



## Economic Valuation of Mangrove Ecosystems in Area Fahiluka-Lakun Pound in Malaka Regency

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### **Abstract**

Mangroves have an important role for life, especially in the field of fishery production, due to increasing human needs, mangrove areas are converted into residential, industrial and recreational areas. The importance of these benefits raises the challenge of knowing how to provide comprehensive value in the mangrove ecosystem. The research was carried out in the Villages of Lakekun, Kletek and Fahiluka. The results showed the total economic value of the mangrove ecosystem was Rp31,787,444,349/year, which consisted of direct benefits of Rp32,515,720/ha/year (26.19%), indirect benefits of Rp111,863,999/ha/year (70.79%) of the breakwater, optional benefit of Rp.213.773 /ha/year (0.17%) from biodiversity, existence benefit of Rp.1.303.973/ha/year (0.99%) from community willingness to pay and benefits inheritance is 3,251,572/ha/year (2.62%). The factors that influence the willingness to pay, namely the education factor and the amount of responsibility as well as environmental quality are analyzed using 3 indicators, namely temperature, pH and salinity. temperature of 300 to 32<sup>0</sup> C and for the pH parameters of these three villages are in the quality standard PP No. 22 of 2021, which is 7-8.5 while the salinity of the three villages shows a fairly large number, namely 40 with measurements using a refractometer.

**Keywords:** *Mangrove Forest; Economic Valuation; Environmental Quality*

### **Introduction**

Indonesia is an archipelagic country with a coastline of 95,181 km and has a diverse culture. The beauty and uniqueness of Indonesia causes this country to become one of the tourist destinations. However, the tourism destination that you want to develop has an uneven distribution in each province so that tourist visits are only centered on a few provinces that have well-known tourist attractions. One of the countries that has natural beauty that is of high value in the natural tourism market industry, especially ecotourism is Indonesia Sagala & Pellokila, (2019). Ecotourism is a tourism that has its own special value because the nature tourism industry prioritizes environmental conservation, the welfare of local residents,

and respects local culture. The province of East Nusa Tenggara (NTT) is known to have natural tourism such as Komodo National Park, Wae Rebo, Koka Beach, Pink Beach and one of them is mangrove forest. One of the regencies that has mangrove potential is Malacca Regency with a total area of 1160.3 Km<sup>2</sup> (1,160,300 Ha) and has an extensive mangrove distribution of 9,193 Ha.

Based on the results of observations, this mangrove forest has been used as a tourist spot so that this can affect or contribute to local revenue (PAD). But on the one hand, being used as a tourist spot can affect the environmental preservation of mangrove forests caused by irresponsible tourists, another thing that was found during observations was the use of some mangrove forest lands as salt ponds and fish ponds. In addition to its use as salt ponds and fish ponds, the existence of mangrove forests also has functions and uses in the coastal environment, of which 3 main functions are physical, biological and economic functions. The physical function of the mangrove forest is as a barrier to abrasion, retaining seawater intrusion, retaining wind, and reducing CO<sub>2</sub> levels, while the biological function is a spawning ground and nursery ground for fish, shrimp, shellfish, and nesting sites. birds, and as a natural habitat for many biota and the last is the main function of mangroves in a fairly high economy, including being used as building wood, firewood, plywood, pulp, piles, and handicrafts Junialdi et al, (2019).

Given the importance of mangrove ecosystems for coastal areas, it is a serious concern for both the government and the people of Malaka Regency so that all activities carried out do not damage the mangrove ecosystem. One way that can be done to maintain and maintain the sustainability of the mangrove ecosystem is to examine the total economic value (total economic value, this economic value is obtained from the use value and non-use value). value) includes direct use value, indirect use value and option value, while non-use value is seen from existence value and bequest value.

