Mangrove ecotourism management at local community in Jangkaran, Kulonprogo, using hierarchy analysis

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Abstract. Mangrove is one of the most pivotal of coastal ecosystems. In this study, Kulonprogo coastal area is considered in the analysis of mangrove ecotourism management. Kulonprogo coastal area is located in the tsunami prone area. Due to rapid population growth, thousands of people are currently believed to be exposed to the danger of tsunami hazard, since they live in the proximity of southern coastal. It also implies that these people are potential victims, hence the existence of mangrove ecosystems can be used as tsunami barrier and reduce the impact when disaster strikes. In order to maintain the existence of mangroves and its important ecological functions, then it is crucial to have an appropriate conservation strategy for mangrove ecosystems as well as to integrate the conservation effort with the element of education and economic. Mangrove ecotourism is one of the best strategy to conserve mangrove, provide education as well as increase prosperity of the community. For this purpose, this study proposes an Analytic Hierarchy Process (AHP) as an effective platform to investigate the management strategy of mangrove ecotourism. Hierarchical synthesis is obtained from the process of weighting by paired comparison based on expert judgments. In-depth interview survey to key person in mangrove ecotourism was used in this study. There were several main elements of mangrove ecotourism in Jangkaran, Kulonprogo Regency, i.e. the potency of mangrove ecotourism; facilities and infrastructure of mangrove ecotourism; access to mangrove ecotourism locations and institutional management of mangrove ecotourism. The results showed that the highest and lowest value of main element were institutional management of mangrove ecotourism (0.36) and access to mangrove ecotourism locations (0.14). Each main element of mangrove ecotourism is divided into several sub-elements. The three sub-elements with highest value were Management Capacity of Human Resources (0.107), Natural Zonation of Mangrove (0.96) and Biodiversity of Mangrove (0.84). Hence, these three highest value of sub-element can be used to arrange the best strategy on mangrove ecotourism management.

Keywords: Ecosystem, Conservation, Kulonprogo, Local Community, AHP

1. Introduction

Indonesia, as a world’s largest archipelagic state, is also known as the center of marine megabiodiversity [1],...
[2]. Mangroves are among the most productive and important coastal ecosystems, especially in Indonesia. Mangrove ecosystem provide a number valuable ecosystem services, i.e. spawning, nursery and feeding ground [3]–[5]; natural coastal barrier from erosion and tsunamis [5]–[7]. As much as 76 % of the total mangroves in the Southeast Asia, is in Indonesia. That ecosystem consist of 15 plant families, with 18 genera and 41 species, and 116 associated species, covering an area of 35.337 km² [8].

Mangrove ecosystem throughout the world face various threats, including pollution, deforestation, fragmentation, and sea-level rise [9]. A number of threats to the Indonesian mangrove ecosystem was also widely reported. Mangrove conversion to aquaculture was occurred in a large area [10]. Moreover besides, timber extraction and the expansion of urban areas, have also been occurred [11]. Healthy coastal ecosystem provides maximum benefits for biodiversity [12]. As contrary, mangrove degradation result to minimum provisioning of ecosystem services. Development a mangrove management strategy to face various threats is crucially needed. One of promising approach that is notable to develop is mangrove ecotourism [8]. Mangrove ecotourism is “a sustainable tourism within a natural and cultural heritage area where community participation, protection, and management of natural resources, culture and indigenous knowledge and practices, environmental education and ethics as well as economic benefits are fostered and pursued for the enrichment of host communities and satisfaction of visitors” [8].

Kulon Progo is one of the coastal area in the south coast of java, Indonesia. Mangrove ecosystem can be found in this coastal area. Kulon Progo is located among three big watershed namely, watershed of Progo, Serang, and Bogowonto. Kulon Progo coastal area is one of the tsunami-prone area [13]. Based on several research, mentioned that, one of the important ecological function of mangrove is natural coastal barrier from erosion and tsunamis [5], [7], [9]. Development strategy of mangrove ecotourism as a strategy to mitigate the impact of coastal disaster is important, especially in the tsunami-prone area. Complexity of the problem of mangrove ecotourism in Kulon Progo, should be explained into several small part, with in the intention of understanding the most important factor/ element in mangrove ecotourism management. Explanation of mangrove ecotourism element can be composed into a hierarchy. Finally, mangrove ecotourism management strategy can be arranged based on the most important elements from hierarchy analysis. Aims of this study was identify several important elements and sub-elements of mangrove ecotourism. Afterwards, the elements and sub-elements will be composed into hierarchy and then determine the most important element/ sub-element that must to be done first.

2. Method
The study was performed in April to September. The research was conducted in mangrove ecotourism area, Jangkaran Village, Kulon Progo, Special Region of Yogyakarta. This study using analytical descriptive method. The data used was primary data, based on in-depth interviews with the experts on mangrove ecotourism.

