

The sustainability of mangrove ecosystem and its implication for mangrove-based rural tourism development in southern Malang Regency, East Java, Indonesia

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Abstract: *The aims of the research was to assess the sustainability of environmental, social, economical law/regulation and technology dimension of mangrove in southern coastal area of Malang Regency, Indonesia. Field survey was done in Sitiharjo mangrove-based rural tourism destination. The sustainability aspect of mangrove was assed using Multi-dimensional Scaling (MDS). Research shows that the status of mangrove-based rural tourism using 54 indicators of 5 dimensions is 44.95. It can be classified as poor or not sustainable. Rehabilitation program of mangrove ecosystem has been identified as a main leverage factor for mangrove sustainability. Funding support and availability to implement mangrove conservation has recognized important. It is also important to perform the community empowerment related to the mangrove-based rural tourism. Poor of law enforcement is a major factor in which often inhibits conservation programs. In the future plan for mangrove-based tourism development, the availability of facility to support mangrove –based rural tourism and human resources to manage rural tourism destination are important factors.*

Keywords: *Mangrove, sustainable tourism, community development*

I. Introduction

Recently, tourism has been accepted as one of the important sector for rural development. In Indonesia, tourism is recently emerging as one of the important sector for development, especially in remotes area with abundance natural and cultural resources. Tourism is a new machine for economic earning in many developing countries, including many remotes area in Indonesia archipelago. Tourism opens numerous opportunities for local economic activity, ranging from transportation services to accommodations. Tourism has identified contributes to the incomes of countries, in which it is important to support local development [1] [2] [3].

Natural attraction is the keyword for tourism destination attractiveness, which is presented by abundance natural resources, good quality of environment, rich of local culture and tradition and hospitality of local people [4]. It is especially curial in Indonesia; where many destinations were depend on the natural and cultural richness [3]. In addition to its function as daily live resources, the natural resources also plays an important role in ecosystems services, both global and local levels [4].

The issues of mangrove conservation have been discussed by numerous authors since it is important for human being, especially among coastal dwellers in tropical developing countries. Tourism is important potential resources for tourism development. Tourism in mangrove area has been identified in some countries. Scholar point out that among the negative impact of tourism to mangrove ecosystem is encompasses pollution, vegetation degradation, wildlife habitat disturbance, and loss of mangrove vegetations. Conflicts over the uses of mangrove resources are emerging as one of the crucial problems for mangrove conservations. Lack of community support in conservation program may make it impossible to promote mangrove conservation. This is often the case when economic benefits from mangrove conservation were not well understood. Scholar point out that inadequate knowledge to support mangrove conservation is another problem [5] [6] [7] .

Developing mechanism to increase sustainability of mangrove ecosystem is important. The sustainable mangrove ecosystem not only crucial for human live in coastal area, but it is also important to develop new strategy for coastal community economic development. The creation and development of rural tourism in an area with abundance mangrove forest as a solution to countermeasure mangrove threats and increase human being in coastal area has been one of the main objectives of mangrove-based rural tourism. This implies the need for new scenarios for development [8] [9].

East Java, Indonesia, has abundance mangrove ecosystem. Recently, many mangrove hotspots have been degraded due to unsustainable uses of natural resources. Some mangrove ecosystem still exist and conserved in some area, including area within national park, strict protected area and Perhutani forest (State owned enterprises on Forestry). The strategy for sustainable uses of mangrove ecosystem for local economic

growth was needed. The aim of the research was to assess the sustainability of environmental, social and economical dimension of mangrove in southern coastal area of Malang Regency. In the sustainability assessment, two important dimension namely law/regulation and technology also assessed.

II. Methodology

Study area

Field survey was set up at Sitiharjo Villages in Southern Malang Regency, East Java Indonesia (Fig.1). Mangrove forest in Sitiharjo area provides a number of benefits to local people. Ecologically, the coastal area of southern Malang regency rich in term of coastal ecosystem types, ranging from mangrove, *Barringtonia* vegetation, *Pandanus* vegetations and coral reefs. Wide area of white sand sea attract tourist to come to southern Malang coastal area.



