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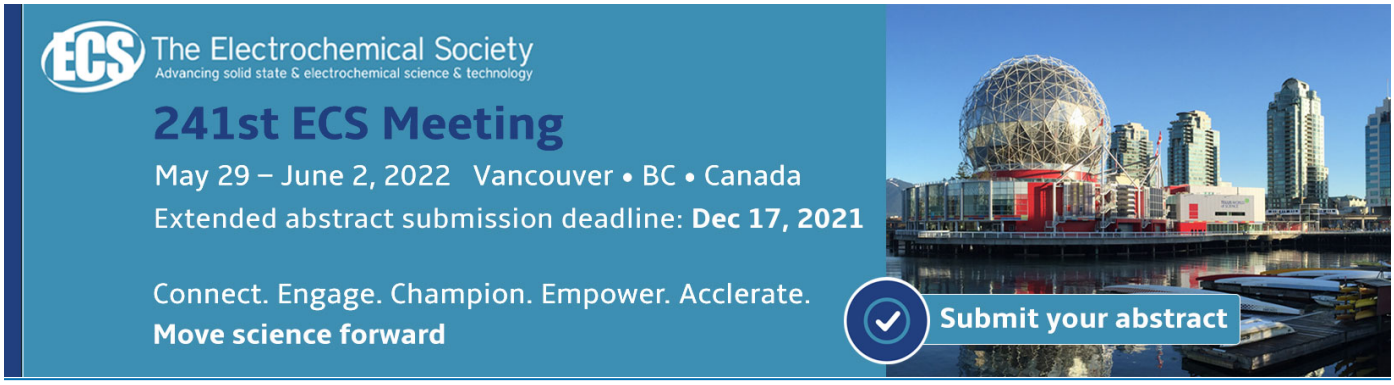

Economic valuation of mangrove ecosystem: empirical studies in Timbulsloko Village, Sayung, Demak, Indonesia

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Abstract. Ecosystem resilience is the capacity of ecosystems to tolerate disorders without collapsing into different circumstances qualitatively controlled by a different set of processes. A robust ecosystem is one that can withstand shocks and rebuild itself when necessary. This study aims to identify the value of use-based economy and non-use value of current economy; calculating the total economic value of mangrove resources; and provide suggestions and recommendations based on observations in Timbulsloko, Sayung, Demak. The method used is economic valuation with total economic value technique. The sampling technique used non-probability and purposive sampling method. The results showed that the direct use value of mangroves was utilized by fisherman, fish pond farmers, *branjang* catchers, oystercatchers, trap makers, shop owner, grilled fish makers and shrimp chip makers. Indirect use value was derived from function as the breakwater, beach belt and hybrid engineering. Existing value was not less than 10 % of the direct use value. The total economic value was Rp. 6,361,430,639/year or about Rp. 202,335,580.1/ha/year. It is need to improve the community awareness to mangrove ecosystem and to the role of breakwater in order to reduce risk disaster and to develop an ecotourism in the area.

1. Introduction

Indonesia is the country with the largest mangrove level in Asia (and in the world), contributing about half the regional level of the mangrove area. Other Asian countries with significant levels of mangroves are (in the order of mangroves) of Malaysia, Myanmar, Bangladesh and India, which, together with Indonesia, account for more than 80 % of the total area of mangrove forests in Asia [1].

The mangrove ecosystem is one of the most threatened on the planet. Mangroves are being destroyed at levels 3–5 times greater than the average rate of forest loss and more than a quarter of the original mangrove cover has disappeared; driven by land conversion for cultivation and agriculture, coastal development, pollution and over-exploitation of mangrove resources. Mangroves are becoming smaller and more fragmented, important ecosystems for goods and services will be reduced or lost.

The consequences of mangrove degradation will then be especially severe for the welfare of coastal communities in developing countries, especially where people rely heavily on mangrove goods and services for daily needs and livelihoods [2].

Approximately 20 % or 3.6 million ha of mangrove areas have been lost since 1980. Approximately 185,000 ha disappeared annually in the 1980s; this number dropped to some 118,500 ha/year in the 1990s and to 102,000 ha/year in the period 2000–2005, reflecting the increased awareness of the value of mangrove ecosystems [1].