Mangrove ecotourism management strategy were arranged first by identified and classified various important element. The important elements that consist of main elements and sub-elements, were arranged into a decision tree using the AHP. The AHP is a basic approach to decision making [14]. Four step were organized in using AHP, i.e. Structuring a hierarchical model and identifying mangrove ecotourism elements; conducting a pairwise comparisons of all elements with the intention of weighting the elements; conducting consistency of the judgmental matrix to determine the judgmental matrix’s consistency; structuring the mangrove ecotourism management model; and determining the most important element that must to be done first in mangrove ecotourism management.

The priorities elements were determined according to the opinion/ judgement from experts consisting, Academician, Government, Practitioner, and Community. The experts were organized to perform pairwise comparisons of strength each element compared other element, follow the rules of AHP. The strenght of preference elements was observed through a 9-point intensity scale (see Table 1). The application of AHP also evaluated consistency in judgment through consistency ratio (CR). Consistency indicates that: if a > b ; b > c then a > c. The value of CR ranges from 0 to 1. If the value of CR was 0.10 or less, it was considered acceptable [14].

Table 1.
| Intensity of Importance | Definition                                                                 | Explanation                                                                                       |
|-------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1                       | Equal Importance                                                         | Two Activities contribute equally to the objective                                                |
| 3                       | Weak importance of one over another                                       | Experience and judgment slightly favor one indicator over another                                 |
| 5                       | Essential or strong importance                                           | Experience and judgment strongly favor one criterion/indicator over another A                   |
| 7                       | Demonstrated importance                                                  | A indicator is strongly favored and its dominance is demonstrated in practice                   |
| 9                       | Absolute importance                                                      | The evidence favoring one indicator over another is of the highest possible order of affirmation |
| 2, 4, 6, 8               | Intermediate values between the two adjacent judgments                   | When compromise is needed                                                                         |

Table 1. Intensity scale of importance [14]
3. Results and Discussion

Four main mangrove ecotourism elements in Jangkaran, Kulon Progo, were identified, namely, Potency of Mangrove Ecotourism (0.326); Facilities and Infrastructure of Mangrove Ecotourism (0.163); Access to Mangrove Ecotourism Locations (0.148) and Institutional Management of Mangrove Ecotourism (0.363) (see Figure 1). Each element consist of several sub-elements. Detail description and classification of each element and sub-element can be seen in the next sub-section.

| Institutional Management of Mangrove Ecotourism | 0.363 |
| Potency of Mangrove Ecotourism | 0.326 |
| Facilities and Infrastructure | 0.163 |
| Access to Mangrove Ecotourism Locations | 0.148 |

Inconsistency = 0.00776 with 0 missing judgments.

Figure 1. Main Mangrove Ecotourism Elements in Jangkaran, Kulon Progo

a. Classification of Main Elements and Sub-elements

The first main elements of mangrove ecotourism in Jangkaran, Kulon Progo was Potency of Mangrove Ecotourism. This element consist of 8 sub-elements, i.e. Manage the Natural Zonation of Mangrove Ecosystem (0.234); Maintain Biodiversity of Mangrove Ecosystem (0.204); Existence of Learning House (0.129); Manage the Density of Mangrove Ecosystem (0.128); Manage the Biota that Associate with Mangrove Ecosystem (0.112); Existence of Development Area of Mangrove Ecosystem (0.092); Existence of Mangrove Tracking (0.064); and Existence of Touring Boat (0.036) (See Figure 2).

Figure 2. Sub-element of Potency of Mangrove Ecotourism

The second element of mangrove ecotourism in Jangkaran, Kulon Progo was Facilities and Infrastructure of Mangrove Ecotourism. This element to be composed into 4 sub-element, i.e. Existence of Education Information Board (0.340); Existence of Rest Area and Toilet (0.281); Existence of Cleaning Facilities (0.239); and Existence of Parking Area (0.140) (See Figure 3).

Figure 3. Sub-element of Facilities and Infrastructure of Mangrove Ecotourism

The third element was Access to Mangrove Ecotourism Locations, consisting of 4 sub-elements. The sub-elements i.e. Manage Road Condition to Mangrove Ecotourism Area (0.312); Existence of Transportation Modes (0.280); Existence of Direction Board (0.280); and The Mileage to Reach Mangrove Ecotourism Area (0.127) (See Figure 4).

Figure 4. Sub-element of Access to Mangrove Ecotourism Locations

The last element was Institutional Management of Mangrove Ecotourism. This element arranged by 5 sub-elements, i.e. Increasing Managerial Capacity of Human Resource who Manage the Mangrove
Ecotourism (0.351); Existence of Institutional Partnership (0.216); The Number of Human Resources in Management Team of Mangrove Ecotourism (0.163); Social Conflict (0.141); and Increasing Education Capacity of Human Resources in Management Team of Mangrove Ecotourism (0.130) (See Figure 5). The classification model of all the elements and sub-elements can be seen in Figure 6.

