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Economic Value of Mangrove Forest in Pannikiang Island, Barru District, South Sulawesi, Indonesia

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Abstract. Mangrove forest area is a very important area in Pannikiang. Mangrove forests in this area are used by the community as a livelihood. This study wants to learn about the economic valuation of mangrove forests on Pannikiang Island, Makassar. A total of 60 respondents were interviewed in depth. Benefit value, calculated using the value of Direct Use, Indirect Use Value, Option Value, Existence Value, and Total Economic Value. The total economic value of mangrove forests on the Pannikiang Island Rp. 16,155,904,158/year or Rp. 183,007,523,300/ha/year. The patterns and manner of utilization, resource mangrove ecosystem is using gear nets, traps, hooks iron in catching shrimp and crab, develop nursery mangrove system with scraped or directly from the fruit, using gear nets, traps, using an iron hook and set traps crab (rakkang) in catch crabs, catch the bat, found in the mangrove forest, using the net, made bridge length, and the middle of the mangrove forest tower area so that the end could be resting and go up to the tower to see the entire expanse of the forest mangrove Pannikiang Island, wanamina cultivation, which combines farming of fish/shrimp with mangroves.

Keywords: Economic Value, Mangrove Forest, Pannikiang Island, Indonesia

1. Introduction

The Indonesian archipelago has the world's largest economic potential of maritime and marine resources are very large. Marine resources in this huge can be transformed into a source of progress and prosperity. One of the natural resources that can be managed is the natural resources found in mangrove ecosystems. Wells et al. estimated the annual economic value of mangroves for \$ 200,000 - \$ 900,000 /hectare [1]. Mangrove ecosystems are known as important in sustaining the livelihoods of households that live in and around the mangrove areas [2], even tens of millions of people in the tropics depend on mangroves as the livelihoods of local and global [3].



Mangrove ecosystems form the habitat for many species of flora and fauna with a high density [4][5][6]. According to Noor et al. that most products have a high economic value of the mangrove ecosystem is a coastal fishery[7]. Various types of fish with high economic value to spend most of their life cycle in the mangrove habitat, namely snapper (*Lates calcacifer*), mud crab (*Scylla serrata*), salmon (*Polynemus sheridani*) [8][9] and even some types of shrimp penaeid is directly dependent on the mangrove habitat.

Management and utilization of mangrove ecosystem are good and true, will directly impact directly to the people who are around the mangrove areas. According Setiyowati et al. that there are four (4) types of utilization of mangrove forest areas can be felt directly by the people, namely: (1) the use of fisheries mullet, (2) the use of aquaculture/pond fish and tiger shrimp, (3) utilization of mangrove seeds, and (4) utilization of mangrove fruit[10]. Furthermore, for the mangrove forest area of 7.1 ha, the highest benefit value that benefits indirectly 63.77% with a value of Rp. 892,000,000/year (Rp. 125,633,803/ha/year), direct benefits 33.30% with a value of Rp. 465,739,500/year (Rp. 29,065,000/ha/year), the benefits of the presence of 2.87% with a value of Rp. 40,136,000.00/year (Rp. 5,652,958/ha/year), and the benefits of choice 0.07% with a value of Rp. 911,640/year (Rp. 128,400/ha/year).

The mangrove forests in small islands have the potential of natural resources and environmental services that height that can be used as a support in realizing our economic independence. Meanwhile, the utilization of the potential of small islands is still not optimal due attention, and government policies are still more oriented to the ground. Based on the mandate of the Act of 1945, Article 33, paragraph 4 stating that the national economy shall be organized based on economic democracy with the principles of justice, solidarity efficiency of justice, sustainability and environmental friendliness, independence, and balancing the advancement and national economic unity, then to the mandate realize there is no excuse for not giving the specific attention to the public in small islands. By him, that mangrove ecosystem management in small islands can be used as the basic capital in creating an independent economy and sustainable society.