## ***Literature Review***

### **Mangrove Ecosystem**

According to Rospita et al., (2017) Forests that grow in tidal areas, especially on protected beaches and river mouths that are flooded at high tide and free from inundation at low tide and whose plant communities tolerate salt are called mangrove ecosystems. Mangrove ecosystems have important benefits and roles for communities, especially those in coastal areas, the physical benefits of mangrove forests include maintaining a stable coastline, protecting beaches from abrasion, resisting strong winds from the sea and being a buffer area against seepage. sea water (intrusion), (Rhomadon, 2008). Mangroves will be difficult to grow in coastal areas where tidal currents are strong, causing mangrove growth to be suboptimal due to the absence of mud deposition which is a substrate that helps mangrove growth (Rahim, 2017). The economic benefits of mangroves are as a producer of firewood and wood for construction and also have an attraction as a tourist spot. While the ecological benefits such as protecting coastal areas from the brunt of the waves and as a habitat for various types of fauna. According to Kusmana (2002), other benefits of mangroves are protecting the coast from seawater abrasion and the brunt of the waves; prevent seawater intrusion; habitat, foraging and breeding places for various types of marine biota; can form sedimentation; maintain water quality (reducing water contaminants); absorb carbon dioxide and produce relatively high oxygen.

### **Assimilative Capacity of Mangrove Ecosystem**

According to Andri and Sadali (2018), assimilative capacity is the limit of the environment's ability to support various development activities and is a key component as a determinant of sustainability. The problem of a mangrove ecosystem being converted into a salt pond is not only about

the lost economic value of the mangroves as a result of the conversion of land to salt ponds, but also has an impact on the assimilative capacity to maintain its ecological and economic functions. According to Umayah et al., (2016) damage to the mangrove ecosystem is caused by human and natural factors. Some of the factors that cause damage to mangrove ecosystems in Indonesia are Virgota & Farista (2021), including land conversion for settlements; land conversion for ponds; wood extraction; and pollution. Utilization of the sea as a final disposal site is not a new thing that we encounter because the last disposal activity in the sea has become a common thing. The phenomenon of waste disposal in the sea as the final disposal site has become a concern because of the increasing number of residents and the increasing development of Sembel (2012).

### **Immediate Benefits**

The direct benefit value is the value resulting from the direct use of a resource. Direct benefits can be interpreted as benefits that can be consumed. The direct benefit value of Mangrove forest is calculated by the formula:

$$DUV = \sum DUVi$$

Where:

DUV = Direct Use Value

Mangrove value that may be obtained is based on the market price per hectare per year on the coast of Malacca Regency together with the value of mangrove wood and direct benefits from mangrove resources in the form of; wood, mangrove fruit, crab.

### **Indirect Benefit Value**

Indirect benefits are the value of benefits from a resource (mangroves) that are used indirectly by the community. Measurement of indirect benefits from mangrove resources includes biological benefits and physical benefits. Biological benefits take into account the function of the Mangrove forest as a feeding ground, spawning ground and nursery ground for various aquatic biota. The indirect benefit value of Mangrove forest is calculated by the formula:

$$IUV = \sum IUVi$$

Where:

IUV = Indirect Use Value

The value of indirect benefits that may be provided by mangroves can be in the form of physical values, namely:

$$\text{Physical Values} = [(PxLxD) \times Pgp \times B]: Dt$$

The benefits of mangrove forests as feeding ground or natural feed providers are evaluated through a replacement cost approach from providing natural shrimp feed. The benefits of mangrove forests as natural feed providers are approached using the regression equation for mangrove forest area and shrimp production as carried out (Dethan 2020) namely:

$$Y = 16.286 + 0,0003536X$$

Where:

Y = Shrimp production (kg/year)

X = Mangrove forest area (Ha)

### Option Value

The benefits of choice for mangrove forests usually use the benefit transfer method, namely by assessing the estimated benefits from other places (where resources are available) and then these benefits are transferred to obtain a rough estimate of the benefits from the environment. This method is approached by calculating the value of biodiversity in the mangrove ecosystem. When referring to the value of Ruittenbeek (1991) in Lio & Stanis (2017), Indonesia's mangrove forests have a biodiversity value of US\$1,500 per km<sup>2</sup>. This value can be used in all mangrove forests in Indonesia if the mangrove forest ecosystem is ecologically important and is maintained naturally. The value of the benefits of this option is obtained by the equation:  $OV = US\$ 15 \text{ per Ha} \times \text{Mangrove forest area (Ha)}$

Where:

OV = Option Value

### Existence Value

Existence benefits are benefits that can be enjoyed by humans in connection with the existence of natural resources and the Mangrove forest environment. In general, the approach technique is carried out by interviewing or interviewing households by asking whether they want to pay (WTP) in maintaining environmental assets at this time (Maryadi 1998). To find out the WTP value, the benefits of this existence are by using the Contingent Valuation Method (CVM). The formulation is as follows:

$$EV = \sum EV_i / n$$

Where:

