

Economic Valuation of Mangrove Forests in Tumbu Village, Topoyo District, Central Mamuju Regency

Nurfitriyana¹, Sanusi Fattah, dan², Anas Iswanto Anwar³

¹Economic Resource Program Faculty of Economics and Business, Postgraduate School, Hasanuddin University, Indonesia

^{2,3}Lecturer of Faculty of Economics and Business, Postgraduate School, Hasanuddin University, Indonesia

Abstract: *This study aims to identify the use of mangrove ecosystems, assess economic benefits, and explain the implications of the use of mangrove ecosystems. This research was carried out in the village of Tumbu, Topoyo district, Central Mamuju Regency from September to November 2018. The methods of data collection used were surveys and questionnaires. Samples of fishermen, farmers, and tourists were selected purposively with 89 respondents. To find out the total economic value of mangrove forests, the data were analyzed by summing the value of direct benefits, the value of indirect benefits, the value of selected benefits, and the benefits of the existence of mangrove ecosystems. The results of the analysis show that the local community uses the mangrove area as a place to make a living, as a tourist asset, guarding the island from the brunt of waves, eliminating biodiversity and the place for their children and grandchildren who depend on the future.*

Keywords: Economic Valuation, Mangrove Ecosystems

1. Introduction

Indonesia is a country that has the most extensive mangrove forest in the world. Based on data from the Ministry of Environment and Forestry in 2006, the area of Indonesia's mangrove forests reached 4.3 million hectares. Meanwhile, according to FAO (2007), Indonesia has mangrove forests covering an area of 3,062,300 hectares in 2005, which constitutes 19 percent of the total area of mangrove forests worldwide (Haryani, 2012).

However, the extent of mangroves in Indonesia tends to fluctuate. Based on data from the Ministry of Maritime Affairs and Fisheries, the total area of mangrove in 2014 was 4.4 million hectares, in 2015 amounted to 3.7 million hectares and in 2016 amounted to 3.9 million hectares. Based on data from the Provincial Marine and Fisheries Service, 2016 mangrove damage was 52 percent. Mangrove forests in Indonesia are spread throughout the province.

The survey results of the Ministry of Forestry in 2007 and the Center for Marine Natural Resources Survey (PSSDAL) - Bakosurtanal in 2009 showed areas in Indonesia that experienced a significant decline in the area of mangrove forests in Sumatera, Java and Sulawesi (BPS, 2017).

The destruction of mangrove forest ecosystems on the coast of the island of Sulawesi, for example, is accelerating along with increasing economic efforts that are more directed towards the coastal area. Changes made to coastal areas have sacrificed thousands of hectares of mangrove areas so that many of the mangrove areas are not functioning properly.

In West Sulawesi Province the damage reaches 30% or 967.8 Ha (BPS, 2017). One example is the mangrove forest area in Tumbu Village, Topoyo Subdistrict, Central Mamuju Regency, which has an area of around 18.2 km² and is right in the coastal area of Tumbu Village which is home to several mangrove species such as *Rhizophora* and *Avicennia*.

Along with the increase in population in the Tumbu Village area from as many as 2,325 people in 2010, it increased to 2,721 people in 2015. As the population increases, economic and residential needs will also increase so as to encourage the rampant land clearing in the region by conducting land conversion such as mangrove forest land becomes residential land or fish and shrimp farming ponds.

In addition, the reduced mangroves have a significant effect on marine and coastal production. Extensive conversion of mangroves into ponds can result in a decrease in fisheries production in the surrounding waters. As a result, fishermen have to pay more to find other fishing / marine products that are certainly far more than before.

Seeing the symptoms of conversion and destruction of mangrove forests for various purposes, it is necessary to manage mangrove forests sustainably. To be able to sustainably manage mangrove forests, all parties, both the community and the government, need knowledge about the strategic value of the existence of mangrove forests that are beneficial to the surrounding community. Not only prioritizing economic aspects but also environmentally friendly.