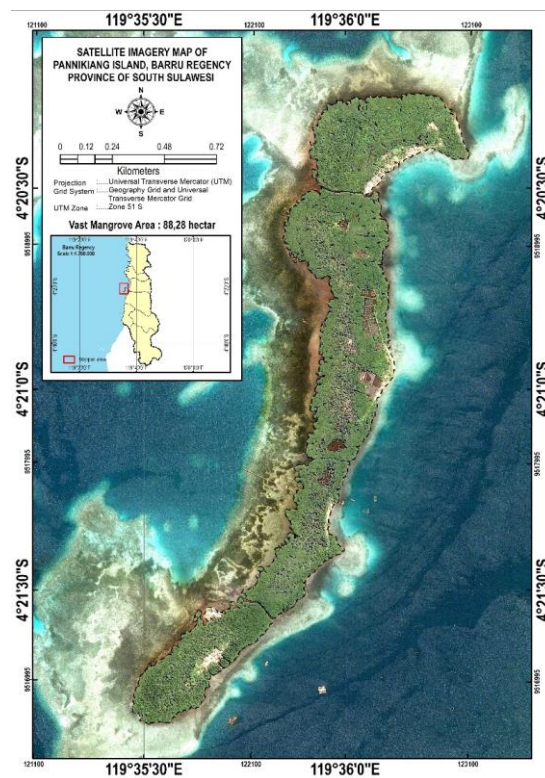


Figure 1. Pannikiang Island

2. The mangrove value of resources in small islands

According to Setiyowati, the value of mangrove benefits can be calculated using the following formula[10]:

2.1. Direct Use (ML) (Direct Use Value)

Direct Use Value is the value generated from the direct use of mangrove forests such as fisheries, firewood, and tourism [11].

$$ML = ML1 + ML2 + ML3 \dots + MLn \quad (1)$$

ML1 = Direct benefits, a total of fishery products

ML2 = Direct benefits, the total of the pond results

ML3 = Direct benefits, the total yield of mangrove seeds

ML4 = Direct benefits, the total from mangrove fruit yield

2.2. Indirect Use Value

Indirect Use Value is indirect values that are perceived indirectly for goods and services produced by resources and the environment [11]. The indirect benefits of mangrove forest ecosystems derived from an indirect holder of coastal erosion and organic matter provider for biota that live in.

$$MTL = MTL_e + MTL_b \quad (2)$$

MTL_e = indirect ecological benefits as a brace of coastal erosion

MTL_b = The indirect benefits as a fish rearing biological

2.3. Benefit Options (MP) (Value Option)

Benefits of choice is a value that indicates a person's willingness to pay to preserve mangrove ecosystems for future utilization. This value is approximated by reference to the value of biological diversity (biodiversity) of mangrove forests in Indonesia. This value is approximated by reference to the value of biological diversity (biodiversity) of mangrove forests in Indonesia is US \$ 1,500/km²/year or US \$ 15/ha/year [12]. According to Maedar; Hiariy; Benu et al., this value can be used throughout the mangrove forest in Indonesia where forest ecosystems are ecologically important mangrove and maintained naturally[13][14][15]. If formulated:

$$\begin{aligned} MP &= MP_b \text{ (Biodiversity Options Benefits)} \\ &= \text{US \$ 15 per ha} \times \text{area of mangrove forest} \end{aligned} \quad (3)$$

2.4. Existence Value (Existence Value)

Benefits of existence are perceived by the public benefit from the existence of ecosystems studied after the other benefits (the benefits of direct, indirect and benefit options). The existence of the benefits measurement with measurement approached directly to individual preferences through Contingent Valuation Method (CVM), measure how much Willingness to Pay (WTP) of respondents against existence and improvement of mangrove ecosystems [11]. Presence Benefits Value obtained by multiplying the average value (USD) given by respondents to the existence of mangrove forests per ha per year with an overall area of mangrove forests. According to Adrianto, the formulation is as follows[16]:

$$ME = \sum_{i=1}^n (ME_i) / n \quad (4)$$

ME_i = Benefits existence of respondents to-i

N = Number of respondents

2.5. Quantify all benefits

The Total Economic Value is the sum of all identified benefits, namely:

$$NET = ML + MTL + MP + ME + MW \quad (5)$$

Information:

NET = Total economic value (TEV) (Rp/ha/year or Rp/year)

ML = Value of direct benefits

MTL = Value of indirect benefits

MP = Value of choice benefits

ME = Value of the existence benefits

MW = Heritage value

3. Results and discussion*3.1. Direct Use*

Direct use of mangrove forests/year on Pannikiang Island can be seen in Table 1.

Table 1. Direct utilization of mangrove forests per year on Pannikiang Island

No	Utilization	Utilization/year
1	Fish	12,250 kg
2	Crab	225 kg
3	Shrimp	250 kg
4	Travel	384
5	Bat	5,400 tail

Direct utilization of mangrove forests is to make the arrest/cultivation of fish, shrimp, and crab. Generally makes people catch fish around the mangrove forest and the cultivation of fish in floating net cages. So even with the shrimp, in addition to cultivated also no arrests in and around the mangrove forest. The utilization mangrove ecosystem as a place for enlargement of crabs in the cage [17]. The succession of fish, shrimp, crab arrested during the year was 12,250 and 250,225 kg/year.

Mangrove tourism objects in Pannikiang Island also greatly benefit the community. Pannikiang Island is one of the tourist destinations in Barru Regency. Bats are a lot of life in the mangrove forests also provide benefits for people around the mangrove forest. Total annual catches of the two respondents, around 5400 tail.

Table 2. The economic value of direct mangrove forest benefits on Pannikiang Island

No	Utilization	Total Economic Value (Rp/year)	Average Economic Value (Rp/ha/year)
1	Fish	1,041,250,000	11,794,857.27
2	Crab	28,125,000	3,185,885,818
3	Shrimp	10,000,000	1,132,759,402
4	Travel	115,200,000	1,304,938,831
5	Bat	54,000,000	611,690,077
Total		1,248,575,000	14,143,350.27

Table 2 shows that the total economic value of the direct benefits of mangrove forest on Pannikiang Island is Rp. 1,248,575,000/year or Rp. 14,143,350.7/ha/year. The biggest benefit value is from fishing results of Rp. 1,041,250,000/year or Rp. 11,794,857.27/ha/year or about 84%.

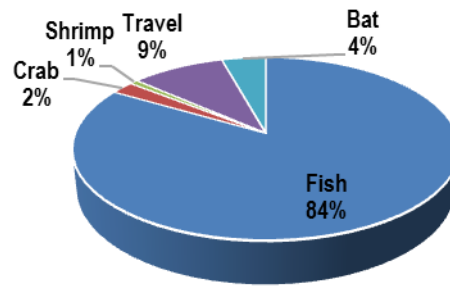


Figure 2. Percentage Value Direct Benefits of mangrove forest on the Pannikiang Island

3.2. Non-Direct Benefits of mangrove forest

3.2.1 Use of a local nursery grounds, feeding ground and spawning ground

Indirect Use Value perceived indirectly to the goods and services produced by resources and environment [11]. The indirect benefits of mangrove forest ecosystems derived from an indirect holder of coastal erosion and organic matter provider for biota that live in. Calculations for the economic value of the breeding, foraging areas and spawning areas by Widiyanto et al. can be calculated using the formula:

$$\text{Land area} \times \text{US \$ } 142.64 \times \text{Rupiah} \\ 88.28 \times 142.64 \times 14,500 = \text{Rp. } 182,587,758.4/\text{year} \quad (6)$$

Based on the calculation of the economic value of the use of a local nursery grounds, feeding ground and spawning ground of mangrove Rp. 182,587,758.4/year