EV = Existence Value

EV<sub>i</sub> = Existence value of respondent i

n = total respondent

Median Value of WTP/yr = Median Value of WTP x 12 month

Total Value of WTP/yr = Median Value of WTP/yr x Number of Visitors/yr

The demand function that will be used is formed with Multiple Linear Regression according to Sudjana (1996) as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \epsilon$$

Where:

Y: Willingness to pay (WTP)

X<sub>1</sub>: Age of respondent

X<sub>2</sub>: Respondent's income level

X<sub>3</sub>: Number of dependents of respondents

X<sub>4</sub>: Respondent's education level

X<sub>5</sub>: Respondent's occupation

X<sub>6</sub>: Environmental Quality

### Inheritance Value (Bequest Value)

Inheritance value is defined as the value of maintaining resources so that options for their use are still available for the future. The heritage value of the Mangrove ecosystem that is owned cannot be assessed using a market value approach. Therefore, the inheritance value is calculated by approximate approach. In connection with this, it is estimated that the inheritance value is not less than 10% of the Direct Benefit Value (DUV) (Ruittenbeek, 1992).

## Factors Affecting Economic Benefits on Existence Value (WTP) of Mangrove Ecosystems in Fahiluka-Lakekun Pond Area, Malaka Regency

To find out the factors that influence people's willingness to pay (WTP), Multiple Linear Regression analysis is performed. The variables tested were the respondent's age (X1), the respondent's income (X2), the number of dependents of the respondent (X3), the respondent's education level (X4), the respondent's occupation (X5) and the quality of the environment (X6). To see the factors that influence this WTP value, SPSS software is used.

$\alpha$  : Constant  
 $\beta_1$ - $\beta_6$  : Regression coefficient  
 $\epsilon$  : error

Based on the results of multiple linear regression analysis, then the simultaneous test (F test), partial test (t test), and the coefficient of determination (R<sup>2</sup>) test were carried out to obtain results regarding the effect of the independent variable on the dependent variable.

### Coastal Water Quality

The measurement of the water quality of the coastal area is carried out in situ at each station, repeated 3 times, at each spot. The types of physical and chemical parameters of seawater tested in this study, as well as the measurement methods and standard of analysis used are presented in the following table

Table 1. Measurement and Standard of Analysis

Parameter	Type Analysis	Analysis Tool/Method Specification
Physics Parameters: Temperature	<i>Insitu</i>	Thermometer digital
Chemical Parameters: Salinity	<i>Insitu</i>	Refractometer
pH	<i>Insitu</i>	pH meter

### Research Methods

This research will be carried out in Kobalima District and Central Malaka District, Malacca Regency. More precisely in Fahiluka Village, Kletek Village and Lakekun Village. Fahiluka Village covering an area of 8.84 km<sup>2</sup>, Kletek Village covering an area of 10.45 km<sup>2</sup> and Lakekun Village covering an area of 7.23 km<sup>2</sup> BPS Malaka Regency, (2020). This research will be carried out in June – July 2021. The sampling method in this study uses the Purposive Sampling method, namely the sampling is not random but based on consideration of the types of benefits that are in accordance with the research objectives. Respondents used for this research are people who use mangrove forests directly and indirectly, such as fishermen, farmers and salt companies with the consideration that the location of their residence is in the vicinity of the mangrove ecosystem, while fishermen are selected based on fishing locations. Data collection methods are through observation, field interviews and making spot/line transects at the research site. Qualitative descriptive analysis was conducted to explain the condition of the Mangrove forest in the Fahiluka-Lakekun area, Malaka Regency based on existing primary and secondary data. This analysis is also carried out to describe the various socio-economic activities of the community around the Mangrove forest.

