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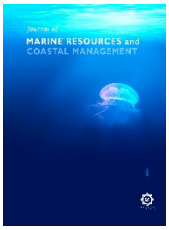

Economic value estimation of Sontoh Laut mangrove ecosystem, Surabaya, Indonesia

Azril Reza Tri Septian Nor*, Iqbal Putra Firmansyah, Fadila Angga Kurniawan, and Dewi Laela Masyitoh
Marine Science Department, Faculty of Science and Technology, UIN Sunan Ampel Surabaya, Indonesia
*E-mail: azrilrezatsn@gmail.com

ABSTRACT

Mangrove ecosystems provide many benefits both indirectly (non-economic value) or directly (economic value) to human life. Mangrove ecosystem has a role as nursery ground, feeding ground, and spawning ground for a number of associated biotas. Mangroves also play the role of pollutant absorbers and abrasion prevention. This study aims to estimate the total economic value (TEV) of Sontoh Laut mangrove ecosystem in Tambak Sarioso Village, Asemrowo District, Surabaya, Indonesia. Using total economic valuation methodology, the economic value of Sontoh Laut mangrove ecosystem is estimated IDR 7,976,672,305. The value of direct use as milkfish ponds, salt ponds, and tourism in the amount of IDR 1,551,435,267. Indirect use value as feeding, nursery, and spawning ground and coastal protection in the amount of IDR 4,921,379,060. Option value (biodiversity), existence value, and bequest value are IDR 2,026,451, IDR 1,346,688,000, and IDR 155,143,526, respectively. The results of the study show that the mangrove resources must be managed based on sustainable basis in line with balanced economic development.

Keywords: mangrove, economy valuation, total economic value

INTRODUCTION

In Indonesia, an area of mangroves reached 8.60 million hectares in 1999. The mangroves were damaged around 5.30 million hectares [1]. Damage that occurs is caused by various types such as by the conversion of mangroves into areas for aquaculture, settlement, and industry. Mangroves have a very strategic function in creating an ecosystem of life organism aquatic and the balance of the ecology of the aquatic environment will be maintained if mangroves presence in coastal waters.

Mangrove is used as one of habitat for community of animal and plant. As a habitat for animals and plants, not all have conditions that are the same, depending on the diversity of species and environmental carrying capacity. Most coastal communities do not yet know about potency of forest mangroves as producers of food reserves to help suffice needs daily food. Ecosystem forest mangroves provide many benefits, both unnecessarily directly (non-economic value) or directly to human life (economics values).

The economic valuation of natural resources and environment is an imposition score monetary to part or whole potency resource natural in accordance with destination utilization. Economic valuation to natural resource have the destination for a human more value its existence and influence benefits natural resource economy. Economic valuation also aims to provide a score economy from natural resources [2]. The purpose of the economic valuation is for advancing the linkages between conservation natural resources and economic development. An economic valuation can be used as a tool to increase the appreciation and awareness communities to the environment [3].

Ecosystem mangroves of Sontoh Laut is an area which offers marine tourism that potentially increase the economy of the communities in Tambak Sarioso, Surabaya, Indonesia. Ecosystem mangroves of Sontoh Laut also has a lot of potential environmental services. This study aims to assessing the value of natural resources and environmental services of the Sontoh Laut mangrove ecosystem.

METHODS

Study Site and Data Collection

This study was conducted at the Sontoh Laut, Tambak Sarioso Village, Asemrowo District, Surabaya, Indonesia. Sontoh Laut is directly adjacent to the Madura Strait. Determination of study locations in accordance with the criteria existence of ecosystem mangroves in the location study (Figure-1). Tambak Sarioso Village has an area of 6.47 km^2 based on Statistics Indonesia. Tambak Sarioso has 20 RT (*Rukun Tetangga*) and 6 RW (*Rukun Warga*) (RT is the division of villages in Indonesia under RW) in total amount 7,014 population.

The data collection was held in June 2022. Data collected in the study are primary and secondary data. The secondary data collected from the government official website, i.e. Statistics Indonesia. Primary data collected based on necessity data for each evaluation through interviews. Population in this study is a group of the communities that work as fisher. In 2021, based on Statistics Indonesia is known that in Tambak Sarioso as much 25 population work as fisher assistant or helper and 85 population as fisher, so the total population is 110

people. Then the determination of total respondents counted using Equation (1).

