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A Study on Relation of the Existence of Mangrove Forest of Coastal Area: A Case Study in Cengkrong-Indonesia

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Abstract **Original Research Article**

Many mangrove areas are considered to be a collection of wild plants along the coastline. Many people ruin it and replace it with other plants. Illegal logging, subsistence, illegal fishing, and illegal hunting have caused wetland destruction as mangrove habitat. Mangrove plants need to be calculated in order for the community to realize the economic value of mangroves. Therefore, the aims of this study are: (1) to describe the current condition of mangrove Cengkrong Indonesia, (2) to analyze the economic value of mangrove in coastal Cengkrong Indonesia. The analysis used economic valuation includes Direct Use Value (DUV) to calculates the wood value, the market value of fish, and crabs. Indirect Use Value (IUV) were used to calculate the value of indirect benefit coastal trader, natural tourist attraction, and rent boat for ecotourism. Option Value (OV) was used to calculate the number of biodiversity value in the mangrove ecosystem. Based on the results of economic valuation mangrove, the condition of mangrove in Cengkrong had increased every year since mangrove forest rehabilitation was carried out by the Department of Marine and Fisheries in 2010. The total use value of mangrove Cengkrong is USD 606,298.75 per years. The highest value of the total use value is the direct use value which is USD 578,522.23 per years. The lowest value is the value of option value which is USD 1,305 per years. Furthermore, the results of this study indicate that in the long term, the existence of mangroves has a great valueand its presence has a large impact. However, people are not aware of the importance of the mangroves existence. Therefore, The Indonesian government have to establish policy and make socialization about the importance of the existence of mangrove.

Keyword: Coastal area, Economic valuation, Total use value, Direct use value, Indirect use value.

INTRODUCTION

Many coastal communities cut mangrove forests only to obtain timber. This activity resulted in the loss of other benefits from mangrove forests, such as spawning, feeding for marine species, abrasion prevention, and ecotourism. Mangrove losses continue despite many studies showing that mangroves can produce much fish, provide breeding habitat for young reef fish from many species and non-fish products such as wood, medicinal plants, and dyes, as well as equiptments that are directly used by the community. Nowdays, many areas mangrove globally lose their rate at crisis point. That cause by the exploitation of mangrove areas used for agriculture and aquaculture is the cause of much loss of wetlands.

Agriculture is a major cause of large-scale loss of mangrove forests such as small island states such as Fiji, about 86% of all reclaimed mangroves are for sugar cane and rice farming. In some cases, illegal logging, subsistence, illegal fishing, and illegal hunting have caused wetland destruction as mangrove habitat [1]. Many local communities, directly and indirectly, appreciate the function of mangroves, such as ecological functions. The ecological function is a function that mangroves provide for commercial, recreational and subsistence fisheries, by providing habitats and breeding grounds for marine life [2]. As of now, about 62% of this broad mangrove in the Mahakam Delta has been lost predominantly because of change into aquaculture [3]. Beachfront security is an especially noteworthy biological community benefit for nearshore environments. For instance, mangroves assurance benefit was esteemed in 15,997 USD/ha in Thailand, it was speaking to the 84% of the aggregate environment worth, and the worldwide normal estimation of coral reefs for insurance against

disintegration speaks to 43% of the aggregate estimation of its biological community administrations. The two commitments to the aggregate esteem are more noteworthy than other estimated biological community administrations, for example, vacationer (31%), sustenance and water provisioning (15%), directing (6%, barring assurance) and environment (5%)[4]. As of now, about 62% of this broad mangrove in the Mahakam Delta has been lost predominantly because of change into aquaculture [3].

Table-1: Mangrove Area and Loss, 2000–2012 in the Top 10 Mangrove-Rich Countries and by Region [5]

Country	Mangrove area in 2000 (km^2)	Mangrove area in 2012 (km^2)	Mangrove loss / year, 200-2012 (%)
Indonesia	24,073	23,324	0.26
Brazil	7721	7675	0.05
Malaysia	4969	4726	0.42
Papua New Guinea	4190	4172	0.04
Australia	3327	3316	0.03
Mexico	3021	2993	0.08
Myanmar	2793	2557	0.70
Nigeria	2657	2654	0.01
Venezuela	2416	2404	0.04
Philippines	2091	2064	0.11
Region B			
Africa and Middle East	10,797	10,765	0.02
Asia	39,715	38,361	0.28
N and C America	10,953	10,800	0.12
Oceania	8555	8523	0.03
South America	13,475	13,400	0.05
GLOBAL	83,495	81,849	0.22-0.66