## Results and Discussion

### Identification of Mangrove Ecosystems in the Village Areas of Lakekun, Kletek and Fahiluka

Mangrove forest is a forest located on the coast that grows in tidal areas. Mangrove forests are also a nursery area for various kinds of organisms that have economic value and mangroves also have a very important function for the environment because they can absorb heavy metals on the coast. According to Benu et al., (2011) heavy metals are substances that are harmful to human health whose presence is usually found in the form of dissolved ions so that and one way to reduce them is by adsorption and the adsorbent used is the *Avicennia* marine plant. The existence of mangroves in Lakekun, Kletek and Fahiluka villages in each spot is dominated by the *Avicennia alba* mangrove species with a percentage of 60% and then followed by *Rhizophora Apiculata* with a percentage of 50%. sample. Meanwhile, *Sonneratia Alba*, *Avicennia Marine* and *Rhizophora Stylosa* species were rarely found in every spot, so it can be concluded that these mangrove species were relatively small at the observation site and affected their distribution in the three research villages.

### Total Economic Value of Mangrove Forest Area in Lakekun, Kletek and Fahiluka Villages

Mangrove forest areas in Lakekun, Kletek and Fahiluka villages have great natural resource economic potential. This economic potential can be obtained from the total economic value of natural resources. The total economic value of mangrove forests in this study is at the villages of Lakekun, Kletek and Fahiluka are obtained from the sum of the use values and non-use values. Use value consists of direct use value, indirect use value, and optional value, while non-use value consists of existence value (existence use value), and bequest value. The total economic value of mangrove forests in 2021 in Lakekun, Kletek and Fahiluka villages is Rp31,787,444,349,- /year.

Table 2. Total Economic Value of Mangrove Forest Area

Benefit Value Category	Benefit Value (Rp/Ha/year)	Benefit Value (Rp/Year)	Percentage %
Immediate Benefits	32,515,720	8,258,793,000	26.00
Indirect Benefits	111,863,999	22,317,273,643	70.25
Choice Benefits	213,773	54,298,406	0.17
Benefits of Existence	1,303,937	331,200,000	0.99
Inheritance Benefits	3,251,572	825,879,300	2.60
<b>Total Benefit Value</b>	<b>149,149,002</b>	<b>31,787,444,349</b>	<b>100</b>

Source: Processed Data

The total economic value of mangrove ecosystems in Lakekun, Kletek and Fahiluka villages listed in the table above is obtained from identifying the benefits of mangrove ecosystems in these villages. The value of these benefits is divided into 2 values, namely the value of Rp./ha/year and the value of Rp./year. The compensation value of the mangrove ecosystem to milkfish ponds with an area of 254 ha is Rp. 149,149,002 /ha/year. This total economic value is different from several economic values in previous studies where the total economic value of mangrove forests in the Mahakam Delta area in 2012 was IDR 503,071,398,869.2, economic value the total (total economic value) of mangrove forests in the Indramayu area is Rp3,504,487,581,00/ha/year. Hidayah (2017) explain the total economic value

(total economic value) of mangrove forests in the mangrove ecosystem area of Bipolo village in 2020 of Rp26,754,621,659,- Dethan F., (2020), this difference is due to studies in the calculation of different benefit values and the number of different mangrove ecosystem areas. The analysis of the economic value of the mangrove ecosystem shows that the indirect benefit value has the highest presentation, which is 70.25%, followed by the direct benefit value of 26%, the inheritance benefit value 2.60%, the existence benefit 0.99% and the choice benefit 0.17%. Based on the results of the research, it is hoped that it can be the basis for the preparation of poverty alleviation programs in Malacca Regency, especially for the Villages of Lakekun, Kletek and Fahiluka.

Communities who live around the mangrove forest area of Lakekun, Kletek and Fahiluka villages should be able to apply awareness of the importance of the function of mangrove forests for the environment so that the mangrove ecosystem is maintained, and the quality of the environment is protected. Benu et al., (2018). The economic value of the mangrove ecosystem from the Villages of Lakekun, Kletek and Fahiluka is IDR 31,787,444,349 IDR / year. This value shows that the mangrove ecosystem is an important ecosystem and has a very strategic value for the community around the 3 villages. This value is an approach to determine the potential of natural resources in Lakekun, Kletek and Fahiluka villages. Mangrove forest management in the villages of Lakekun, Kletek and Fahiluka at the current condition can be said to be not optimal because there is still overlapping in the management and utilization authority of mangrove forests between the Ministry of Maritime Affairs and Fisheries and the Ministry of Forestry and Environment. Synergistic management of mangrove forests is needed in the Villages of Lakekun, Kletek and Fahiluka, Malaka Regency among all authorized agencies, both the central government and local governments as well as local communities.