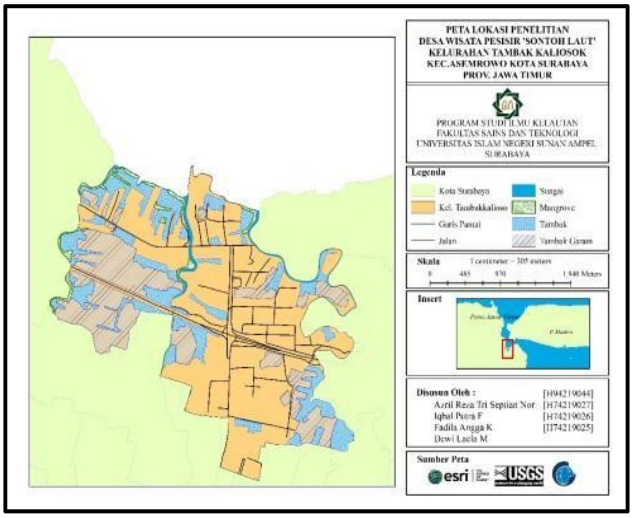

Figure-1. Map of study site

$$n = N/(1 + (N \times e^2)) \quad (1)$$

where n is total of sample, N is total of population, and e is margins error.

Data Analysis

The total economic value consists of two groups, i.e utilization based economic value (use value) and non-utilization based economic value (non-use value). Use value consists of direct use value, indirect use value, and option value. Meanwhile, non-use value consists of bequest value and existence value.

Direct Use Value

Direct use value is a value which benefits resulting from the direct utilization of resources. Direct use value in Sontoh Laut mangrove ecosystems in the form of milkfish and salt production, and tourism. Data collected through interviews and observation is land area, production costs, income, market prices, and harvest amount. The formula for calculating the value of direct benefits of Sontoh Laut mangroves ecosystem shown in Equation (2).

$$DUV = \sum_{i=1}^{3} DUV_i \quad (2)$$

where DUV is direct use value, DUV_1 is value of milkfish pond, DUV_2 is value of salt production, and DUV_3 is value of ecotourism.

Indirect Use Value

Indirect use value is a benefit of resources which not directly felt by the communities. The indirect use value of mangroves forest could form physical benefit, like as retainer seawater abrasion. The assessment of indirect use value of Sontoh Laut mangrove ecosystem estimated with the function of mangrove as detention areas of seawater abrasion, and feeding, spawning, and nursery ground. Benefit transfer approach used in the estimation of this benefit. Indirect use value of Sontoh Laut mangroves ecosystem calculated by Equation (3).

$$IUV = \sum_{i=1}^{2} IUV_i \quad (3)$$

where IUV is indirect use value, IUV_1 is value of feeding ground, nursery ground, and spawning ground and IUV_2 is value of abrasion resistance.

Options Value

Options value is an assessment of potential biodiversity ecosystem mangroves as resilience and sustainability in the future. Option values (OV) were quantified using the benefit transfer approach [4] and shown in Equation (4).

$$OV = \text{US\$ } 15/\text{Ha/Year} \quad (4)$$

Bequest Value

Quantification of ecosystem mangrove's bequest value cannot be calculated with the market value approach and conducted based on [4]. Bequest value (BV) is calculated by multiplying by 10% from the direct use value (DUV) [5]. Bequest value calculation shown in Equation (5).

$$BV = 10\% \times DUV \quad (5)$$

Existence Value

The calculation of value of willingness to pay is conducted with the CVM (Contingent Valuation Method) approach. CVM approach conducted with interview on a number of respondents to ask availability of respondents in paying when the mangrove ecosystem has change and decline. Data collected with interviews and observation are name, occupation, age, last education, and amount of family members. The formula to calculate the existence value is shown in Equation (6).

$$EWTP = \frac{\sum_{i=1}^{n} W_i}{n} \quad (6)$$

where $EWTP$ is average of willingness to pay (WTP), W_i is value of WTP, i is respondent that willing to paid, and n is total of respondents.