Source: Secondary data, 2016

Many mangrove areas are considered to be a collection of wild plants along the coastline. So many people ruin it and replace it with other plants. Mangrove plants need to be calculated in order for the community to realize the economic value of mangroves. Ecosystem assessments are increasingly being used to support economic cases for habitat conservation and improvement [6]. The assessment also supports the calculation of the national environment (eg System Environmental-Economic Accounting) [SEEA] [7]. There are two values that can be used to determine the economic value of natural resources using direct and indirect values directly by humans. The value of benefits perceived through the process can be regarded as an indirect value both useful and valuable to humans. Optimizing the benefits of mangrove forests has a positive impact on household income in coastal communities.

Indonesia has extensive mangrove forest, has 29,000– 31,894 km2 of mangroves which is more than some other nation on earth, but the rate of deforestation of mangrove forest is a problem of mangrove forest destruction [3]. Deforestation of mangrove forests can be determinate by their conditions, first to be heavily damaged by 42%, second light damaged area reaches 29%, third good condition reaches wide <23%, and in the development conditions only 6%. Mangrove forest existence increasingly squeezed by human need, so mangrove forest often cut down even until extinct [8]. If it continues to do so will result in the occurrence of abrasion, loss of wildlife or marine life whose habitat requires support from mangrove forests. In tropical and subtropical areas mangrove forests have a very important role in protecting coastal erosion and maintaining hydrological functions in the region.

Based on the explanation above, Indonesia's mangrove forests face the threat of damage. Based on the development of international conditions, not only Indonesian mangroves are threatened by damage, but mangroves in various parts of the world. Therefore, the efforts to prevent mangrove damage need to be carried out by examining mangroves conditions, so that community awareness can be taken to protect mangroves. Under these conditions, it can be formulated the aims of in this research are as follows:

- To discribe the conditions of mangrove Cengkrong ?
- To analize the economic value of mangrove in coastal Cengkrong ?

MATERIALS AND METHODS

Method of Determination of Location and Time of Research

Data in this study used census method the population of coastal Cengkrong and Damas. Total of data consisting of 55 households, 19 households from coastal Cengkrong and 36 households from coastal Damas. mangrove communities representing jobs 10 households management of mangrove (beachside traders), 33 fishermen (crab seekers), and 12

management and fisherman. To calculated economic value used data production mangrove, average trees, and height. The study was conducted in February 2016. Data collection in this study aims to identify the economic value of mangrove in coastal Cengkrong used primary and secondary data. Data primary got from the questioner. Data secondary got from previous research. The sampling of trees using line transects is sampling of data by way of ascending the 10 m to the sea with the initial position which has been marked (stakes or tree painting) then determining the block (sample plot) on the left and right of the line square-shaped transects measuring 10 x 10 meters for tree-phase observation [9]. This study used secondary data from previous research and which is collected to support the needs of this research. Data collected included Average density Cengkrong mangrove, the price of volume mangrove, the price of catching, Biodiversity value, Curs IDR to USD. These data can be obtained by the official website of the Central Statistics Agency Trenggalek Indonesia.

Empirical Analysis

The calculation method uses economic assessment (direct, indirect, and option value) to analyze, predict, and identify the economic value and existence of mangrove forest resources (tree population, average diameter, height, and mangrove production). The results of these observations will be estimated in the value of money. The positive and negative impacts of the value are presented to coastal communities of Cengkrong.

Direct Use Value (DUV)

The value of direct benefits generated from the utilization of mangrove resources, where the value is calculated from the value of wood and the value of mangrove forest production. Wood value using volume analysis. This volume analysis is used to describe the condition of coastal mangroves of Cengkrong, and can also be used as an initial calculation of the economic potential of mangrove wood. [10]. The formula is:

VHA = timber average volume (m^3 / ha)
= basic area x T x K

Description:

Basic area = $((\frac{D}{100}$ x 0.5)^2) x *Phi* (π)
D = Average Diameter (m)
T = Average Hight(m)
Phi (π) **= 3,14**

K = average density of trees / ha

Calculation of the potential of mangrove wood will be calculated by determining the price of mangrove wood refers to Regulation of the Minister of Trade No. 22 / M-DAG / PER / 4/2012 of Rp 216,000 / m^3[9]. His method is calculating the wood values present in the mangrove forest ecosystem.