Economic valuation is one of the choices of instruments that can be used to monetize the strategic value of the existence of mangrove forests to be able to increase the appreciation and awareness of the public and government towards goods and services produced by natural resources and the environment (Garrod & Willis, 1999). The ignorance of some parties about the value of natural resources and the environment such as mangrove forests will lead to disproportionate decision making in utilization, and even tends to damage.

Based on the various explanations above, it is interesting to do research on how much the economic value / valuation of mangrove forests and what are the benefits of the mangrove forest area in Tumbu Village, towards the socio-economic conditions of the surrounding communities.

Volume 8 Issue 1, January 2019

www.ijsr.net

Licensed Under Creative Commons Attribution CC BY

2. Research Methods

Research sites

This research was conducted in Tumbu Village, Topoyo Subdistrict, Central Mamuju Regency, West Sulawesi Province. This location was deliberately chosen with the consideration that this area is one of the mangrove forest areas that received priority in West Sulawesi District and is still rarely published.

Population and Samples

To simplify the sample selection process, Purposive Sampling techniques are used, namely the sampling method is not done randomly but based on certain considerations and intentionally appropriate to the research objectives (sampling area). Sampling in the purposive sampling method must contain certain characteristics, characteristics, and characteristics that can be the subject of the research subject. This technique will simplify the process of retrieving data, saving, and guaranteeing accuracy.

Sampling is generally done by interviewing each respondent to estimate the total economic value consisting of direct benefits, indirect benefits, and the selected benefits of the mangrove forest. In determining the number of samples Slovin formula is used, namely:

$$n = \frac{N}{1+N(e)^2} \dots\dots\dots (1)$$

Information :

- n = required sample size
- N = Population
- e = margin error (0,1)

The total population taken to determine the number of respondents interviewed is based on data on the population of Tumbu Village who work as fishermen, farmers, and tourists. This selection is based on a review in the field and interviews with community leaders who say that the mangrove areas in the area are many who work as fishermen and many lands are converted into pond areas, so it is considered that they have a large contribution to the existence of mangrove ecosystems in the area, besides the community has a lot of recreation on the beach near mangroves in this village.

Based on equation 1, the results of calculating the number of samples in this study can be seen in Table 1 below:

Table: Klasifikasi Sampel Penelitian

| No. | Stakeholder | Jumlah Sampel (Orang) |
|---------------|--------------|-----------------------|
| 1 | Fisherman | 22 |
| 2 | Fish farmers | 18 |
| 3 | Tourists | 49 |
| Total Samples | | 89 |

Source: Processed Data, 2018

Data analysis method

The data analysis method used is descriptive, qualitative and quantitative analysis. To identify the benefits and functions of mangrove ecosystems in Tumbu Village, economic valuation methods are used. According to the State Ministry of Environment (2007), the economic valuation of natural resources and the environment is an effort to control the

monetary value of some or all of the potential of natural and environmental resources in accordance with their utilization. This economic valuation is used to calculate the total economic value of natural resources and the environment. Total nilai ekonomi tersebut dapat dirumuskan sebagai berikut :

$$TEV = DUV + IUV +OV +EV\dots\dots\dots(2)$$

Information :

- TEV = Total Economic Value
- OV = Choice Value
- DUV = Direct Use Value
- EV = Value of Existence
- IUV = Indirect Use Value

a) Direct Use Value

$$DUV = ML 1 + ML 2 + ML 3 + \dots + MLn (IDR)\dots\dots (3)$$

Information :

- DUV=Direct Use Value
- ML1=Direct benefits of fish
- ML 2 = Direct Benefits of Shrimp
- ML 3=Direct Benefits of Crab
- MLn =Direct Benefitsto-n

b) Indirect Use Value

$$IUV = MTL1 + MTL2 + \dots + MTLn (IDR) (4)$$

Information :

- IUV =Indirect Use Value
- MTL1 =Indirect Benefits as surge protectors
- MTL2 =Indirect Benefits as tourism
- MTLn = Indirect Benefits to -n

c) Option Value

$$OV = US\$ 1.500/km^2 \times \text{Extensive mangrove ecosystem} (5)$$

Information : OV = Choice Value

d) Existence Value

According to Fauzi (2005), the stages in conducting research to determine Willingness To Pay (WTP) using CVM which are also applied in this study include :