**Figure 5.** Sub-element of Institutional Management of Mangrove Ecotourism

![Figure 5](image)

**Figure 6.** The classification model of all the elements and sub-elements

b. The Priority Elements of Mangrove Ecotourism

A set of important mangrove ecotourism element have been determined. Based on integrated analysis using AHP to all of elements and sub-elements, the most three important sub-elements were Increasing Managerial Capacity of Human Resource who Manage the Mangrove Ecotourism (0.107); Manage the Natural Zonation of Mangrove Ecosystem in Mangrove Ecotourism Area (0.096); and Maintain the Biodiversity of Mangrove Ecosystem in Mangrove Ecotourism Area (0.084) (see Figure 7).
Most of experts agreed that Increasing Managerial Capacity of Human Resource who Manage the Mangrove Ecotourism element, was the most important element that must to be done first. Mangrove ecotourism in Jangkaran was managed by local community. They had various education background, most of them were graduated from elementary-high school. The society did not have sufficient knowledge about tourism management. Increasing managerial capacity of the society can be a good strategy to strengthen mangrove tourism management. Nevertheless, the society have great enthusiasm to activity related to mangrove. More than 65% of local society around the mangrove area, were participated in several mangrove training activity from government [15]. Moreover, more than 65 % of the same community have also participated in mangrove replanting program [15]. However, mangrove replanting activity, have not been successful.

There were several problem related to mangrove zonation. One of the main problem of unsuccessful mangrove replanting program was incompatibility the mangrove species with habitat characteristic in replanting area. In other word, there was a supposition of incompatibility natural mangrove zonation compared to replanting activity. Mangrove have unique zonation pattern across topographic gradients. Topographic gradients were divided into three type, i.e. downstream, intermediate and upstream sections (see Figure 8). Incompatibility mangrove replanting area with the natural zonation pattern would resulting to an unsuccessful of replanting. Moreover, unsuccessful of mangrove replanting in Jangkaran Village was lack of maintenance after mangrove replant.

Diversity of mangrove ecosystem is one of the important element in mangrove ecotourism. Actually, the main purpose of mangrove ecotourism was to conserve mangrove ecosystem, particularly to conserve mangrove diversity. There were 7 mangrove species in Jangkaran Village, which classified in 5 family, i.e. *Avicennia marina*; *Avicennia alba*; *Rhizophora mucronata*; *Sonneratia caseolaris*; *Acanthus ilicifolius*; *Acrostichum aureum*; and *Nypa fruticans* [15]. The mangrove species, were divided into natural species and introduction species. Natural mangrove species were *Avicennia marina*; *Avicennia alba*; *Rhizophora mucronata*. Mangrove diversity must be maintain according to the mangrove natural zonation pattern. It was important, because, in fact there was only 1 species that be replanted in mangrove area. Maintain mangrove diversity can increase the quality of mangrove ecotourism, moreover strenghten ecological function of mangrove as coastal disaster natural barrier.
4. Conclusion

Important main elements on mangrove ecotourism management were Potency of Mangrove Ecotourism; Facilities and Infrastructure of Mangrove Ecotourism; Access to Mangrove Ecotourism Locations and Institutional Management of Mangrove Ecotourism. There were several important sub-element that must to be done first to manage mangrove ecotourism, i.e. increasing managerial capacity of human resource who manage the mangrove ecotourism; manage the natural zonation of mangrove ecosystem in mangrove ecotourism area; and maintain the biodiversity of mangrove ecosystem in mangrove ecotourism area. Several policy of government can be arranged based on this result as an effort to manage the mangrove ecotourism. Conserving mangrove ecosystem in a tsunami-prone area is crucially to be done as a coastal disaster mitigation strategy. Mangrove ecotourism is one of promising strategy to conserve mangrove ecosystem.

Acknowledgments

The authors would like to thank Institute for Research and Community Services (LPPM), Universitas Pembangunan Nasional (UPN) Veteran Yogyakarta for funding this research through the “Hibah Penelitian Dasar Internal UPN Veteran Yogyakarta tahun 2018”, agreement no. B/02-01/UN.62/V/2018.

We would like thank to many external experts who kindly gave their advice and assistance: Dr. Frida Purwanti; Arie Budiarto, M.Env; Warso Suwito; Taufik Walinono, M.Sc.

We also thank to many colleagues who have contributed to this study: River and Coastal Management Study Center of UPN Veteran Yogyakarta; Wanatirta Mangrove Ecotourism; Headman and Village Administrator of Jangkaran Village; Student of UPN Veteran Yogyakarta.
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