RESULTS AND DISCUSSIONS

Characteristics of Respondents

Asemrowo District has 3 sub-district, that is Asemrowo, Genting Kalianak, and Tambak Sarioso. Tambak Sarioso has a population number of 7014 with a male and female population is 3553 and 3461 people, respectively. Based on Statistics Indonesia data, it is known that there are 25 residents working as fisher assistant or helper and 85 residents as fisher in 2021.

A range age of respondents shown in Table-1. This age of respondents is categorized a productive age group which generally has the ability to carry out activities actively, directly, and deftly. Group of age productive is usually capable of doing duty, obligation, and profession optimally [6]. Based on the productivity age group, it appears that each respondent has different knowledge about the preservation of the Sontoh Laut mangrove ecosystem. This is indirectly related to understanding the sustainable use of mangroves, directly or indirectly.

Table-1. Characteristics of respondents by age

No	Range of age (years)	Number of Respondents	Percentage
1	21-26	12	23%
2	27-32	13	25%
3	33-38	9	17%
4	39-44	4	8%
5	45-50	7	13%
6	51-57	7	13%
Total		52	100%

Ecosystem mangroves that have the potential as tourism areas will provide great potential and opportunities for the local community to produce income through the use of mangrove ecosystems [7]. In the Sontoh Laut mangrove ecosystem area, the local community plays a role as traders, tourism administrator, boat driver, odd jobs and the majority as fisher, milkfish cultivator, and salt farmer. As shown in Table-2, 29% of the respondent have job as milkfish cultivator and catcher. The study also show that 38% of the respondents have a range income of around IDR 1,601,000 to IDR 2,200,000 (Table-3). In that class, the respondent has a job as a milkfish cultivator, salt farmer, and trader.

Furthermore, the level of education will influence knowledge and understanding related sustainable environment [6]. As much 6 respondents have been educated bachelor's degree (12%), 36 respondents have taken education in senior high school (69%), 5 respondents take education junior high school (10%), and 4 person respondents have completed primary education (8%), as shown in Table-4. Usually coastal communities will learn and understand directly about mangrove ecosystem based on experience and life daily.

Table-2. Characteristics of respondents based on jobs

No	Jobs	Number of Respondents	Percentage
1	Milkfish cultivator	15	29%
2	Salt farmer	7	13%
3	Manager Tour	8	15%
4	Trader	5	10%
5	Activist Environment	5	10%
6	PKK (Family Welfare Programme)	3	6%
7	Teacher	1	2%
8	Charter boat	3	6%
9	Odd jobs	5	10%
Total		52	100%

Table-3. Characteristics of respondents based on income

No	Range of Income (IDR)	Number of Respondents	Percentage
1	1,000,000 - 1,600,000	18	35%
2	1,601,000 - 2,200,000	20	38%
3	2,201,000 - 2,800,000	2	4%
4	2,801,000 - 3,400,000	6	12%
5	3,401,000 - 4,000,000	6	12%
Total		52	100%

Table-4. Characteristics of respondents based on education

No	Education	Number of Respondents	Percentage
1	Primary Education	4	8%
2	Junior High School	5	10%
3	Senior High School	36	69%
4	Bachelor's degree	6	12%
Total		52	52

Direct Use Value of Sontoh Laut Mangrove Ecosystem

Ecosystem mangroves generally have roles as biofilters, pollution traps, binding agents, and environmental bioremediation [8]. Sontoh Laut mangroves located in the milkfish pond environment can act as biofilters for water pollution (Figure-2). Salinity in the pond milkfish will affect the continuity of life and behavior of milkfish. Pond cultivation milkfish is one form of mangrove utilization as a commodity that tends easy conducted with affordable production costs as well as harvest [9].

Figure-2. Milkfish pond in Sontoh Laut

Pond milkfish production costs are intended for the purchase of milkfish seeds, fertilizer, feed and probiotics, maintenance costs, fuel, taxes, and harvesting labor. In one year, milkfish ponds experience three times of harvests. With a total pond area of 19.3 hectares, the production cost for pond milkfish in Sontoh Laut is IDR 299,111,400 (Table-5). The price of milkfish in the Surabaya market is IDR 30,000/Kg so the sales of milkfish for a year in Sontoh Laut with a large milkfish pond of 19.3 hectares is IDR 1,737,000,000. The total benefit of using milkfish as a pond is calculated by the annual sales of milkfish minus production costs per year so the total profit as a milkfish pond is IDR 1,437,888,600.