- 1) Hypothetical Market Formation, which is a market that describes different mangrove qualities. Respondents who have previously answered questions about perceptions of mangrove conditions are then given a statement or scenario description of a hypothetical situation
- 2) Estimates the mean of the WTP. This value can be estimated using the following formula :

$$\Sigma WTP = \sum_{i=1}^n W_i . P_{fi} \dots\dots\dots(6)$$

Information :

- ΣWTP = Alleged average WTP
- N = Class Number
- Wi = WTP class lower limit
- I = Class to- i
- Pfi = The relative frequency of a particular class

- 3) Calculate aggregate WTP. This data processing is a process where the average value of WTP is converted to the total population. This value can be calculated using the formula:

$$TWTP = \sum_{i=1}^n WTP. \left(\frac{ni}{N}\right) P \dots\dots\dots (7)$$

Information:

TWTP : willingness of the population to pay WTP

WTP: respondent's willingness (sample) to pay
 n: the number of samples that are willing to pay is WTP
 N: number of samples
 P: population
 i: sample to -i

3. Research Results and Discussion

Direct Use Value

The value of the direct benefit of mangrove ecosystems is obtained by summing the value of the economic benefits of fishing, shrimp and crabs so that the value is around Rp.4.972.170.338 per year. Based on the type of business utilization, fishing businesses in the mangrove ecosystem area and in the surrounding waters provide the greatest annual benefit value, which is 58,95%. This is something reasonable considering that most of the population lives as fishermen.

Tabel 1 Value of Direct Benefits of Mangrove Ecosystems in Tumbu Village, 2018

| Direct benefit types | Benefit Value Per Year (Rp.) | Percentage (%) |
|-----------------------------------------------------------------|------------------------------|----------------|
| Retrieval of sea water fish | 2.931.112.800 | 58,95 |
| Taking fish ponds | 486.404.538 | 9,78 |
| Shrimp collection | 1.477.082.000 | 29,71 |
| Collecting Crab | 77.571.000 | 1,56 |
| Total | 4.972.170.338 | 100 |
| Value of benefits per hectare per year (IDR / ha / year) | 255.806.073 | |

Source: Primary data processed, 2018

Indirect Use Value

The value of indirect benefits of mangroves as protectors from abrasion can be calculated using the replacement cost approach, ie the cost of making embankments is equivalent to the function of mangrove forests as an abrasion barrier. Based on the results of the study, along the coastline in Tumbu Village there was a breakwater embankment building built by the government with funding from the 2017 APBD and ADD 2018, with an estimated economic life of around 25 years. The cost of making break-water embankments is the APBD of Rp.972.658.890 and ADD of Rp.240.000.000. This value is then divided by 25 to get the value per year, which is Rp.48.506.356. This value is the indirect value of the mangrove ecosystem as an abrasion barrier per year.

The economic value of utilization derived from tourism related to mangrove areas is calculated based on the travel cost method approach, namely calculating the amount of average expenditure (expenditure based) and the number of tourists visiting tourist sites for mangrove ecosystems per year. The average expenditure for tourists in this region for one day or per visit (trip) is Rp. 105.540 per person. These costs include: transportation costs from the respondent's house to the mangrove area, consumption costs and lodging costs.

Tabel 2 Total Value of Indirect Benefits of Mangrove Ecosystems in Tumbu Village, 2018

| Types of Benefits | Total Benefits (Rp/Year) | Value of Benefits per Hectare (IDR/ha/year) | Proportion |
|---------------------------------------|--------------------------|---------------------------------------------|------------|
| Benefits of Beach Abrasion Protection | 48.506.356 | 80.618 | 13,09 |
| Tourism Benefits | 321.922.741 | 100.600.857 | 86,91 |
| Total Indirect Benefit Value | 370.429.097 | 100.681.475 | 100 |

Source: Primary data processed, 2018

The average number of trip respondents is 7 trips per year. The average number of visitors during 2017 was 423 visitors. With an area of tourism sites of 3,2 hectares, it was found that the direct value of tourism-related uses related to mangroves was Rp. 321.922.741, - per year or Rp. 100.600.857, - per hectare per year.

