addition, the role of direct CWS may be able to accommodate the community hope to participate in the process of restoration of mangrove forests.

**Table 8: EFAS Matrix**

External Strategy Factors	Weight	Rating	Score
<b>Opportunity:</b>			
1. Easily cooperative society	0.14	4	0.56
2. Active role of community	0.18	4	0.72
3. Social culture change	0.04	2	0.08
<b>Threats:</b>			
1. Corruption in bureaucracy	0.25	4	1.00
2. Overlapping authority	0.11	2	0.22
3. Restoration mangrove project is delayed because of bureaucracy factors	0.07	3	0.21
4. Illegal mangrove logging	0.21	4	0.84
Total	1.00		3.63

Based on the analysis of EFAS matrix, it can be seen that the external factor score is 3.63. matrix, it can be seen that the external factor score is 3.63.





**Figure: 4 Internal-External Matrix to restore mangrove in Mayangan**

As explained in the analysis of IFAS matrix that it has score 3.53. While, score of EFAS matrix is equal to 3.63. Both scores are implementing to the matrix of IE. Based on the matrix Internal - External above, it can be seen that the strategy according to the position of "Growth". Growth is horizontal integration strategy by expanding into a larger area. This strategy can be applied in the presence of a more thorough dissemination to the public. In addition, the growth strategy through vertical integration can also be done in the bureaucracy. For example, it needs closer scrutiny in the process of handling mangrove restoration.

**Table 11: SWOT Matrix**

<b>EFAS</b> 	<b>IFAS</b>	<b>Strenghts (S)</b> 1. Available of funds for restoration 2. Excellence CWS performance 3. CSR fund from private sector 4. Rules and regulation	<b>Weakness (W)</b> 1. Lack of transparency of budget 2. Lack of coordination among government, private and local people 3. Lack of community awareness 4. Lack of human resources 5. Government is less serious in mangrove restoration program
	<b>Opportunities (O)</b> 1. Easily cooperative society 2. Active role of community 3. Social and culture change	<b>Strategy SO</b> 1. Increase the dissemination to the public. 2. CWS given authority to run the mangrove restoration program. 3. CWS given the authority to oversee the mangrove forest. 4. Budget planning, especially for mangrove restoration involve the community.	<b>Strategy WO</b> 1. Current Reports on the activities and financial restoration of mangrove opened to the public. 2. People are asked to participate in monitoring government performance, especially in mangrove restoration. 3. Establish a more intense communication between government, private, and community. 4. Improving the quality of human resources.
	<b>Threats (T)</b> 1. Corruption in bureaucracy 2. Overlapping authority 3. restoration mangrove project is delayed because of bureaucracy factors 4. Illegal logging of mangrove	<b>Strategy ST</b> 1. Formulated clear rules and regulations concerning the rights and obligations, duties, and penalties for noncompliance. 2. Involve the community especially CWS in performance monitoring. 3. The application of customary law in accordance with the collective agreement.	<b>Strategy WT</b> 1. capitalize Pokmaswas to prevent illegal logging. 2. The Government shall coordinate with the community to promote mangrove planting program. 3. The application of a more serious legal sanctions both legal regulations and customary law.

Based on the SWOT matrix above, it could be Formulated strategy as follows:

### **I. Strength-Opportunity Strategy**

Based on the strategy established in the SWOT matrix, SO strategy includes:

1. Increase the dissemination to the public.
2. CWS is given authority to run the mangrove restoration program.
3. CWS is given the authority to oversee the mangrove forest daily.
4. Budget planning, especially for mangrove restoration should involve the community.

### **II. Weakness-Opportunity Strategy**

Strategy is composed of the following:

1. Current Reports on the activities and financial restoration of mangrove opened to the public.
2. People should participate in monitoring government performance, especially in mangrove restoration.
3. Establish a more intense communication between government, private, and community.
4. Improving the quality of human resources.

### **III. Strategy Strength-Threats**

Strategy is composed of the following:

1. Local government should prepare rules and regulations concerning the rights and obligations, duties, and penalties for noncompliance.
2. Involve the community especially CWS in performance monitoring.
3. The application of customary law in accordance with the collective agreement.

### **IV Strategy Weakness-Threats**

Strategy composed of the following:

1. Capitalize CWS to prevent illegal logging.
2. The Government shall coordinate with the community to promote mangrove planting program.
3. The application of legal sanctions over seriuts both statutory law and customary law.

## **CONCLUSION**

The role of CWS to participate in mangrove restoration in the coastal area is extremely important. The local government should give more authority and delegate to CWS to plan and to execute as well as to monitor mangrove growth. The existing condition CWS in doing monitoring of mangrove is just relying on the assistance from local government and they could not stand alone. CWS has strong motivation and courage to restore mangrove with their own cost. Unfortunately, their limited budget could not do much. Sometimes, local government contribute with thousands of seed mangrove, but in the maintenance stage, there is no budget for operation and maintenance. Therefore, there is opportunity to restore damaged mangrove even to expand for other lands. the key to success for coastal restoration is a partnership among the community and the government as well as with the private sector. thus, strengthening institutional CWS become an important requirement. They include strengthening human resources through various training and education , financial assistance on a regular basis for operations, preparation of program planning, mangrove planting and monitoring as well as reporting

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