Wood value = P * VHA * L

Description:
P = Price volume (Rp/m^3)
Vha = Volume (m^3 / ha)
L = area (ha)

Production of Mangrove

The market value of fish, crabs, and ecotourism. The value of direct benefits from the productivity of fish and crabs can be obtained based on the average number of catches/year and multiplied by the market selling price. The value of tourism was calculated from average visits/year multiply by ticket price.

Indirect Use Value (IUV)

The value of indirect benefits from mangrove forests can be identified from the income of coastal traders, use mangrove forest as a natural tourist attraction and boat rent service for tourists. The value of indirect benefits is derived from the average income of coastal traders/year.

Option Value (OV)
Existence Value

The method used is Benefit Transfer. This method uses a benefit scoring system from elsewhere, where resources are available, then those benefits are transferred to get a rough estimate of environmental benefits Tuwo, 2011. The method is approached by calculating the number of biodiversity values present in the mangrove forest ecosystem. Indonesia's mangrove forests have biodiversity value of USD 15 / hectare.

OV = USD15 * forest area

Total Use Value (TUV)

Identifying the benefits of mangrove forests is to measure all the benefits convert into the value of money. This value is calculated based on the total economic value of mangrove forests as a whole. The total benefit value is defined as follows:

TUV = DV + IV + OV

Description:
TUV : Total Use Value (USD)
DUV : Direct Use Value (USD)
IUV : Indirect Use Value (USD)
OV : Option Value (USD)

RESULTS AND DISCUSSIONS

The Condition of Mangrove in Cengkrong

The population of Cengkrong mangrove forest was under pressure from the destruction and conversion of land and coral reefs damaged because fishermen used poisons, bombs and were also taken as souvenirs by domestic tourists. In 2010, there has been an improvement in mangrove forests and coral reefs because of the Cofish Project. Cutting down mangrove

forests and converting mangrove forests to planting coconut is a mistake in the ecological behavior of coastal communities, which are trapped in economic behavior but sacrifice the ecological functions of a region, which in fact will ultimately damage their lives.

The area of mangrove in Cengkrong has experienced an increase in area from 42.557 ha to 87 ha. This expansion was carried out by the community and the government and managed by the surrounding community group called "Pokmaswas Kejung Samudra". The high level of land conversion from mangrove forests to coconut plantation areas and plantation crops over the past few years has caused the area of mangrove forests to shrink dramatically in the region. In 2010 mangrove forest rehabilitation was carried out by the Department of Marine and Fisheries, Trenggalek Regency by planting ± 95,000 mangrove seedlings. They have many species of mangrove. The rehabilitation of mangrove forests in the Cengkrong beach area began in 2008, by replanting mangrove trees in an area of 1 ha. Along with the rehabilitation of mangroves in Cengkrong Beach, in the development of management, Pokmaswas Kejung Samudra has productive economic activities on mangrove forest ecosystems including ecotourism activities, mangrove crab cultivation, Annadara sp shellfish cultivation, and mangrove nursery. The following are presented productive activities managed by Pokmaswas Kejung Samudra.

Direct Use Value

The direct use value of mangrove was all the potentials founded in the coastal mangrove in Cengkrong and its usefulness can be taken directly by the community. In this case, all types of flora and fauna can be directly utilized potential of mangrove trees. The potential of mangrove trees in the study location was calculated by analysis of wood volume. The calculation results from this analysis can describe the condition of mangrove forests on each hectare and serve as a preliminary calculation to determine the value of the benefits of mangrove wood, which is the price of mangrove wood is IDR 216,000 /m^3

Table-2: Value of potential mangrove trees

Information	Value/year	Unit	
Average Diameter	0.203	m	**[A]**
Average Hight	5.031	m	**[B]**
Average Density of Tree	2750	/ha	**[C]**
Phi (π)	3.14		
Basic Area	0.157		**[D]**
Area	87	ha	**[E]**
Volume (m^3 / ha)	447.821	m^3/ha	**[F]**
Price volume (Rp/m^3)	IDR 216,000	/m^3	**[G]**
Total Wood Value of Mangrove	IDR 8,415,466,122.86	/m^3	**[H]**

*Note: Exchange rate 1 USD = 14,766.89 IDR; Basic area [D] = (A * 0.5)^2 * *Phi* (π); Volume of mangrove [F] = D * B * C; Total wood value of mangrove [H] = E * F * G

Based on Table 2. the total potential value of mangrove trees in Cerngkrong was obtained at 38,960.49 m^3/ha. With the price of timber amounting to IDR 216,000.00/m^3, the total potential value of mangrove trees is IDR 8,415,466,122 or (USD 569,887.51).