Area of mangrove ecosystem in Central Java covering ± 15,184.15 ha (not including Karimunjawa Islands) [3]. The destruction of coastal ecosystems coupled with the existence of buildings that jutted into the sealeads to abrasion. The total area affected by abrasion in Central Java is 6,566.97 ha where the districts of Brebes and Demak become areas affected by abrasion is quite severe. However, arising land or accretion also occurs on the coast of Central Java, which is 12,585.19 ha. Area of the acres land that is the potential in the rehabilitation of ecosystems especially mangrove ecosystem.

At this time, the level of environmental damage that threatens coastal areas is very high. According to a study conducted by [4], mangrove area in Central Java Coastal area of 10,786 ha in which 96.9 % of them are in damaged condition. The mangrove area continues to degrade, so that the mangrove study results in 2014 only get the area of vegetation cover 5,381.15 ha [3].

In the past, Timbulsloko Village; which located on the coast of Sayung District Demak; was an agricultural land and ponds and mangroves along the coast. However, in the 1980s there was a considerable conversion of agricultural land and mangroves due to the opening of ponds. In the 2000s, erosion began to occur on the coast of Timbulsloko Village and by 2013 the village has lost about 400–1300 m of coastal areas. Temporary estimates of the causes of high erosion rates are due to increased tidal intensity, use of wave retaining embankments and loss of mangroves [5].

Timbulsloko is a dynamic area and vulnerable to the threat of environmental degradation. The high rate of mangrove forest decline, the conversion of mangrove ecosystem to farm land and the problem of sedimentation become the main factor changing the ecological and economic function of mangrove ecosystem in Timbulsloko.

This is interesting and requires a research on what makes the reasons people do not want to move and whether there is still an economic side to take from the region. The concept of resilience may be an example of a precise concept that disaster-prone areas will not fall or collapse as they can improve on their own and be helped with community awareness.

The aim of this research are to identify the value of use-based economy and non-use value of existing economy, to calculate the total economic value of mangrove, to provide suggestions and recommendations to the community and local government.

2. Research Methods

The method used in this research is economic valuation with Total Economic Value technique, this method is used to calculate the value of direct and indirect benefit from mangrove ecosystem at research location. Sampling technique using non-probability sampling with sampling technique using purposive sampling method.

The economic valuation method concerns the monetary measurement of a change in one's well-being caused by changes in the quality of the environment [6]. This measurement value is known as Total Economic Value (TEV). Moreover, economic value as measuring the maximum amount a person wants to sacrifice goods and services to acquire other goods and services [7]. The economic value of goods and services is measured by the sum of the will to pay (Willingness to Pay-WTP) of many individuals to the goods or services in question. Economic valuation is about measuring the preferences of the community. The result of the valuation is expressed in the value of money as a way of looking for confidential preferences.

TEV is the sum of the value of use-based economy and non-value-based economic value [8]. UV consists of Direct Use Value, Indirect Use Value and Option Value. Meanwhile, NUV consists of two

components of value that is the bequest value (Bequest Value) and the value of existence (Existence Value).

Several methodological approaches for valuing ecosystems/resources based on the above typology presented by [9]. Most of the approaches are based on a cost-approach on the grounds that the benefits approach is relatively difficult to predict. Some of the best-known methodologies are Effect on Production (EOP) or production analysis and benefit-cost analysis or benefit and cost analysis, where benefits are described by revenue from production. The definition of total economic value can be seen in table 1 [9].

Table 1. Definition total economic value.

No	Type of Value	Definition
1	Direct Use Value	The economic value derived from the direct utilization of a resource/ecosystem.
2	Indirect Use Value	The economic value derived from the indirect use of a resource/ecosystem.
3	Option Value	The economic value derived from the potential of direct or indirect utilization of a resource/ecosystem in the future.
4	Bequest Value	Economic value derived from the benefits of conserving resources/ecosystems for the benefit of future generations.
5	Existence Value	The economic value derived from a perception that the existence of an ecosystem/resource exists, regardless of whether the ecosystem/resource is utilized or not.