Mangrove is a plant that can survive in an environment that has a high level of salinity or is still affected by sea water [10]. Salt production in ponds is also another benefit used by the community around the Sontoh Laut Mangrove Ecosystem (Figure-3). The area of the salt ponds in Tambak Sarioso Village is 14.54 Ha. Salt production in coastal areas is carried out with sea distilled water to crystallize it into fine salt [11]. Based on the results of observations and interviews, the salt harvest in Tambakalioso is carried out in a year with a production cost of IDR 3,000,000 per production. So that with an area of 14.54 salt ponds, the production cost of salt ponds in

Tambak Sarioso District in one harvest area is IDR 43,620,000 and produces 8,333 kg/Ha.

For salt resources that have a market price, the valuation is measured by its productivity multiplied by the market price. The market price of salt is IDR 1000/Kg. So in one harvest each year the sale of salt covering an area of 14.54 Ha of pond salt is IDR 121,166,666.67. The total profit of salt ponds is calculated from the sale of salt minus production costs each year. The total benefits of the salt ponds in Sarioso Pond amount to IDR 77,546,666.6 as shown in Table-6.

Table-5. Utilization of milkfish pond

Formula	Information	Total
A	Pond area (Ha)	19.3
B	Harvest (Kg/Ha)	1000
C	Yields (Kg/Ha/Year)	3000
D	Price of milkfish/Kg (IDR)	30,000
E = A×C×D	Results of milkfish sales (IDR)	1,737,000,000
F	Cost production/year (IDR)	299,111,400
G = E - F	Total benefit of pond milkfish (IDR)	1,437,888,600

Table-6. Utilization of salt production

Formula	Information	Total
A	Pond area (Ha)	14.54
B	Harvest (Kg/Ha)	8333.33
C	Yields (Kg/Ha/Year)	8333.33
D	Price of salt/Kg (IDR)	1000
E = A×C×D	Results of salts sales (IDR)	121,166,666.67
F	Cost production/year (IDR)	43,620,000.00
G = E -F	Total benefit of salt production (IDR)	77,546,666.67

Figure-3. Salt production in Sontoh Laut

Another direct use value of Sontoh Laut mangrove ecosystem is a tourism object. Sontoh Laut Marine Tourism offers various facilities, destinations and tourist attractions. Sontoh Laut ecotourism includes the Bird Park of Sontoh Laut (BSPL) (Figure-4a), Kampung Pelangi Sontoh Laut (KAPSOL) (Figure-4b), mangrove walking tracks, gazebos, etc. Sontoh Laut ecotourism has an average number of visitors a week of 150 visitors and accumulated over a year, the number of visits to Sontoh Laut has reached 7,800 people.

The price of the entrance ticket offered is also relatively affordable at IDR 5,000. The total maintenance cost for Sontoh Laut tourism reaches IDR 3,000,000 with the availability of clean water destinations and the repair of several damaged facilities. The value of the benefits of the Sontoh Laut mangrove ecosystem as a tourist area is shown in Table 7, which is IDR 36,000,000.

The utilization of the direct use value of the mangrove ecosystem felt by the Sontoh Laut community is in the form of utilization as milkfish production, salt production, and utilization as a tourist area. The percentage of benefits from milkfish production is the highest with a percentage of 93% of the total direct utilization. While the utilization of pond salt shows a percentage of 5%, and the use of Sontoh Laut as a tourist area shows a percentage of 2%. So that the total direct use value of the Sontoh Laut mangrove ecosystem is IDR 1,551,435,267 (IDR 1.55 billion).

This shows that the Tambak Sarioso community has utilized the mangrove ecosystem optimally. In addition to carrying out sustainable utilization, coastal communities must maintain, monitor and preserve mangrove ecosystems [3]. The presence of the Tourism Awareness Group (Kelompok Sadar Wisata/POKDARWIS) is expected to be able to provide insight to the surrounding community in the sustainable use of ecosystems and at the same time maintain their sustainability.

Indirect Use Value of Sontoh Laut Mangrove Ecosystem

Mangrove ecosystems provide environmental services as a feeding ground, nursery ground, and spawning ground for a number of associated biota. Environmental services are indirectly felt by coastal communities in particular, because environmental services are related to the abundance of catch biota. When the mangrove ecosystem is sustainable, then fish, crabs, tiger prawns, and various other related biota will also be abundant [12]. These things indirectly also provide benefits for fisher and coastal communities.

