Economic valuation of coral reef ecosystem for marine tourism in Karimunjawa National Park

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Abstract. Karimunjawa Islands has been designated as Marine National Park since the enactment of Kepdirjen PHKA No. SK. 28/IV-SET/2012. Marine tourism utilization zones have 2.45% of the total area in Karimunjawa National Park which has great potential to be developed. One of the resources used in tourism utilization zones is coral reefs. The value of economic valuation of coral reefs is considered necessary as an approach to demonstrate the benefits of managing coral reef ecosystems in policy making and providing useful information for the development of marine tourism. Marine tourism activities in Karimunjawa National Park are snorkelling and diving. The consumer surplus is predicted to be used as input for the management of coral reef resources for marine tourism activities in Karimunjawa National Park. The method used is the Travel Cost Method with structured interviews using questionnaires with 45 respondents. Correlation and regression analysis shows that the demand for marine tourism is influenced by travel costs, age, education, income, gender, travel length and distance. The economic value of snorkelling tours is 94,549,044 IDR / person / year and diving tourism is about 29,254,711 IDR / person / year. Total economic value of coral reefs amounting to 474,535,386 IDR / year. Based on this, the marine tourism of snorkelling and diving Karimunjawa National Park has potential to be developed economically through the determination of entrance costs or other management step such as a promotion.

1. Introduction
Coral reefs are one of the marine resources that have great benefits or are called services for humans and the environment. The role and benefits of coral reef ecosystems consist of economic, ecological and social-cultural benefits [8]. The economic value of coral reef resources based on the calculation of economic valuations from fisheries, coastal protection and tourism in Indonesia is estimated to produce a value of around $1.6 billion. Judging from the aspect of marine tourism, Indonesia has an economic potential of around $60 billion / year from 11 other marine sectors that need to be considered as contributors to the national economic contribution [3]. Tourism continues to be a large industry with broad effects on the economy [12]. In an ecosystem utilization area, the economic assessment of coral reefs is currently seen as a good approach to demonstrate the benefits of managing coral reef ecosystems in policy making and providing information that is useful for improving decisions [7].

Karimunjawa Islands has been designated as Marine National Park since the enactment of Kepdirjen PHKA No. SK. 28/IV-SET/2012. Marine tourism utilization zones have 2.45% of the total area in Karimunjawa National Park which has great potential to be developed. Coral reef resources in Karimunjawa National Park have an important role for the community, but tourism activities are still low. This is indicated by the trend in the number of Karimunjawa National Park tourists for fluctuating...
tourism activities from 2008-2016 [2]. This condition needs analysis for management related to the existence of coral reefs as the main object of marine tourism activities. Research related to economic valuation is carried out as one of the management inputs. The purpose of this research is to calculate the valuation of resource economics so that a strategy for developing marine reef tourism in Karimunjawa National Park is obtained through a resource valuation approach.

2. Material and Methods
The study was conducted in August-September 2017 in Karimunjawa National Park, Jepara Regency, Central Java Province (Figure 1). Location of observations of coral reefs is carried out in the marine tourism utilization zone according to Kepdirjen PHKA No: SK. 28/IV-SET/2012, which covers around Karimunjawa waters which are suspected to be favorite and potential dive spots (Table 1).

Interviews are conducted on visitors to snorkeling and diving. The research location is limited in the utilization zone that is most visited by marine tourism tourists according to the results of the interviews in the preliminary research which was then referred to as the main marine tourism utilization zone of Karimunjawa National Park. Collecting socio-economic data using structured questionnaires and through interviews. Other data obtained from WCS secondary data (2016) and based on other literatures (Table 2).
Table 1. Location coordinate of the research.

| No. | Location                  | Latitude      | Longitude     | Ket                  |
|-----|---------------------------|---------------|---------------|----------------------|
| 1.  | Menjangan Kecil Selatan  | 05º 52' 48,72'' LU | 110º 21' 33,84” BT | Secondary Data      |
| 2.  | Menjangan Besar Selatan  | 05º 53' 53,16'' LU | 110º 26' 01,68” BT | [11]                |
| 3.  | Menjangan Kecil Utara    | 05º 53' 13,7'' LU | 110º 24' 23,1” BT | Primary Data        |
| 4.  | Menjangan Besar Utara    | 05º 52' 42,5'' LU | 110º 25' 0,5” BT  | (2017)              |
| 5.  | Tanjung Gelam            | 05º 50' 10,8'' LU | 110º 25' 17,6” BT |                      |
| 6.  | Karimunjawa Barat        | 05º 51' 52,5'' LU | 110º 25' 32,6” BT |                      |

Table 2. Type of data.

| Type of Data               | Sources and Methods          |
|----------------------------|------------------------------|
| Tourist Travel Cost        | Questionnaires and interviews|
| Number of Tourist per year | WCS and BTNKJ               |
| Type of Tourism            | Questionnaires               |
| Location of Tourism        | Questionnaires               |
| Cover area of Coral Reef   | GIS analysis                |