3. Results and Discussion

Demak as one of the districts in Central Java lies in the coordinates of 6°43'26"–7°09'43" South Latitude and 110°27'58"–110°48'47" East Longitude. Demak is adjacent to Jepara and the Java Sea in the North, Kudus and Grobogan District in the East, Grobogan and Semarang District in the South, Semarang City in the West. The farthest distance from West to East is 49 km long and from North to South along 41 km. Administratively the area of Demak District is 89,743 ha, consisting of 14 sub-districts, 243 villages and six urban villages.

In this research, Timbulsloko village was chosen as research location with Dusun Wonorejo and Dusun Bogorame as a specific research area. Timbulsloko Village is a village located in Sayung Sub-district, Demak District. Located in the Western part of Demak, adjacent to Semarang City and the Java Sea. The population in Timbulsloko village is 3,469 people, has an area of 4.61 km^2, consists of four sub-village.

Coastal areas in Timbulsloko were formerly agricultural land, ponds and mangroves [5]. However, in 1980, there was a large-scale conversion of agricultural land and mangroves in the pond. This triggered abrasion along the coast of Timbulsloko which began in 2000. In addition to the loss of mangroves, abrasion is caused by the increased intensity of the tidal wave. All sub-villages in Timbulsloko are affected by abrasion. However, Bogorame suffered the most from other areas. Many locals work as tambak farmers, although abrasion has damaged much of the aquaculture in the village. Most are in Karanggeneng and Wonorejo. Fishermen are found to be in areas close to the sea, especially in Wonorejo

The result of the research shows that there are some activities or work that utilize or intersect with mangrove ecosystem that is the fisherman, farmer, *branjang* catcher, shrimp catcher, processed fish

maker, trap maker and also warung. Most of them have main income as fishermen and fish farmers. Work as fishermen and farmers, of course, a bit much tangent to the mangrove ecosystem. For fishermen, mangroves are where small fish take shelter before reaching adult size, while for farmers is a protector of the waves.

Much attention was devoted to four villages in Sayung Sub-district, Demak District, Morodemak, Purworejo, Surodadi and Timbulsloko village. Coastal rehabilitation programs such as mangrove planting, making wave breakers, hybrid engineering or sedimentation tools installed along the coast and making beach belts. Mangrove planting program is mostly done in Timbulsloko village, Sayung Sub-district, Demak District, for example from Marine and Fisheries Department.

Mangrove is destined to be a natural fortress for coastal areas. With expanding mangrove forests, it is expected to strengthen the area of Timbulsloko Village, Sayung Subdistrict, Demak District. Public awareness should also be improved on the importance of mangrove for coastal areas. Not only useful as a natural fortress, but mangroves also have benefits that can be felt directly by the community.

Table 2. Direct use value.

No	Description	People	Income (rupiah)		
			Daily	Month	Year
1	**Direct Use Value**				
	Fisherman	20	150,000	90,000,000	1,080,000,000
	Fish pond farmer	24		8,400,000	403,200,000
	Branjang catchers	10	75,000	22,500,000	270,000,000
	Oyster catchers	10	100,000	30,000,000	360,000,000
	Trap makers	1	75,000	1,500,000	18,000,000
	Shop owner	1	100,000	3,000,000	36,000,000
	Grilled fish makers	1	50,000	1.500,000	18,000,000
	Shrimp chips maker	1	75,000	2,250,000	27,000,000
	Total				2,212,200,000

The direct use value of the mangrove ecosystem in Timbulsloko Village, Sayung District, Demak District with an area of 31.44 ha is Rp. 2,212,200,000/year or Rp. 70,362,595.42/ha/year (table 2). Direct benefits calculated from the fisheries sector, namely fisherman, fish pond farmers, *branjang* catchers, oyster catchers, trap makers, shop owner, grilled fish makers and shrimp chip makers.

The indirect use value of the mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District was obtained from the cost of making breakwater, seawall and hybrid engineering (table 3). Breakwater located in Timbulsloko Village is help from the Department of Marine and Fisheries of Central Java Province. The seawall is a relief from the Environment Agency of Central Java Province. The hybrid engineering tool is the result of cooperation between the government of Indonesia and the Netherlands.

Table 3. Indirect use value and option value.