Estimation of the value of the Sontoh Laut mangrove as a nursery ground, feeding ground, and spawning ground was carried out using the benefit transfer approach [13]. Transfer of benefits is the quantification of the environmental services of an ecosystem based on the results of studies of other locations [14]. The value of mangroves as a nursery ground, feeding ground, and spawning ground is US$ 439/Ha/Year [13]. The transfer benefit value is then converted according to the dollar exchange rate for rupiah as of June 2022. In accordance with Bank Indonesia regulations, the dollar exchange rate for rupiah as of June 2022 is IDR 14,198. After conversion, calculations are performed by multiplying the area of the mangrove ecosystem in Sontoh Laut. Total benefit as nursery ground, feeding ground, and spawning ground of Sontoh Laut mangrove ecosystem is IDR 59,307,471.06 as presented in Table-8.

Table-7. Utilization of ecotourism

Formula	Information	Total
A	Total of visitor/week	150
B	Total of visitor/year	7800
C	Price of admission (IDR)	5,000
D = B×C	Total income (IDR)	39,000,000
E	Maintenance fee/year (IDR)	3,000,000
F = D - E	Use value as ecotourism area (IDR)	36,000,000

Table-8. The value of Sontoh Laut mangrove as nursery, feeding, and spawning area

Information	Value
Value as nursery ground, feeding ground, spawn ground [13]	US$439/ha/year
Mangroves area (Ha)	9.11
Value US$ 1 at 2022	IDR 14,829.5
Equation for value of nursery ground, feeding ground, spawn ground	US$439/ha/year × mangrove area
Total benefit as nursery ground, feeding ground,spawn ground	IDR 59,307,471.06

(a)

(b)

Figure-4. Sontoh Laut Ecotourism's Facilities: (a) Bird Park of Sontoh Laut (BSPL) and (b) Kampung Pelangi Sontoh Laut (KAPSOL)

The mangrove ecosystem has a role as a shoreline protection as well as a shoreline stabilizer. Mangroves are able to protect beaches and prevent abrasion through the physical properties of their roots. The existence of mangrove vegetation will prevent erosion and protect coastal areas from waves, floods, and even tsunamis [15]. Quantification of the benefits of the Sontoh Laut mangrove ecosystem as a coastal protection is calculated using the replacement cost approach from the construction of a sea wall that functions as a breakwater.

The cost of building a sea wall as a breakwater was approached in accordance with the policy of the Minister of Public Works and Public Housing Number 28 of 2016 concerning the value of building a sea wall with a size of 50 meters × 1.5 meters × 2.5 meters with 5 years durability valued at IDR 273,010,000. Based on this approach, the cost per meter of sea wall and yearly needs of IDR 1,092,000 was obtained in 2016. The value in 2016 was converted using the future value approach according to Bank Indonesia's June 2022 interest rate (5.5%). Then the cost of construction of a sea wall as a beach protector with a coastline of 3,229 meters requires a cost of IDR 4,862,071,589.29 as presented in Table-9.

Utilization of the Sontoh Laut mangrove ecosystem in the form of indirect use value is in the form of utilizing the mangrove ecosystem as a nursery ground, feeding ground, spawning ground, and utilization as a beach protector. Indirect utilization with the highest percentage is as a beach protector with a percentage of 98.79% of the total indirect utilization, while utilization as a nursery ground, feeding ground, and spawning ground shows a percentage of 1.21%. The total indirect utilization value of the Sontoh Laut mangrove ecosystem is IDR 4,921,379,060 (4.92 billion rupiah).