Ecotourism

Table-3: Value of mangrove ecotourism

the average number of visitors	Person/year	Ticket price (IDR)	Total/year (IDR)
Weekdays	4400	5000	22,000,000
Weekends and holiday	8000	10,000	80,000,000
Total Revenue			102,000,000

*Note exchange rate 1 USD = 14,766.89 IDR

Based on Table 3. value of mangrove ecotourism calculated by the average number of visitors multiplied ticket price. Base on the results, the average number of visitor were divided two, first is weekday and second is weekends and holiday in one year. Total revenue from mangrove ecotourism is IDR 102,000,000 or (USD 6,907.34)/year.

Mangrove Crabs (Scylla serrata)

Mangrove crabs had an impact on the lives of biota around the mangrove ecosystem. Mangrove crabs are found in the Cengkrong mangrove forest area. Many mangrove crabs were caught for consumption and sale. Mangrove crabs that could live in the area around the mangrove can also be cultivated so as to produce benefits for the local residents.

Table-4: Production of Mangrove Crabs

Commodity	Average production/year (kg)	Price (IDR/Kg)	Total/year
Crab (Scylla serrata)	1,642.5	45,000	73,912,500

*Note exchange rate 1 USD = 14,766.89 IDR

Based on Table 4. Production of mangrove crabs calculated by average crabs caught multiple price crab. Mangrove crabs ware a species founded in the mangrove Cengkrong. Average crab caught is 1642.5/year with the selling price of crabs is IDR 45,000/kg. Total production of mangrove crabs is IDR 73,912,500 or (USD 5,005.29)/year.

Couth fishes

Mangrove forests around the Cengkrong beach estuary also provide benefits to the surrounding community. Some activities carried out by the community in utilizing the mangrove forest ecosystem at the Cengkrong beach estuary include fishes. The type of fish in the research location that is often found is fish that are usually taken directly by residents and fishermen. The types of fish were Mullet *(Mugil Cephalus)*, snapper fish *(Lutjanus sp)*, and Frigate tuna *(Auxis thazard)*.

Table-5: Production of Fishes mangrove

Commodity		Average production/year (kg)	Price (IDR/Kg)	Total/year
Fish	Mullet (Mugil Cephalus)	1,095	30,000	32,850,00
	snapper fish (Lutjanus sp)	730	48,000	35,040,000
	Frigate tuna (Auxis thazard)	365	28,000	10,220,000
Total				78,110,000

*Note exchange rate 1 USD = 14,766.89 IDR

Based on Table 5. production of mangrove fishes calculated by average fishes caught multiple price fish. Total production fishes of Cengkrong mangrove is IDR 78,110,000 or (USD 5,289.54)/year. The amount consists of 3 types of fishes is Mullet, snapper fish, and frigate tuna, which ware widely captured and consumed by the community.

Shrimps

Along the coast of Cengkrong, several fishermen also caught white shrimp. White shrimp *(Penaeus mergulensis)* is a type of shrimp that lives in the bottom of the water, especially in areas with a lot of large rivers, with white to yellow body colors, there were brown and green spots on the tip of the tail.

Table-6: Production of Shrimp

Commodity	Average production/year (kg)	Price (IDR/Kg)	Total
Shrimp (*Penaeus mergulensis)*	182.5	35,000	6,387,500

*Note exchange rate 1 USD = 14,766.89 IDR

Based on Table 6. production of mangrove shrimp calculated by average shrimp caught multiple price shrimp. Total production of shrimp in Cerngkrong was obtained IDR 6,387,500 or (USD 432.56)/year. The average caught was 182.5 kg/year.

Indirect Use Value

Indirect use value is the benefits of natural resources and environmental services even without going through the actual consumption process. Mangroves in Cengkrong that had various indirect benefits. For example, providing opportunities for the surrounding community to sell around the mangrove area and provide an opportunity for the community to make boats rental services.

