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Economic valuation of mangrove forests at Secanggang, Langkat

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Abstract. Mangrove forest is the main life-supporting ecosystem for organisms in coastal and marine areas. It got serious pressure as the impact of land conversion. The objective of the study was to analyse the total economic valuation of mangrove forest in Secanggang, Langkat. The number of samples is determined as many as 30 by using cluster sampling. Data were analysed using economic valuation techniques for calculating the total value of the mangrove ecosystem. Total economic value is carried out by interviewing each respondent to estimate economic value, namely the direct use value, the indirect use value, and the option value of the mangrove forest. The total economic value is IDR 22,497,463,608 per year. It is obtained from direct use value is IDR 4,662,525,000 per year, indirect use value amounted IDR 17,507,736,480 per year, while option value amounted IDR 327,202,128 per year. Direct use value comes from the benefits of the firewood, shrimp, fish, and crab utilization. For the indirect use value was obtained from retaining abrasion and provider of fishery resources, i.e. shrimp feed resource and the option value was obtained by calculating the value of biodiversity in the mangrove ecosystem.

1. Introduction

Mangrove ecosystems have an important role, both in the maintenance of coastal waters as well as in productivity support the life of the population. For the coastal areas, the existence of mangrove forests, especially as the green line along the coast or river estuary is very important to supply firewood, fish, and shrimp as well as maintaining the quality of the agricultural areas, fisheries and settlements located behind it from abrasion disruption, intrusion and sea breeze wind. Therefore, in some conditions of mangrove resources should be conserved and protected with a number of options for sustainable management viable.

The benefits that exist in the ecosystem of mangrove forests, providing consequences for the ecosystem of mangrove forest itself, with increasingly high rates of exploitation on the environment which ended in environmental degradation. The examples are the reduced area of mangrove forests from year to year, the existence of mangrove land conversion into agricultural lands such as plantations of palm, agricultural food crops, and residential location.

Local communities that have a low education is very susceptible to outside cultural influences that consumerist. Large resources are needed to support a consumptive lifestyle, which results in a person not being able to use natural resources wisely [1]. This situation caused the society no longer utilizing forest resource wisely, but tend to do encroachment and uncontrolled exploitation. It happens almost to all regions in Indonesia, especially in forest conservation. The Mangrove forest is largely utilized by



communities around the forests, but the society for less find out important values and benefits of the forest to their lives.

The existence of power support forests against all aspects of life is determined by the public awareness of the importance of forests to be utilized and managed. The forest became a place of reciprocity relation between humans and other organisms with natural factors comprise the process ecology and is a unity that can support life cycle [2].

Society in general only knows how to take or make use of forest products based on their own knowledge that has been passed on orally without knowing the right way to keep continuity and existence of the forest. Remember it is still low level of appreciation society against the potential of mangrove forests as an economic asset, then it needs to be done of the economic valuation of mangrove resources, so that it can be known the magnitude of the benefits and functions of mangrove forests either benefits Economic and ecological benefits.

The value of the benefits of the mangrove forest obtained is then continued by quantifying all the benefits of the mangrove forest into the value of money by calculating the total economic value. Information on the total economic value of mangrove forests is then used by the government in the sustainable management of mangrove forests and the determination of effective policies on mangrove forests.

2. Methods

The location of the research is determined by purposive in Secanggang, Langkat. Secanggang was chosen because it is surrounded by mangrove forest ecosystem and has a long coastline and the largest among other subdistricts geographically, so it has a high interrelatedness with mangrove forest ecosystems.

The respondents in the research community was that utilized the resources of mangrove and also the community related to mangrove indirectly. Sampling is based on geographical location, and the smallest sample area is determined at the village. The number of samples is determined as many as 30 by using cluster sampling. The number of samples taken was 15 samples in the Kwala Besar Village and 15 samples in the Jaring Halus Village.

Economic valuation of mangrove ecosystems in the study using a two-stage [3]. First, the identification of the benefits and functions of mangrove ecosystem function and second, quantifying against mangrove ecosystems utilization. Data were analysed using economic valuation techniques for calculating the total value of the mangrove ecosystem.

Economic valuation is an effort that is used to provide a quantitative rating against the goods and services produced in natural resources and the environment regardless of either market value or non-market value. The purpose of the valuation study is to determine the magnitude of Total Economic Value (TEV), the utilization of natural resources and environment, and assist decision-making for the suspected economic efficiency of various utilization which may be made against the ecosystem in the coastal region and the marine area [4].

Economic assessment of mangrove ecosystems conducted using a two-stage approach. First, The identification of the benefits and functions of mangrove ecosystem and second, quantification of all benefits and functionality into the value of money [5].