Table-9. Indirect use value as protection area

Information	Total
Value of sea wall (/50 m/5 year) as a substitute for mangrove vegetation (according to Permen PUPR No. 28 of 2016)	273,010,000.00
Value of sea wall (/m/ year) as a substitute for mangrove vegetation	1,092,040.00
Value of sea wall (/m/ year) at 2022 as a substitute for mangrove vegetation	1,505,751.50
Shoreline length (m)	3,229
Indirect use value/year (IDR)	4,862,071,589.29
Indirect use value/ha/year (IDR)	486,207.16

Option Value of Sontoh Laut Mangrove Ecosystem

The option value is an assessment of the biodiversity potential of the mangrove ecosystem as resilience and sustainability in the future. Option values are quantified using the benefit transfer method [12]. The estimation of the option value is done by multiplying the mangrove area by the value of biodiversity of US$ 15/Ha/Year [4]. The conversion of the dollar value to the rupiah is adjusted to the exchange rate in June 2022. The estimated value of the option value of Sontoh Laut mangrove ecosystem is presented in Table-10. With a mangrove area of 9.11 hectares, the total option value

(biodiversity) of the Sontoh Laut mangroves is IDR 2,026,451.

Table-10. Option Value

Information	Value
Biodiversity value of mangroves [4]	US$15/Ha/year
Mangroves area	9.11 Ha
Value US$1 at 2022	IDR 14,829.50
Equation of total benefit of biodiversity	US$15/Ha/year × mangroves area
Total benefit of biodiversity	IDR 2,026,451.18

Bequest Value of Sontoh Laut Mangrove Ecosystem

Quantification of ecosystem mangrove's bequest value cannot be calculated with the market value approach and conducted based on [4]. Bequest value is calculated by multiplying by 10% from the direct use value [5]. The Sontoh Laut mangroves ecosystem has a total bequest value of IDR155,143,526.

Existence Value of Sontoh Laut Mangrove Ecosystem

Existence value is the maximum quantification of a person providing goods and services to fulfill, pay for, and achieve a goal. This existence value is hereinafter known as Willingness to pay (WTP) or someone's willingness to pay to support the preservation of mangrove ecosystems [16]. WTP in mangrove ecosystems is carried out to provide an appreciation value for the existence of a mangrove ecosystem in coastal areas. The average WTP of respondent for the Sontoh Laut mangrove ecosystem is IDR 16,000 per month. With a population of 7,014 people in the Tambak Sarioso Village, the total WTP in Sontoh Laut is IDR 1,346,688,000 (IDR 1.34 billion) with an average respondent's WTP per year of IDR 192,000 as presented in Table-11.

Table-11. Existence Value

No	WTP (IDR)	Total Respondents
1	10,000	39
2	15,000	3
3	25,000	3
4	30,000	1
5	35,000	1
6	50,000	5
Total of respondents		52
Total of WTP (IDR)		825,000
Average of WTP/respondent/ month (IDR)		16,000
Average of WTP/respondent/year (IDR)		192,000
Total population of Tambak Sarioso (BPS, 2021)		7,014
Total of WTP/year (IDR)		1,346,688,000

In accordance with the characteristics of the respondents, there are several factors that can influence them related to the WTP value. Based on multiple linear regression analysis, it can be seen that the variable X1 (income), X2 (education), and X3 (number of family members) on the variable Y (willingness to pay) is 0.8334. The value of 0.8 – 1 means that it has a very strong relationship level according to the regression interval correlation coefficient in the study [17]. Based on these values, it can be seen that the variables X1 (income), X2 (education), and X3 (number of family members) have a very strong influence on the variable Y (willingness to pay). It was also obtained that the R Square value among the variables was 0.6946 which means that the total of income, level of education, and number of family members contributed to the willingness of respondents to pay for the preservation of the Sontoh Laut mangroves by 69.4%.

Furthermore, the correlation value between the income variable and the willingness to pay is 0.01485 which indicates that the correlation is very weak and can be ignored. While the relationship between the education variable and the willingness to pay is 0.37183 which shows a moderate correlation. For the relationship between the number of family members variable and the willingness to pay is -0.4734 which shows the meaning of the two opposite variables. When variable X3 increases, variable Y decreases and or the reverse.

Total Economic Value of Sontoh Laut Mangrove Ecosystems

The quantification of the total economic value (TEV) of the Sontoh Laut mangrove ecosystem is grouped into several uses i.e. direct use value, indirect use value, option value, bequest value, and existence value. The direct use value assessed were the utilization for milkfish production and salt production, while indirect use value are assessed as utilization as a nursery ground, feeding ground, spawning ground, and utilization as a beach protector. The other benefits that are measured are the option value, the bequest value, and the existence value.