Fig.1. The location of Sitiharjo in coastal area of Malang Regency, East Java

Methods

The sustainability aspect of mangrove in Sitiharjo was assessed using Multi-dimensional Scaling (MDS). Five dimensions which are related to the sustainability of mangrove were assessed, namely environmental, economical, social, law-regulation and technology. In each dimension, related attributes -in which it contributes to the sustainability of dimensions- was set up to identify the sustainability of each dimension. A questionnaire was distributed to the respondents. Each dimension of sustainability was assessed using specific criteria. There are about 11 items were asked to evaluate environmental dimensions, 10 items questions to evaluate economical sustainability and 10 items question to evaluate social sustainability. About 12 attributes were asked to evaluate law-regulation and 11 attributes were asked to evaluate infrastructure sustainability.

Data analysis

Data was analyzed using Multidimensional Scaling (MDS) techniques. Analyses were started from reviewing attributes and defining attributes. This was followed by scoring of attributes based on RAPFISH guidelines. Technically, the Ordination of RAPFISH was developed by assessing each dimension using its related aspect. It was presented in scales, ranging from 0 to 100%. Sustainability was drawn in both vertical and horizontal lines. Line shows the sustainability point from poor (0%) to good (100%) conditions. The sustainability point was given in Table 1. The accuracy and precision of attributes importance was calculated using determinant coefficient (R^2). The stress value was allowed when value below 0.25, in which analysis can be said good.

Table 1. Index and sustainability status of Mangrove utilization and management in southern Malang Regency

Index value	Category
0 – 25	Poor (Not sustainable)
26 – 50	Less (Less sustainable)
51 – 75	Moderate
76 – 100	Good

Sources: Modified from Kavanagh 2001.

Leverage factor determination

In this research, the leverage factor was examined from the analysis of Rapfish, especially from the highest value of root means square (RMS) to the medium value in each sustainability dimensions. Attribute with highest value represent the important attributes in sustainability

Monte Carlo Analysis

The analysis of Monte Carlo was done in confidence interval 95%. In order to generate difference value more higher (MC-MDS>5%) or less (MC – MDS < 5%), the comparison of Monte Carlo and MDS results was done in interval confidence 95%. MDS analysis not suitable as an index to predict sustainability when difference value of two analysis >5%. MDS result able to used as an index to predict sustainability when two value has <5% it means.

III. Result and Discussion

The sustainability of mangrove ecosystem

Basically, the sustainability of mangrove utilization can be evaluated from environmental, economical and social dimensions. In this study, however, there are also important dimension to be involved, namely law/regulation and technology. This two aspects has been identified important for resources utilization evaluations.

Environmental aspect

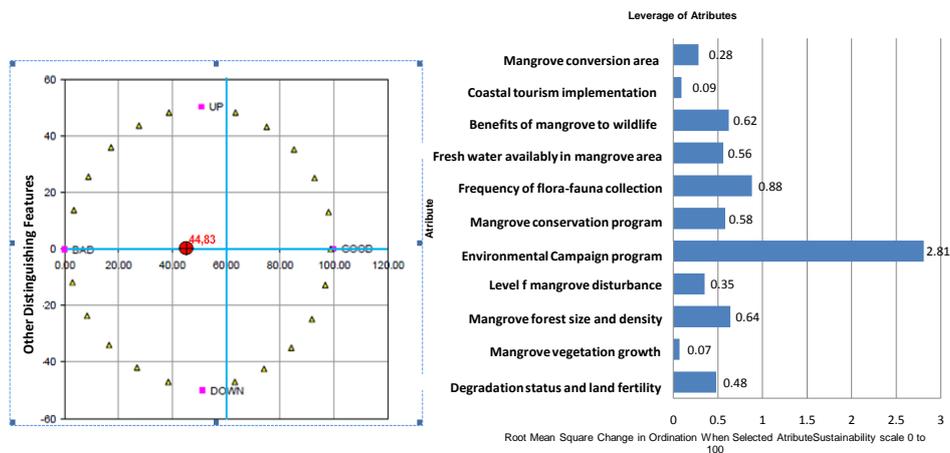


Fig.2. The Multidimensional Scaling (MDS) figure of the sustainability of mangrove in the perspective of environmental and its leverage attributes to the sustainability.

Based on the Fig. 2, it is clear that environmental indices sustainability of mangrove in study area was calculated about 44.83%. It can be classified that the mangrove ecosystem has less sustainability status. In the field, it is supported by visual observation that mangrove has been degraded due to human activity. Opening new farmed shrimp and establishing house and settlement area become the major contributors to mangrove degradation. Therefore the rehabilitation program of mangrove ecosystem is needed.