No	Description	Area	Value (rupiah)
1	**Indirect Use Value**		
	Breakwater	180 m	900,000,000
	Sea Wall	980.8 m	1,286,276,000
	Hybrid Engineering	1.2 Km	1,200,000,000
2	**Option Value**		
	Mangrove forest	31.44 ha	6,263,038.94

To get the benefits of biodiversity than the value of biological diversity mangrove in Timbulsloko Village, Sayung Sub-district, Demak District multiplied by the average value of US $ 1,500/km^2/year or the US $ 15/ha/year [10]. The total area of mangrove forest located in Timbulsloko Village, Sayung Sub-district, Demak District reached 31.44 ha. If multiplied by the biodiversity value of mangrove forest in Indonesia US $ 15/ha/year, then the value of ecosystem choice of mangrove forest reached the US $ 471 or Rp. 6,263,038.94/year.

The value of the existence of mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District was estimated using contingent valuation method technique. This method is used to ask the community how much value or price given for mangrove ecosystem remains maintained. From the calculation results can be seen that the value of existence for people who are around Timbulsloko, has an existing value of Rp. 535,471,600/year with an average value of Willingness to Pay (WTP) of Rp. 471,000/family/year (table 4).

Table 4. Non-use value.

No	Description	Value(rupiah)
1	**Bequest Value**	**535,471,600**
	average value of WTP	471,000
2	**Existence Value**	
	10 % direct use value	221,220,000

Mangrove ecosystem as an existence has a very high value. Accordingly, it is estimated that the existence value is not less than 10 % of the direct use value of ecosystem mangroves [10]. Therefore it is estimated that the existence value of mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District is 10 % × Rp. 2,212,200,000 = Rp. 221,220,000/year. Total economic value (Total Economic Value) is based on the results of the identification of all types of benefits from the mangrove ecosystem in Timbulsloko. The calculation result of Total Economic Value of mangrove ecosystem is Rp. 6,361,430,639/year or about Rp. 202,335,580.1/ha / year.

Suggestions and recommendations that can be given are addressed to the community are utilize the mangroves as the ingredient for edible product, as coastal protection and supporting the recreation sector. Based on observations in the field, the use of mangroves that can be directly used cannot be done continually. Some woman which mostly fisherman's wives said that the mangrove could be processed to be mangroves crackers. Seeing the building of breakwater, sea wall and also *Hybrid Engineering* structure, it can be seen that the effort done by the government to protect Timbulsloko Village area, Sayung Sub-district, Demak District is very good. It would be better if accompanied by a wider public awareness of the importance of these programs so that in the future people in Timbulsloko are more concerned about the environment and also understand about the usefulness of various programs. Community assistance is needed regularly and also learning for children about the importance of loving the coastal areas and also care for mangrove trees. Another thing that might be taken into consideration for the future is recreation. Seeing the intensity of coastal rehabilitation programs as well as research conducted on the impact of the program, it is undeniable that the region is heeded. Coastal areas and mangrove have been like can not be separated in the village area Timbulsloko, District Sayung, Demak District. So, look at it, the need for the utilization of Timbulsloko into Ecotourism area that can be adopted from the Mangrove Tourism Area Mangunharjo Village, Tugu Sub-district, Semarang City.

It can be started first and reinforced by village regulations that are integrated with the local government so that people can better care for the environment and open themselves to the concept of ecotourism. Citizens who want to enter the seaside area and enjoy the beauty of the afternoon above the structure of the breakwater can provide extra money. Then the fisherman who owns the vessel can rent out to just around the mangrove area. It can be started first and reinforced by Village Regulations that are integrated with the local government so that people can better care for the environment and

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4. Conclusion

The mangroves ecosystem provides direct use value which was utilized by the fisherman, fish pond farmers, *branjang* catchers, oyster catchers, trap makers, shop owner, grilled fish makers and shrimp chip makers. Indirect use value was the function of mangroves as the breakwater, beach belt and hybrid engineering. The option value is obtained from mangrove forest area multiplied by the US $ 15/ha. The Bequest value is obtained by using the contingent valuation method technique. Existence value is not less than 10 % of the direct use value. Total Economic Value that exist in the mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District. Rp. 6,361,430,639/year or about Rp. 202,335,580.1/ha/year. Therefore, the suggestions and recommendations for the community in Timbulsloko Village are utilize the mangroves as the ingredient for edible product, as coastal protection and supporting the recreation sector.

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