Quantifying against mangrove ecosystems with various approaches is determined by direct use value, indirect use value and options use value. Direct use value is the value resulting from the utilization of a resource directly. Direct benefits could be interpreted the benefits that can be consumed. The value of mangrove ecosystem direct benefits is calculated by using the below equation:

$$DUV = \sum DUV_i \quad (1)$$

where:

DUV = Direct Use Value

DUV_1 = Benefit of firewood

DUV_2 = Benefit of fishing

DUV_3 = Benefit of crab fishing

DUV_4 = Benefit of shrimp fishing

Indirect use value is the value of the benefits of mangrove resources are utilized indirectly by society. Indirect benefits of mangrove ecosystems can be either physical benefits as the retaining sea water abrasion. Assessment of mangrove forests physically can be estimated with the function of mangrove forests as retaining abrasion. Moreover, option use value is usually calculated using the benefits transfer method, by way of assessing their estimated benefit from somewhere else (where the resource available). Indonesia mangrove forest has a biodiversity value of USD 1500 per km². This value can be used throughout mangrove forests in Indonesia when ecosystem of mangrove forest was important ecologically and preserved naturally. The option value is obtained by using the below equation [6]:

$$\text{Option Value} = \text{USD 15 per acre} \times \text{Wide of mangrove ecosystems area} \quad (2)$$

3. Results and discussion

The identification of direct use value of mangrove ecosystems in Secanggang only on the utilization of firewood (wood twigs) and catching fish, shrimp and crab utilization.

Table 1. The Identification of the direct uses of mangrove ecosystem (direct benefits)

Type of Use	The Number of Generated per Year
Firewood/wood twigs (bunch)	1,250
Fish (kg)	34,107
Shrimp(kg)	42,280
Crab(kg)	26,385

Table 1 shows that the community in Secanggang more directly utilizing the ecosystem of mangroves and the utilization of firewood/wood twigs, as fishermen fishing, the utilization of shrimp and the utilization of crabs. Timber harvesting is done by the community is the dry wood found in the mangrove forest. In a year the firewood produced by mangrove can reach 1250 bunch per year. The average yield of fishing is done by using fishing rods and nets that is 34,107 kg per year. The average yield of shrimp catch per year is 42,280 kg per year, and the average yield of crab catch is 26,385 kg/year.

Mangrove forest ecosystems have important roles and functions that support human life either directly or indirectly. The ecosystem of mangrove forests has two main functions, namely the function of ecological and socio-economic functions.

3.1. Direct use value

Based on processed primary data obtained with respondents, it can be identified the value of the economic benefits of mangrove forests in Kwala Besar village.

Table 2. Direct use value of mangrove ecosystem in Secanggang Subdistrict

Type of use value	Market Value (IDR)	The Number of Generated per Year	Benefit Value per Year (IDR)	Percentage (%)
Firewood (bunch)	5,000	1,250	6,250,000	0.13
Fish (kg)	25,000	34,107	852,675,000	18.28
Shrimp (kg)	65,000	42,280	2,748,200,000	58.94
Crab (kg)	40,000	26,385	1,055,400,000	22.65
Amount			4,662,525,000	100.00

Table 2 shows the benefits analysis of any type of direct use value, the number of direct values obtained from mangrove resources was 4,662,525,000 IDR per year. The highest direct use value on the type of utilization of shrimp catching was 2,748,200,000 IDR per year (58.94%) while the lowest direct use value on the type of firewood utilization was 6,250,000 IDR per year (0.13%). The other of direct use value was the type of fish utilization was 852,675,000 IDR per year (18.28%), and utilization of crabs was 1,055,400,000 IDR per year (22.65%).

3.2. Indirect use value

Indirect use value is a value that is perceived indirectly to goods and services produced by natural resources and the environment [7]. Indirect use value perceived by the community around the mangrove forest consists of physical and ecological benefits. The research results obtained that type of indirect use value from the mangrove ecosystem in Secanggang, namely retaining abrasion and provider of fishery resources, i.e. shrimp feed resources as one of the activities agribusiness (feeding ground).

Table 3. The indirect use value of mangrove ecosystem in Secanggang Subdistrict

Types of Benefit	Benefit Value (IDR per Year)	Percentage (%)
Retaining Abrasion	17,506,792,264	99.90
Shrimp feed resource provider	944,216	0.10
Amount	17,507,736,480	100.00

The indirect use value physically as coastal anchoring abrasion was estimated through the replacement cost approach by building concrete of coastal for the breakwater. Data on building abrasion-retaining using the shadow price approach that is using the standard of the Ministry of Public Works to make abrasion-resistant buildings. Shadow price approach is needed if there is no data available in the research area.