The leverage factor analysis for sustainability confirms that ultimately there are 11 environmental attributes which area contributes to the sustainability of mangrove. These attributes includes mangrove conservation area, coastal tourism implementation, benefit of mangrove to wildlife, fresh water availability in mangrove ecosystem area, frequency of flora-fauna collection, mangrove conservation program, environmental campaign program, level of mangrove disturbance, mangrove forest size and density, mangrove vegetation grows rate, and degradation status and land fertility.

Among the leverage factor, environmental campaign program has the highest value. The leverage value of environmental campaign is about 2.81. Environmental campaign especially is important to increase community attention and support in mangrove conservation programs. Campaign becomes important to build environmental awareness. The intensive and widespread of campaign to conserve mangrove and promotes its sustainability utilization could have led to greatly increase public support [10] [11]. In south Malang, the potential agents for environmental campaign includes local NGOs, university and stakeholders become important, especially in the situation where problems is complicated and integrated approach was needed.

Economical aspect

The economical sustainability of mangrove ecosystem in study area is calculated about 48.06%. It can be classified that sustainability of economical was moderate. This value is close to the critical point of sustainability level, 50%. Ten attributers which are contributes to the economical aspect of mangrove sustainability are encompasses economic community development program, cost recovery for mangrove degradation, the existence of economic facility, coastal development program to induce local economic growth,

fisheries and marine economic contribution to regency income, economics of tourism in coastal area, economic value of mangrove, impact to coastal income, impact to community income and impact to jobs opportunities.

The leverage attributes analyses confirm that there are four attributes becomes sensitive factors to the sustainability, namely (1) impact to coastal income with leverage value 3.92, (2) cost recovery for mangrove degradation with leverage value 3.53, (3) economic community development program with leverage value 2.54 and (4) impact to jobs opportunities with leverage value 2.50 (Fig.3). Income is sensitive issues among local people, especially among poor community. The amount of income is related to the skill of labor, in which labor with limited skill will generate low income. In order to increase income, therefore, it is crucial to improve human skill. There is also report that people without permanent jobs often have illegal activity in mangrove ecosystem, including collecting numerous flora and fauna. Increasing local people economic is crucial. Funding support and availability to implement mangrove conservation has recognized important. In the limitation of governmental budget in conservation program, there are challenges to generate public support for mangrove rehabilitation programs [12] [13].

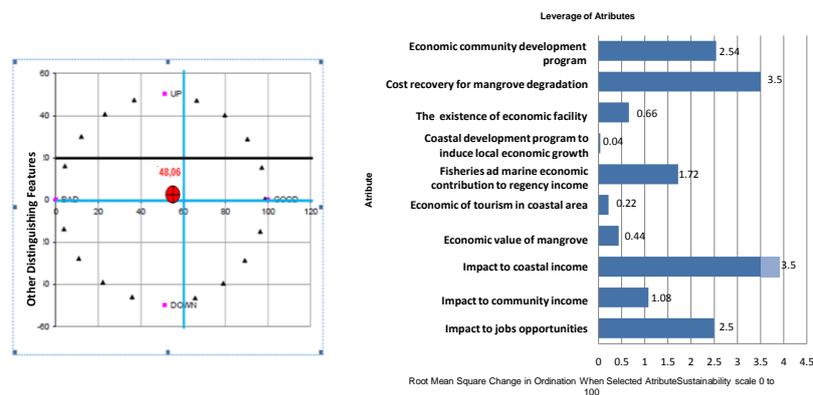


Fig. 3. The Multidimensional Scaling (MDS) figure of the sustainability of mangrove in the perspective of economic aspect and its leverage attributes to the sustainability.

Social aspect

Based on the Multidimensional Scaling analysis, it is calculated that social sustainability value is 46.79%, or it can be said that social sustainability was less. Ten attributes related to the leverages of social sustainability are encompasses community awareness to countermeasure social impact of tourism in mangrove area, community perception to rural tourism based mangrove ecosystem, community awareness in environmental quality, impact of rural tourism in education improvement, level of conflict of interest, social impact of mangrove-based rural tourism to community, community development program in related to mangrove-based rural tourism, community relationship to tourism activity in coastal area, community welfare in coastal area and level of labor absorption.