2.1. Analysis of the Number of Marine Tourism Tourists in Karimunjawa National Park

Annual tourist data is obtained from secondary data according to WCS 2016 and BTNKJ 2016. Special tourists who do snorkeling and diving marine tourism are calculated using a number of assumptions multiplied by the average tourist per year from 2010-2016. Calculation of the number of tourists is shown in the following formula:

\[ \sum W = W_{\text{average}} \times \% W_{(s/d)} \] (1)

Where:
- \( \sum W \) : Number of tourist (person)
- \( WT \) : Tourist per year (person)
- \( W_{(s/d)} \) : Percentage of tourists who do snorkeling or diving tours (%) [6]

2.2. Travel Cost Analysis

Estimating the economic value of tourism potential can be used as a Travel Cost Method by calculating tourist travel costs since departing to those used at tourist attractions. This approach is used in estimating the value of a tourist spot by using various variables [10]. The amount of total travel costs incurred is calculated using:

\[ BPT = BT + BP + BK + BD + BM + BP + BL \] (2)

Where:
- \( BPR \) : Total travel costs (IDR / person)
- \( BP \) : Lodging costs (IDR / person)
- \( BT \) : Transportation fee (IDR / person)
- \( BK \) : Cost of consumption (IDR / person)
- \( BD \) : Documentation fee (IDR / person)
- \( BM \) : Entrance fee for tourist area (IDR / person)
BP : Parking fee (IDR / person)
BL : Other costs (IDR / person)

Then by using travel costs, it can be estimated the relation and tourism demand function of an area with other variables. The function of the demand curve is shown in the following equation Adrianto [1]:

\[ Y = f(c, a, e, I, s) \] (3)

Where:
- \( Y \) : Number of visits
- \( c \) : Travel costs (Rp)
- \( a \) : Age of tourists (years)
- \( e \) : Education (years)
- \( I \) : Monthly income (Rp)
- \( s \) : Length of stay (days)

To measure the value of resources carried out based on the concept of total value that is the use value and non-use values [5]. One of them is with the request function derivative. The function of tourism demand is then used to determine consumer surplus with a utility approach. The request function is converted into a simple function, where the number of visits (\( Y \)) is a function of the average travel cost. The utility function (\( U \)) is integral to the request function. The consumer surplus is calculated by Ms. Excell and use this bellow formula:

\[
\ln Y_i = \beta_0 - \beta_1 \ln c_i + (\beta_2 \ln a_i + \beta_3 \ln e_i + \beta_4 \ln I_i + \beta_5 \ln s_i)
\]

\[ \ln Y_i = \beta_0 + \beta_1 \ln c_i; Y_i = \beta_0 \times c_i^{\beta_1} \] (4)

\[ U = \int_0^1 f(Y1)dY1 \] (5)

\[ \text{CS} = U - T_{\text{total}} \] (6)

Where:
- \( Y_i \) : Number of i-visits (times / years)
- \( c_i \) : Travel cost for i (Rp)
- \( a_i \) : Age of the i-year traveler (year)
- \( e_i \) : I (year) education
- \( I_i \) : monthly income i (Rp)
- \( s_i \) : Long stay i (day)

3. Results and Discussion
The number of marine tourists in Karimunjawa National Park was approached by calculating the percentage of each type of tourism [6]. The average visitor total is 13,252 people / year which is divided into beach tourism, snorkeling, boating, diving and fishing. The respondents that interviewed are 45 persons, which is 34 persons are snorkeling tourist and 11 persons are diving tourist. Tourists are spread throughout the island in Karimunjawa National Park. Based on the results of field interviews (Research, 2017), 92% conducted marine tourism snorkeling and diving in the main marine tourism utilization zone (Table 3).

Tourists in the main zone of marine tourism use are spread on certain islands. Some of the main island tourist destinations are Menjangan Besar Island, Menjangan Kecil, Karimunjawa and Tanjung Gelam. In general, snorkeling tourists are more than diving tourists (Table 4).

The marine tourism surplus for snorkeling and diving Karimunjawa National Park is different (Table 5). This value is the economic value of benefits and does not take into account the value of costs of resource damage due to tourism activities. The value of snorkeling tours is greater than diving. This value is calculated based on the calculation of consumer surplus for each tourism activity. This means snorkeling tourists get greater benefits than diving tourists.
Table 3. Number of tourists snorkeling and diving in the main utilization zone of Karimunjawa National Park marine tourism.

| Type of Marine Tourism | Presentage in Karimunjawa National Park (%) | Total (person) | Presentage in the Main Utilization Zone (%) | Total (person) |
|------------------------|---------------------------------------------|----------------|---------------------------------------------|----------------|
| Beach                  | 29                                          | 3843           | -                                           | -              |
| Snorkeling             | 39                                          | 5168           | 92                                          | 4755           |
| Boating                | 2                                           | 2650           | -                                           | -              |
| Diving                 | 7                                           | 928            | 92                                          | 853            |
| Fishing                | 5                                           | 663            | -                                           | -              |