3.2.2 Erosion protection and pond protection

One of the ecological functions of mangrove forests are protective / barrier protects the land from erosion and embankment from abrasion. Meanwhile, for the construction of river dikes requires materials such as sand, gravel, stone and concrete iron. The cost allocated for the construction of river dikes is estimated at Rp. 1,029,000. The average height of the embankment which is 3 meters, a width of the 0.5-meter embankment, embankment length of 9418 meters and durability embankment 10 years.

$$\text{Value of Indirect Benefits} = 14,127 \text{ m}^3 \times \text{Rp. } 1,029,000. = \text{Rp. } 14,536,683,000/\text{year}$$

Based on the results of the quantification of indirect benefits (local nursery grounds, feeding ground and spawning ground, as well as retaining soil erosion/protective embankment) and mangrove forest on the Pannikiang Island, then obtained the total value of the overall indirect benefits Rp. 182,587,758.4 + Rp. 14,536,683,000 = Rp. 14,719,270,758.4/year.

3.3. Benefits of choice

Benefits of choice is a value that indicates a person's willingness to pay to preserve mangrove ecosystems for future utilization. This value is approximated by reference to the value of biological diversity (biodiversity) of mangrove forests in Indonesia. This value is approximated by reference to the value of biological diversity (biodiversity) of mangrove forests in Indonesia is US \$1,500/km²/year or US \$ 15/ha/year, and is formulated:

$$\text{MP} = \text{MPb (Biodiversity Options Benefits)} \\ = \text{US \$ } 15 \text{ per ha} \times \text{area of mangrove forest} \quad (7)$$

Under these conditions, the benefits of choice are:

$$= 15 \times \text{Rp. } 14,500 \times 88.28 = \text{Rp. } 19,200,900/\text{year}$$

3.4. Existence Value/Benefits of Existence

Presence Benefits Value obtained by multiplying the average value (USD) given by respondents to the existence of mangrove forests per ha per year with an overall area of mangrove forests.

Table 3. Benefits of mangrove forests in Pannikiang Island

No	WTP (Rp)	Number of Respondents	Total WTP (Rp)
1	1,000,000	39	39,000,000
2	5,000,000	1	5,000,000
3	10,000,000	-	-
Total		40	44,000,000

3.5. Benefits Heritage

According to Wahyuni et al., found that the heritage value is not less than 10% of the value of the direct benefits of mangroves. Thus the legacy benefits of mangrove forest on the Pannikiang Island is $10\% \times \text{Rp. } 1.248575 \text{ billion} = 124,857,500/\text{year}$.

3.6. Total Economic Value (TEV) mangrove ecosystem in Panikiang Island

The total economic value is the sum of all the benefits that have been identified, as shown in Table 4.

Table 4. Benefits of mangrove forests in Pannikiang Island

No	Benefits Type	Rp/ha/year	Rp/year	%
1	Direct benefit	14,143,350,700	1,248,575,000	7.73
2	Indirect benefits	166,733,923,400	14,719,270,758	91.1
3	Benefits of choice	217,500,000	19,200,900	0.12
4	Benefits of existence	498,414,137	44,000,000	0.27
5	Heritage benefits	1,414,335,070	124,857,500	0.77
Total		183,007,523,300	16,155,904,158	100

4. Conclusion

The total economic value of mangrove forests in Pannikiang Island is Rp. 16,155,904,158/year or Rp. 183,007,523,300/ha/year. Patterns and ways of resource utilization of mangrove ecosystem is using gear nets, traps, hooks iron in catching shrimp and crab, develop nursery mangrove system with scraped or directly from the fruit, using gear nets, traps, using an iron hook and put up a crab trap (rakkang) in catch crabs, catch bats found in mangrove forest using the net, made bridge length, and the middle of the mangrove forest tower area so that the end could be resting and go up to the tower to see the entire expanse of mangrove forests in the Pannikiang Island, wanamina cultivation, which combines farming of fish/shrimp with mangroves, the natural looking and milkfish fry.

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