From the analysis, community empowerment related to the mangrove-based rural tourism has highest leverage value (1.60) (Fig.4). Tourism potentially contributes to social aspects of community. Scholar point out that impact was numerous, encompasses cultural clashes, loss of authenticity, co-modification and standardization [14] [15].

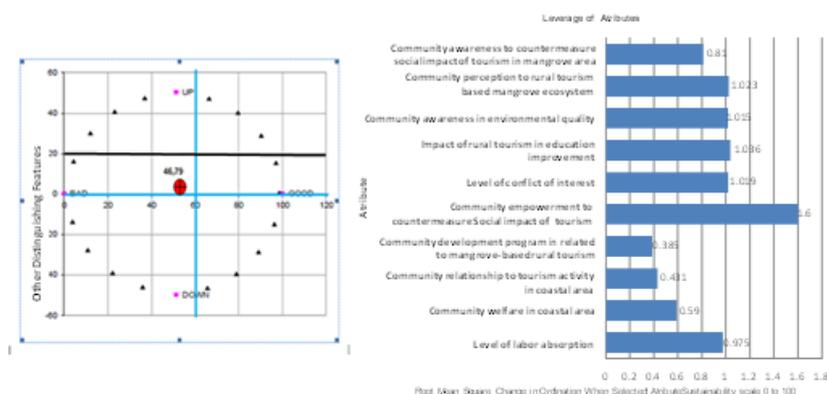


Fig. 4. The Multidimensional Scaling (MDS) figure of the sustainability of mangrove in the perspective of social aspect and its leverage attributes to the sustainability.

Law and regulation aspect

From the MDS analysis, the sustainability index of law and regulation was about 42.16%. This means, the sustainability of law and regulation was poor. There are 12 leveraging factor related to law and regulation, encompasses law enforcement towards factors contributes to rural village disturbance, perception about rural tourism, legal certainty to implement mangrove-based rural tourism, problems of mangrove forest conversion, collaboration multi-sector in the rural tourism development, synchronization of regulation, conflict with farmed shrimp owners, conflict with community in forest and plantation zone, law enforcement in environmental aspect, law counseling and implementation of regional spatial planning, conformity in environmental law and law and regulation to ensure environmental preservation.

The leverage analysis shows that there are two important attributes, namely problems of mangrove forest conversion with leverage 2.95 and law enforcement in environmental aspect with leverage value 2.87 (Fig.5). Problems of mangrove conservation become the ultimate global concern, and it is crucial among tropical developing countries. Issues for mangrove conservation therefore should be accommodated in national and regional regulation. It is important to provide legal guideline and any conservation program related mangrove rehabilitation. Poor of law enforcement is a major factor in which often inhibits conservation programs. According to scholar, better law and regulation implementation both at national and local level could greatly reduce forest disturbance [16] [17].