The average total of tourist per year (person) 13252

* Hazmi [6]; ** Research data

The value of the consumer surplus can be used as a reference to determine the entrance ticket for each Karimunjawa National Park marine tourism activity. The value of total annual consumer surplus is calculated by multiplying it with marine tourist data on snorkeling and diving. Based on the results obtained, the price of admission to Karimunjawa National Park for marine tourism activities can still be increased. If currently the entrance ticket through SIMAKSI (Lisence to Enter the Conservation Area) management at BTNKJ is only 5,000 IDR / person for all types of tourism activities in Karimunjawa National Park based on APPD Marine National Park, this value can still be reviewed related to the management of admission tickets in accordance with scientific studies of the benefits of Karimunjawa National Park coral reefs. This is also considering the status of this area is the Marine National Park which is part of the Conservation Area, so it is also necessary to pay for the interests of the rehabilitation and conservation of coral reefs to remain protected from damage caused by marine tourism activities and continue to be sustainable.

Table 4. Estimation of marine tourist distribution in the main tourism utilization zones of Karimunjawa National Park.

| Destination Location | Presentage (%)* | Tourist of Snorkeling (orang/tahun) | Tourist of Diving (orang/tahun) |
|----------------------|-----------------|-------------------------------------|--------------------------------|
|                      | Snorkeling      | Diving                             |                                |
| Menjangan Kecil      | 40.74           | 34.78                              | 1937                           | 297             |
| Menjangan Besar      | 29.63           | 26.09                              | 1409                           | 223             |
| Karimunjawa          | 20.37           | 13.04                              | 969                            | 111             |
| Tanjung Gelam        | 1.85            | 17.39                              | 88                             | 148             |
| Lain-lain            | 7.41            | 8.70                               | 352                            | 74              |

Total tourist in main marine tourism utilization zone 4755 853

* Research data (2017)

The economic value of coral reef resources based on the calculation of the surplus of existing marine tourism consumers is 474,535,386,835 IDR. Utilization of potential is of course paying attention to the principles of preservation and sustainability that have been studied previously through the study of the carrying capacity of the area obtained by considering the ecological potential of the park's main marine tourism utilization zone. Ecological values or the importance of certain ecosystems are determined both by the integrity of the rules and the habitat function of an ecosystem, and by ecosystem parameters such as complexity, diversity, and scarcity so that in a utilization are also taken into account [4].
Table 5. Consumer surplus Karimunjawa National Park marine tourism.

| Type of Marine Tourism | Tourist (person/year) | Consumer Surplus (IDR/year) | Total (IDR/year) |
|------------------------|-----------------------|-----------------------------|------------------|
| Snorkeling             | 4755                  | 94 549 044 IDR              | 449 568 304 788 IDR |
| Diving                 | 853                   | 29 254 711 IDR              | 24 967 082 046 IDR |

The surplus of tourists per person per day is 259 038 IDR for snorkeling tours and 80 149 IDR per day for diving tours. Pendleton and Rooke (2006) said that based on their research it was said that the nonmarket value of snorkeling marine tourism activities was between $3 - $199 per day (around 40 000 IDR – 260 000 IDR) and for diving was between $31 - $319 per day (around 400 000 IDR - 4 150 000 IDR). This means that diving tourists have almost paid the benefits that Karimunjawa National Park's coral reef resources have provided.

The economic value of Karimunjawa National Park's coral reef resources analyzed based on tourism demand is indirectly related to the condition of the quantity and quality of the coral reef resources. The total area of coral reefs that can be utilized in the appropriate category is an area of 886,302,784 m². The better and broader the resources of coral reefs, the higher the carrying capacity of the region for tourism, the economic value of resources is also increasing. On the other hand, one way to increase the economic value of resources is by rehabilitating damaged resources so as to increase the area of resources with good status so that they can be used for marine tourism. The strategy for managing marine tourism is one of economic management strategies, namely by using prices as an incentive to modify visitor habits [8]. Including the form of management of coral reef resources in Karimunjawa National Park after the assessment of economic value should be applied to a form of tourism development based on the application of tourist incentives for community income and the importance of rehabilitation of damage to coral reefs as the main object of marine tourism activities to be sustainable.

4. Conclusions
Economic value of the potential of coral reefs in the area of Karimunjawa National Park's main marine tourism utilization zone with an area of 886,302,784 m² based on resource assessment through the calculation of consumer surplus amounting to 474 535 386 835 IDR / year. The management step that can be formulated is to improve the promotion of marine tourism as optimally as possible based on the high economic value of coral reef ecosystem.

Acknowledgements
This research was supported by the Karimunjawa National Park Office (BTNKK) and the Wildlife Conservation Society (WCS). We would like to thank all the staff of BTNKK and WCS who have provided input, direction and assistance to secondary data and to fellow correspondents who have helped the research process.

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