Option Value

The benefits of choice in the mangrove forest ecosystem in Tumbu Village can be approached using the benefit transfer method. that is by assessing the estimated benefits of other places (where resources are available) then the benefits are transferred to obtain a rough estimate of the benefits of the environment. The method was approached by calculating the benefits of biodiversity in this mangrove area. According to Ruitenbeek (1991) in Fahrudin (1996) Indonesian mangrove forests have biodiversity values of US \$ 1.500 per km² or US \$ 15 per ha per year. This value can be used throughout mangrove forests in all parts of Indonesia if the forest ecosystems are ecologically important and remain naturally preserved. The total value of the biodiversity benefits is obtained by multiplying the benefit value of US \$ 15 per ha per year with the exchange rate of the rupiah against the US dollar against the rupiah of Rp.14.267 (November 2018). Then the value of mangrove forest biodiversity obtained in Tumbu Village in 2018 is Rp.10.730.211 per year.

Tabel 3 Benefits of the Choice of Biodiversity of the Mangrove Ecosystem in Tumbu Village

| Information | Benefit Value Per Year (Rp.) |
|-----------------------------------------------------------------|------------------------------|
| Value of Biodiversity (US\$/ha) | 15 |
| Extensive mangrove forest (ha) | 50.14 |
| Value of choice before multiplied by the exchange rate | 752 |
| Exchange rate (IDR / US\$) | 14.267 |
| Choice value after multiplied by the exchange rate (IDR / Year) | 10.730.211 |
| Value of choice per hectare (IDR/ha/year) | 214.005 |

Source: Primary data processed, 2018

Existence Value

The value of the existence of mangrove ecosystems in Tumbu Village has benefited both directly and indirectly by the community. This existence value is obtained by using the CVM method, namely by asking the willingness to pay (WTP) of the people who know the existence of the mangrove ecosystem. The stage in determining WTP is to form a hypothetical market. get a large WTP offer. estimate the average WTP, add data, and evaluate the use of CVM.

Table 4 WTP Value The existence of a Mangrove Ecosystem in Tumbu Village, 2018

| WTPI (IDR/month) | total | Frequency of relatives | Total WTP (IDR/month) |
|----------------------------------------|-----------|------------------------|-----------------------|
| 5,000 | 5 | 0.08 | 391 |
| 10,000 | 10 | 0.16 | 1,563 |
| 20,000 | 3 | 0.05 | 938 |
| 50,000 | 20 | 0.31 | 15,625 |
| 100,000 | 8 | 0.13 | 12,500 |
| 125,000 | 15 | 0.23 | 29,297 |
| 150,000 | 1 | 0.02 | 2,344 |
| 200,000 | 1 | 0.02 | 3,125 |
| 500,000 | 1 | 0.02 | 7,813 |
| Total | 64 | | 73,594 |
| Average WTP value | | | 73,594 |
| Average WTP / Year | | | 883,125 |
| Population (people) | | | 2,797 |
| Value of Total WTP / Year (IDR) | | | 2,470,100,625 |

Source: BPS Kab. Mamuju (2017) and primary data processed (2018)

The willingness to pay for the Tumbu Village community for the presence of mangrove forests varies greatly from Rp.5.000 to Rp.500,000 per month. Based on the results of processed data on community PAPs. it is assumed that the average WTP of the community is Rp.73.594 / month. The annual WTP value is obtained from the multiplication of the average WTP value with the number of months in one year which is Rp.883.125 The total value of PAPs per year is an estimate of the value of mangrove ecosystems in Tumbu Village obtained from the multiplication of the average WTP per year with population in Tumbu Village (2.797 inhabitants).The total benefit of the existence of the mangrove ecosystem is Rp.2.470.100.625.

Assessment of the Total Benefits of Mangrove Forests

Total economic value (total economic value) of mangrove forest in Tumbu Village, Central Mamuju Regency is the sum of use value and non-use value. Use value consists of direct use value and indirect use value, while non-use value consists of option value and existence value (existence). use value).