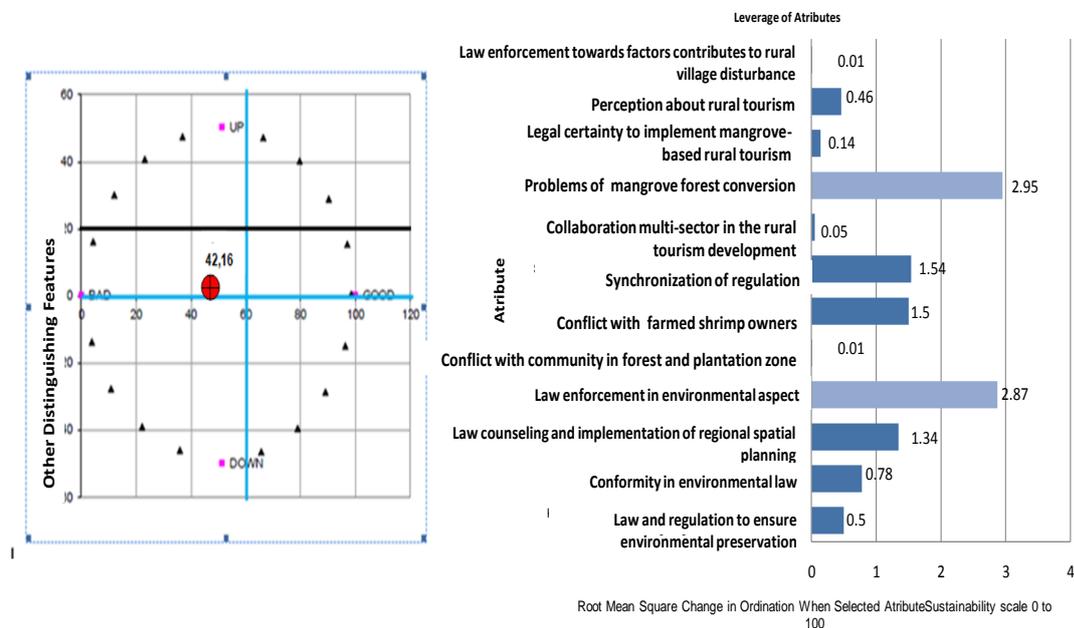


Fig. 5. The Multidimensional Scaling (MDS) of the sustainability of mangrove in the perspective of law and regulations aspect and its leverage attributes to the sustainability.

Infrastructure and technology

The MDS analysis shows that infrastructure and technology has sustainability index 42.89%. This means, the sustainability of infrastructure and technology is classified less sustainable. There are 11 leverages factors to identify the sustainability, namely mangrove resources calculation techniques, availability of conservation techniques and standard operation procedure, availability of human resources to manage rural tourism destination, routine monitoring by movement to control rural tourism destination, forest management techniques, seedling and plant selection techniques, availability of facility to support mangrove –based rural tourism, sea water pollution control techniques, seedling and planting techniques, mangrove rehabilitation techniques, and understanding of mangrove-based rural management

Based on the calculation of 11 indicators in the evaluation of leverages, there are two important attributes which plays a crucial sensitive factors to the infrastructure and technology, namely the availability of facility to support mangrove –based rural tourism (3.5) and availability of human resources to manage rural tourism destination (3.00). Scholars point out that the availability of technology has been identified important for mangrove conservation. Technology enhances the success of seedling and planting of re-vegetation program [18].

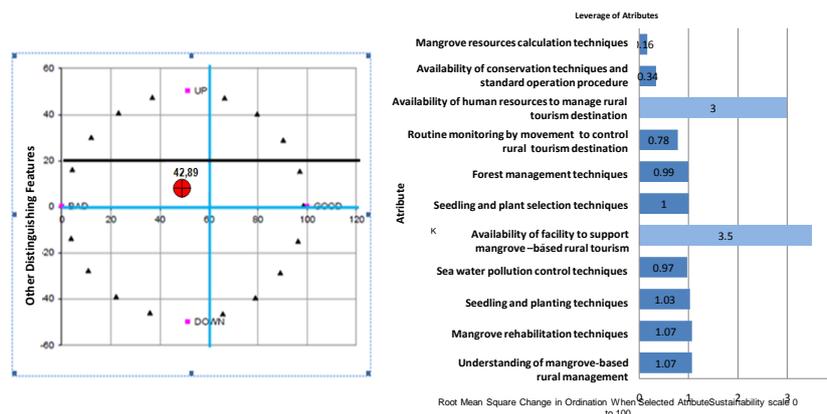


Fig. 6. The Multidimensional Scaling (MDS) of the sustainability of mangrove in the perspective of technology and its leverage attributes to the sustainability.

The pentagonal diagrams to represent the integrated management of mangrove ecosystem in related to tourism development was given in Fig. 7.

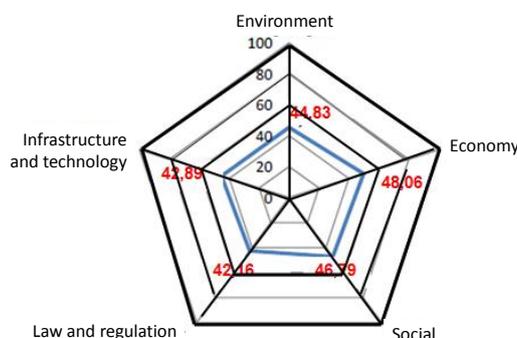


Fig. 7. The pentagonal diagram for sustainability of mangrove conservation

This research confirm that the status of mangrove-based rural tourism using 54 indicator of 5 dimension about 44.95. Based o the calculation, the sustainability of mangrove can be classified as poor or not sustainable. This is similar with Kavanagh notes, that value under 25 can be classified poor or not sustainable [19]. Challenge for local government of Malang Regency is improving numerous poor aspect related to the sustainability of mangrove.