The replacement cost of the breakwater value (length x width x depth) the size of 1 m x 5 m x 6 m with 5 years of the durability of IDR 5,839,880 per meter [8]. According to the Zoning of the coastal areas and small islands, province of North Sumatra 2016, length of coastline mangrove ecosystem in Secanggang is 14,989 m. The value of the cost of building a breakwater is then multiplied by the length of the coastline protected by mangrove forests, with a length of 14,989 m. It is because the breakwater building can replace the function of the mangrove forest as a breakwater on the length of the coastline so that the indirect benefits of mangroves as a retaining abrasion is IDR 87,533,961,320. Then the value is divided by 5 to get the annual value. Thus, the benefit value is IDR 17,506,792,264 per year.

Mangrove ecosystem assessment based on its function as a provider of resources feed the shrimp by using techniques of EOP (Effort on Production), by assessing the magnitude of resource productivity of shrimp feed on mangrove ecosystems.

Next, the economic value of mangrove ecosystems based on its function as a provider of resources feeding the shrimp can be calculated with the method using wide of mangrove forests area, and shrimp feed production with the model is thus:

$$Y = 16.286 + 0.0003536 X \quad (3)$$

where:

Y = shrimp feed production

X = wide of mangrove forest area [9]

The wide of mangrove forests area in Secanggang was 1,626.9 acre, then the shrimp feed production potential is of 16,861 kg per year, to get the value of the resource providers to feed shrimp, it was multiplied by the needs of feed per 1 kg of shrimp is 2 kg and then it was multiplied by the price of shrimp is IDR 28,000 per kg, so it can be retrieved the value of the economic benefits of mangrove based on its function as a provider of the feed resource shrimp is IDR 944,216 per year.

3.3. Option value

The value is approached by using the value of biodiversity. The option value was obtained by multiplying the value of biodiversity with the value of IDR exchange rate against Dollar at the time of the study amounted to 13,408 IDR. The option value of mangrove ecosystems in Secanggang was calculated by the approach of the benefits of biodiversity, by the method of Benefit Transfer, where the mangrove ecosystem in Indonesia has a value of biodiversity for USD 1,500 per km² per year or USD 15 per acre per year [10].

So that the option value = USD 15/acre/year x the extent of mangrove ecosystem in Secanggang, where the value of IDR against the dollar adjusted for the value of the currency while the research, so that the option value = 15 (13,408)/acre/year x 1,626.9 acres, then it was obtained the option value IDR 327,202,128 per year.

3.4. Total economic value

This value is based on the results of the identification of all types of benefits of mangrove resources in Secanggang. Then the calculation is done on the entire value of benefits.

Table 4. Quantifying the use value of mangrove ecosystems in Secanggang Subdistrict

Type of Use Value	Use Value (IDR/year)	Percentage (%)
Direct Use Value	4,662,525,000	20.72
Indirect Use Value	17,507,736,480	77.80
Option Value	327,202,128	1.45
Amount	22,497,463,608	100.00

The total economic value of indicates that the natural resources and the environment require a higher award and it became the basis of the information quantitatively to determine various options policy, fiscal policy as well as monetary, structural adjustment and stabilization efforts because it has an impact on the sectors that depend on natural resources.

After obtaining the total benefit value from the mangrove forest ecosystem, it is hoped that it can be used as a reference for the government and the community in terms of managing and utilizing mangrove ecosystems. The results of the economic assessment show that the mangrove forest area has a large value of benefits so that it can support the community's economy in Secanggang, Langkat.

The government has ordered the integrated team involving the forestry service and related agencies to conduct a large-scale operation to handle the encroachment or conversion of mangrove forests into oil palm plantations in Secanggang, Langkat.

4. Conclusions

Based on the findings of this study, we conclude that the direct use value of mangrove ecosystem in Secanggang Subdistrict which utilized by community consists of fire woods, fishes, shrimps, and crabs. The direct use value of mangrove ecosystem amounted IDR 4,662,525,000 per year. Indirect use value amounted IDR 17,507,736,480 per year, while option value amounted IDR 327,202,128 per year. The wide of mangrove ecosystem area in Secanggang was 1,626.9 acre, and total economic value amounted IDR 22,497,463,608 per year.

Therefore, the government should provide counselling to the Secanggang community around the mangrove forest ecosystem and the wider community in an effort to preserve mangrove ecosystems so that the benefits or value of the mangrove ecosystem can be maintained. The government also should create a policy in order to stop the activities land conversion of mangrove forests into the residential location in the area of mangrove forests in Secanggang.

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