In table 5 it can be seen, the direct use value which has the largest percentage is 63,55 percent compared to other benefits with a value of Rp. 4.972.170.338 per year. The value of direct benefits obtained is greater than other benefits because the real benefits of mangrove ecosystems for the surrounding area are as breeding grounds, natural food sources, and shelter from various disturbances for various types of fish and other marine biota which are their catches as fishermen. In addition, the existence value of the mangrove ecosystem are also quite large, which is around Rp. 2.470.100.625 per year, or around 31,57 percent. This considerable value is due to the fact that some people have begun to care about the benefits of this mangrove ecosystem to remain for their lives now and in future generations.

Table 5 Total Economic Value (TEV) of Mangrove Ecosystems in Tumbu Village in 2018

| Benefit Category | Value of Benefits (IDR per year) | Percentage |
|----------------------------------------------------------------|----------------------------------|--------------------|
| Direct Use Value | 4.972.170.338 | 63,55 |
| Indirect Use Value | 370.429.097 | 4,73 |
| Option Value | 10.730.211 | 0,14 |
| Existence Value | 2.470.100.625 | 31,57 |
| Total Economic Value (TEV) | 7.823.430.271 | 100 |
| Total Economic Value per hectare per year (IDR/ha/year) | | 156.031.717 |

Sumber : Data primer diolah (2018)

Furthermore, other benefits obtained by successive indirect values of 4.73 percent with a value of Rp.370.429.097 per year and the options are Rp.10.730.211 or 0,14 percent. Based on the area of mangrove ecosystem in the area studied, which is 50.14 Ha, the total economic value of the mangrove ecosystem in Tumbu Village is Rp.7.823.430.271 per year or an average of Rp.156.031.717 Ha per year.

Use of the Mangrove Ecosystem in Tumbu Village

Mangroves are very productive ecosystems. Various products from mangroves can be produced either directly or indirectly, including: fuel wood, building materials, household needs, paper, leather, medicine and fisheries. Seeing the diversity of mangrove benefits, the level and rate of rural economies in coastal areas often depend heavily on the surrounding mangrove habitat. For example, coastal fisheries that are highly influenced by the presence of mangroves, are products that indirectly affect the standard of living and the economy of fishing villages.

Based on this research shows that the variety of benefits and uses obtained by the community from the existence of mangrove ecosystems in the Tumbu Village area proves that mangrove is one of the potential natural resources and supports the survival of the community. Mangroves become the foundation of life and a source of income for the surrounding community and this is appropriate and appears from the results of the research obtained. Direct use in mangrove ecosystems in Tumbu Village includes fisheries and indirect use including break water and tourism. Land use around the mangrove ecosystem includes fisheries / ponds, agriculture, as well as development and building areas.

The proportion of each benefit obtained based on calculations shows that mangrove forests have a diverse and very important role. The direct benefits that have been obtained by the community have turned out to be the largest proportion of the overall benefits of mangrove forests in the village. In addition, the benefits of existence also show a considerable proportion. This shows that the mangrove forest ecosystem in Tumbu Village not only provides large economic benefits directly but also has high value ecological functions. The anthropogenic activity has reduced the ecological, economic and social cultural role of the mangrove ecosystem, therefore many restoration efforts have been carried out. The restoration efforts that have been carried out but the results failed to occur around the coast of Tumbu, the main cause of this failure seems to be the selection of seeds and the lack of maintenance that is significant. Therefore the role of the surrounding community is very important in the management of a good and

sustainable mangrove forest, so that the economic benefits directly obtained by the community also guarantee the sustainability of the functions and benefits of the mangrove forest itself.

The total economic value of mangrove forests in Tumbu Village can be used to build public awareness about the value of services from mangrove forests that have no market value but it turns out to be very influential on the value of their income. Information about the value of mangrove can also be evidence for the local government to more easily convince the community to actively participate in wisely utilizing, protecting and conserving mangrove forests.