It is also hoped that the Central Government should be more actively involved in making policies in the supervision and management of mangrove forests in Lakekun, Kletek and Fahiluka villages, even in every area that still has mangrove forests effectively. The policies and regulations that have been made should also be coordinated by the central government by looking directly at the condition of the location of mangrove forests in Lakekun, Kletek and Fahiluka villages. If the natural resources of the mangrove forest can be maintained, conserved and managed properly, it will contribute as an asset to the Indonesian state which is rich in natural resources.

### **Factors that affect the value of the benefits of the existence of mangrove forests in Lakekun, Kletek and Fahiluka villages**

To find out the factors that influence the willingness to pay, this study used multiple regression analysis which in this case is described by the respondent's willingness to pay (WTP). The calculation results from this study show  $R^2 = 74\%$ , meaning that the diversity in the value of WTP existence can be explained by the explanatory diversity contained in the model, while the remaining 26% is explained by other factors or variables not included in the model. The F-Count value obtained in this model is 21.850 with a Sig value. of 0.000, this indicates that the explanatory variables in the model together have a significant effect on the WTP value of existence which is carried out at the level of  $\alpha = 0.05$ . The model resulting from the regression analysis is as follows:

$$\begin{aligned} \text{WTP} &= \alpha + \beta_1UR + \beta_2TP + \beta_3PD + \beta_4PK + \beta_5JT... + \beta_nXY + \epsilon_i \\ &= +1,198 - 0,079UR + 0,041TP + 0,221 JT + 0,080 PD + 0,003 PK - 0,028KL + \epsilon_i \end{aligned}$$

### **Water Quality**

The environmental quality at the research site was measured, namely temperature, pH and salinity. The purpose of measuring these parameters is to find out how much these indicators affect the growth and reproduction of aquatic biota in Lakekun, Kletek and Fahiluka villages. The results of

measuring the water quality of Lakekun, Kletek and Fahiluka villages around the coast on the Parameters of Temperature, pH, and salinity with three repetitions and carried out in situ. For the temperature parameter in the coastal area, Fahiluka Village has a temperature of 34<sup>0</sup>C while Lakekun and Kelek Village has a temperature of 30-32<sup>0</sup>C. 22 in 2021, which is 7-8.5 while the salinity of the three villages shows a fairly large number, namely 40 with measurements using a rafactometer.

### **Conclusion**

The total economic value produced by mangrove forests in Lakekun, Kletek and Philuka Villages in 2021 is Rp31,787,444,349,- or Rp149,149,002,- per hectare which consists of direct use value of Rp8,258,793,000,- Indirect Use Value of Rp22,317,273,643,- Option Value of Rp54,298,406,- Existence Value of Rp331,200,000,- and Bequest Value) of Rp825,879,300, -. The factors that influence the value of willingness to pay (WTP) on the value of the existence of the mangrove ecosystem are the level of education and the amount of debt. The higher the level of education and the number of respondents' liabilities, the higher the value of willingness to pay for the existence of the mangrove ecosystem in Lakekun, Kletek and Fahiluka villages, Malaka Regency. The results of measuring the water quality of Lakekun, Kletek and Fahiluka villages around the coast on the Parameters of Temperature, pH and salinity with three repetitions and carried out in situ. For the temperature parameter in the coastal area, Fahiluka Village has a temperature of 34<sup>0</sup>C while Lakekun and Kelek Village has a temperature of 30-32<sup>0</sup>C. 22 in 2021, which is 7-8.5 while the salinity of the three villages shows a fairly large number, namely 40 with measurements using a rafactometer.

This research is expected to provide input for local governments and related agencies, especially the Department of Marine Affairs and Fisheries of Malaka Regency so that they can provide compensation in the form of levies in the amount of economic benefits, which is Rp. mangroves for commercial purposes and so on, while for water quality the measured parameters indicate that there are parameters that exceed quality standards so that a more complete study is needed to describe water quality in more detail. Regulations in preserving mangrove forests need to be carried out and implemented by the Government and the community together. Further research is urgently needed to formulate regulations and policies regarding the monitoring of mangrove forests so that they remain sustainable.

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