The income of coastal traders

Coastal traders were selling on the beach of Cengkrong since the tour of the mangrove forest. These traders sell sea catches such as smoked fish, squid, crabs, and also sell drinks such as coffee, rice, and young coconut.

Table-7: Income of coastal traders

Mangrove service	Average income/month (IDR)	Total/year (IDR)
Coastal traders	15,000,000	180,000,000

*Note exchange rate 1 USD = 14,766.89 IDR

Based on Table 7. income of coastal traders calculated by average income/month multiplied total month/year. The condition in research area provided income for coastal traders around IDR 180,000,000 or (USD 12,189.43)/year.

Boats rent service for tourists

Boat rental activities were carried out according to the condition of the sea water if the condition of the water recedes the boat cannot be leased. The ticket for renting a boat is IDR 10,000 / person. At weekend the number of visitors to boat renting increases than the weekdays.

Table-8: Boat service income

Mangrove service	Average tourists rent boat	Ticket price (IDR)	Total/year (IDR)
Boat	7800	10,000	124,000,000

*Note exchange rate 1 USD = 14,766.89 IDR

Based on Table 8. boat service income calculated by average tourists rent boat multiplied by a ticket for the boat. Base on condition in research area, income from boats service is IDR 78,000,000 or (USD 5,282.08) / year.

Option Value

The existence of mangrove forests at the research site provides many benefits for the coastal and terrestrial environments. This can be assessed from the value of biodiversity obtained. The value of biodiversity is the value of species abundance, their genetic composition, communities, ecosystems and the landscape in which they are located. To calculate the biodiversity value of mangrove forests in the study location, based on Ruitenbeek's theory. The value for biodiversity is USD 15 / hectare.

Table-9: Value of biodiversity

Area of mangrove (ha)	Biodiversity value (USD / ha)	Total value
87	15	1305

Based on Table 9. the area of mangrove forest in the research location is 87 hectares and value of biodiversity of mangrove is USD 1305 / year.

Total Economic value of mangrove Cengkrong

The total economic value of mangrove Cengkrong ware results of data processing on the total economic value of mangrove forests in Cengkrong. Total economic value is a value obtained from the accumulation of use values and nonuse values. Use value is the economic value associated with the utilization of natural resources and the environment, such as consumption and recreation utilization. The value of this utilization is divided become direct use values, indirect use values, and option values.

Based on the calculation of the total use value of mangroves in Cengkrong, the total value of mangrove use is obtained by summing all types of benefits that have been explained.

Table-10: Total use value of mangrove Cengkrong

No	Type of use	Value (USD)	Total (USD)
1	Direct use value		
	-Trees	569,887.51	
	-Ecotourism	6,907.34	
	-Crabs	5,005.29	
	-Fishes	5,289.54	
	-Shrimps	432.56	578,522.23
2	Indirect use value		
	-Coastal traders	12,189.43	
	-Boats service	5,282.09	17,471.52
3	Option value		
	-Biodiversity value	1305	1,305
	Total		606,298.75

*Note exchange rate 1 USD = 14,766.89 IDR

Based on Table 10, the total use value of mangrove Cengkrong is USD 606,298.75/year. The highest value of the total use value is the direct use value which is USD 578,522.23/year. The lowest value is the value of option value which is USD 1,305/year.

CONCLUSIONS

Based on the results of this study then it can be concluded as follows as:

- The condition of mangrove in Cengkrong based on the research result shows the mangrove area has experienced an increase in area from 42.557 ha to 87 ha. In the beginning of 2010 mangrove forest rehabilitation was carried out by the Ministry of

Maritime Affairs and Fisheries and continues to be carried out by the surrounding community to date. Management and education of the surrounding community can maintain the presence of mangroves. Making mangrove tourist areas keeps mangrove forests in a well-maintained condition.

- The value economic mangrove in Cengkrong based on the research result show the total use value of mangrove Cengkrong is IDR 606,298.75/year. The direct use value is 578,522.23 USD/year. The indirect use value is 17,471.52 USD/year. The option value is 1,305USD/year. The highest value of the total use value is the direct use value which is USD 578,522.23 per years. The lowest value is the value of option value which is USD 1,305 per years. The possibility that the value will continue to increase based on the increase in mangrove area that continues to increase every year.

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