Table 2. Sustainability index of Mangrove based rural tourism destination in Southern coastal area of Malang Regency

Dimension	MDS	Monte Carlo	Difference
Ecology	44.83	45.02	0.19
Economy	48.06	48.54	0.48
Social	46.79	47.04	0.25
Law-regulation	42.16	42.61	0.45
Infrastructure and Technology	42.89	42.97	0.08
Index Multidimensional MDS	44.95	45.84	0.89

Result shows that there are gaps between MDS and *Monte Carlo* analysis about 0.19-0.89. Stress analysis shows value between 14–15%, far from permitted value 25%. Determinant co-efficient close to the value 1 or 100%. MDS analysis shows that all of the evacuated attributes has significant accuracy to evaluate the sustainable aspect of five dimension (Table 2). Following these statistical evaluation, the result of the sustainability assessment for five dimensions was given in Table 3.

Table 3. Sustainability analysis of five dimension of mangrove sustainability in Malang Regency

Statistical value	Ecology	Economy	Social	Law-regulation	Infrastructure and Technology	Multi Dimension
Stress	0.16	0.16	0.14	0.14	0.14	0.14
R2	0.95	0.95	0.95	0.95	0.95	0.95

From 54 indicators of sustainability status, about 10 indicators have highest sensitivity and become the important leverage factors in order to increase the sustainability status (Table 4.)

Table 4. Leverage factors to sustainability index

Variable	Indicator	RMS
Ecology	Environmental campaign program	2.81
Economy	Impact to coastal income	3.92
	Cost recovery for mangrove degradation	3.53
	Economic community development program	2.54
	Impact to jobs opportunities with leverage	2.50
Social	Community empowerment related to the mangrove-based rural tourism.	1.60
Law and regulation	Law enforcement in environmental aspect.	2.87
	Problems of mangrove forest conversion	2.95
Infrastructure and Technology	Availability of facility to support mangrove –based rural tourism	3.35
	Availability of human resources to manage rural tourism destination	3.00

The implication for sustainable mangrove-based rural tourism destination

The sustainability of mangrove ecosystem in Sitiharjo contributes to the success of tourism. The success of tourism will contribute to the society well being. Therefore it is crucial to minimize numerous negative aspects which contribute to mangrove degradation. Attempts to develop sustainable mangrove utilization from creative industry were important. One opportunity and possibility is to designate some of the mangrove area as tourism attraction. There are, however, programs should be planned and implemented. It is especially crucial to increase and enhance the sustainable uses of mangrove resources. Area that has high biodiversity content and unsuitable for tourism should be protected and conserved [1] [8] [20].

There should be regulation and policy to enhance tourism and conservation program in integrative perspective. This means, mangrove-based rural tourism programs should be designed to be able to involve numerous stakeholders and local community in destination scenario. Strengthening sustainable tourism issues and practices in mangrove area should be viewed as collective responsibility from local people to government. [21].

Mangrove tourism should be able to facilitate environmental, economic and social benefits. Strengthening the capacity of local people and developing proper regulation is crucial. Educational and numerous informal human capacity educational training are important. Besides technical aspect, the skill in organization and management is crucial. Improving skill will increase the success of mangrove based rural tourism destination. Fundamentals to the process are the concept of community based tourism, in which the involving schema of local people into tourism business in Sitiharjo is prioritized as active players in tourism industry. It is especially important to increase local people welfare, including reducing poverty [22].

IV. Conclusion

The mangrove ecosystem utilization in Sitiharjo, Malang Regency was unsustainable. Human impact in mangrove ecosystem is the main contributor for unsustainable mangrove utilization. For the future, it is important to promote sustainable tourism implementation in rural area of Sitiharjo, with the objectives is increasing sustainable economic growth, appreciating and preserving local culture and conserving mangrove ecosystems. There are need law and regulation enforcement to countermeasure human negative impact to mangrove ecosystem. Technology is important aspect in mangrove conservation, ranging from basic implementation to mangrove seedling and planting to mangrove monitoring using advance technology. In such a case, collaboration among government, local people and stake holder is important to enhance the sustainability of mangrove ecosystem, and increase the sustainability and competitiveness of mangrove-based rural tourism in Sitiharjo.

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