4. Conclusions and Recommendations

4.1 Conclusion

Based on the research on the economic valuation of mangrove ecosystems in Tumbu Village, it can be concluded :

- 1) The total economic benefit of mangrove forests in Tumbu Village at the time of the study was Rp. 156.031.717 / ha per year, or around Rp 7.823.430.271 per year. The total economic value in sequence consists of a direct value of Rp. 4.972.170.338 (63,55%), the existence value of Rp.2.470.100.625 (31,57%), indirect value of Rp. 370.429.097 (4,73%) and the option value of Rp.10.730.211 (0,14%).
- 2) Mangrove ecosystems in Tumbu Village provide ecosystem benefits which consist of direct benefits, namely the benefits of catching fishery products, consisting of marine fish and cultivation, shrimp and crabs. The next benefit is that indirect benefits include the benefits of abrasion restraint and tourism. Other benefits are the benefits of choice in the form of biodiversity benefits and the benefits of existence.

4.2 Recommendations

Based on a number of shortcomings, it is recommended :

- 1) Due to the value of indirect benefits (indirect use values) as well as option values found based on calculations are still quite low, it is necessary to have a good management of mangrove ecosystems that involve all parties. The limited knowledge, level of education and awareness of some people about the value of the benefits of mangroves for the lives of people in the research location is a priority scale to be immediately improved, so that the value of the mangrove ecosystem sourced from its improved ecological value can be immediately addressed. Moreover, based on the results of the study, it is known that there are variables such as the level of education that are not affected by the value of mangrove forest resources in the region, indicating that one's education is not necessarily accompanied by knowledge of the importance of the role and benefits of mangrove forests.
- 2) Integrated mangrove management cannot be carried out individually, but must establish solid cooperation between research institutions, non-governmental organizations, research and data academics, and the private sector. In addition, there must be coordination

between government agencies both at the central and regional levels supported by experts and other competent parties.

References

- [1] Badan Pusat Statistik Kabupaten Mamuju. 2017. "Kabupaten Mamuju Tengah Dalam Angka".
- [2] Badan Pusat Statistik. 2017. "Statistik Sumber Daya Laut dan Pesisir". Badan Pusat Statistik Indonesia.
- [3] Badan Pusat Statistik Kabupaten Mamuju. 2016. "Kecamatan Topoyo Dalam Angka".
- [4] Badan Pusat Statistik Kabupaten Mamuju. 2017. "Kecamatan Topoyo Dalam Angka".
- [5] BAKOSURTANAL, 2005, "Pedoman Penyusunan Neraca dan Valuasi Sumberdaya Alam Pesisir dan Laut".
- [6] Fauzi, A. Anna S., 2005. "Panduan Penentuan Perkiraan Ganti Rugi Akibat Pencemaran dan Kerusakan Lingkungan". Jakarta (ID): Kementerian Negara Lingkungan Hidup.
- [7] Garrod, G. and Willis, K.G. 1999. *Economic Valuation of The Environment: Methods and Case Studies*, Edward Elgar, Cheltenham.
- [8] Munasinghe, M. 1993. *Environmental Economics and Sustainable Development*. The World Bank. Washington DC.
- [9] Nagelkerken I., S.J.M. Blaber., S.Bouillon, P.Green, M.Haywood, L.G.Kirton.,J.O.Meynecke, J.Pawlik, H.M.Penrose, A.Sasekumar, and P.J.Somerfield. 2008. *The Habitat Function of Mangrove For Terrestrial and Marine Fauna; A Review*. *Aquatic Botany*, (Online), 89: 155-185) (www.elsevier.com/locate/aquabot)
- [10] Paramita, Ahsani. 2015. "Valuasi ekonomi sumberdaya hutan angrove di Desa Munte Kecamatan Tanalili Kabupaten Luwu Utara". Pascasarjana. Universitas Hasanuddin.
- [11] Wahyuni, Yuyun. 2013. "Valuasi Total Ekonomi Hutan Mangrove Di Kawasan Delta Mahakam Kabupaten Kutai Kartanegara Kalimantan Timur". Pascasarjana, Institut Pertanian Bogor.