A total direct use value of IDR 1,551,435,267 was obtained with a percentage of 19.45% of TEV. The total of indirect use value is IDR 4,921,379,060 with a percentage of 61.70% of TEV. The total option value is IDR 2,026,451 with a percentage of 0.03% of TEV. The total of the existence value is IDR 1,346,688,000 with a percentage of 16.88% of TEV. Furthermore, the total bequest value is IDR 162,892,526.67 with a percentage of 1.94%. So the total economic value of the Sontoh Laut mangrove ecosystem is IDR 7,976,672,305 as presented in Table-12.

Based on TEV, it can be seen that the indirect use value provides the highest proportion of 61.65% of the TEV. This value is higher than the direct use value which is only 19.45% of TEV. This is because the local communities of Tambak Sarioso Village have not used the Sontoh Laut mangrove area optimally, in addition to the Sontoh Laut Marine Tourism which has only recently resumed operations after having been in a vacuum during the Covid-19 pandemic.

Table-12. Total economic value of Sontoh Laut mangrove ecosystem

No	Parameters	IDR/year	Percentage
1	Direct use value	1,551,435,267.00	19.45%
2	Indirect use value	4,921,379,060.35	61.70%
3	Option value	2,026,451.18	0.03%
4	Existence Value	1,346,688,000.00	16.88%
5	Bequest Value	155,143,526.67	1.94%
	TEV	7,976,672,305.20	100.00%

CONCLUSIONS

The direct use value in the Sontoh Laut mangrove ecosystem consists of utilization as milkfish ponds, salt ponds, and utilization as a tourism area with a total value of IDR 1,551,435,267, while the indirect use value consists of mangrove as a nursery ground, feeding ground, and spawning ground, and also mangrove as a beach protector with a total value of IDR 4,921,379,060. The option value of the Sontoh Laut mangrove ecosystem is IDR 2,026,451. Bequest value is calculated as 10% of the direct use value obtained in the amount of IDR 155,143,526, while the existence value is based on willingness to pay with a value of IDR 1,346,688,000. Based on multiple linear regression analysis, respondents' willingness to pay is strongly influenced by income, education, and number of family members with a regression value of 0.8334. So the total economic value of the Sontoh Laut mangrove ecosystem is IDR 7,976,672,305.

REFERENCES

[1] Mulyadi, E., Hendriyanto, O., & Fitriani, N. 2010. Konservasi hutan mangrove sebagai ekowisata. *Jurnal Ilmiah Teknik Lingkungan*. 2(1): 11-18.

[2] Parmawati, R. 2019. *Valuasi Ekonomi Sumberdaya Alam dan Lingkungan Menuju Ekonomi Hijau*. Universitas Brawijaya Press.

[3] Trianingsih, N. & Noor, A. 2021. Valuasi ekonomi limbah pada penjual es kelapa di Kecamatan Samarinda Ulu. *Kinerja*. 18(1): 101-112. https://doi.org/10.30872/jkin.v18i1.9253

[4] Ruitenbeek, H. J. 1991. *Mangrove management: An economic analysis of management options with a focus on Bintuni Bay, Irian Jaya*. School for Resource and Environmental Studies, Dalhousie University.

[5] Dafani, F. F. & Muhsoni, F. F. 2021. Valuasi Ekonomi Sumberdaya Hutan Mangrove Desa Taddan Kecamatan Camplong Kabupaten Sampang. *Juvenil: Jurnal Ilmiah Kelautan dan Perikanan*. 2(4): 293-306. https://doi.org/10.21107/juvenil.v2i4.12504

[6] Amelia, S., Nurmayasari, I., & Viantimala, B. 2020. Faktor-Faktor yang Berhubungan dengan Partisipasi Masyarakat dalam Program Lampung Mangrove Center (LMC) di Desa Margasari Kecamatan Labuhan Maringgai Kabupaten Lampung Timur. *Jurnal Ilmu-Ilmu Agribisnis: Journal of Agribusiness Science*. 8(2): 218-225. http://dx.doi.org/10.23960/jiia.v8i2.4056

[7] Sari, F. A. B. 2016. Karakteristik Kawasan Wisata Kampung Laut Bontang Kuala Berbasis Ekowisata. Jurnal Teknik ITS. 5(2): C112-C117. http://dx.doi.org/10.12962/j23373539.v5i2.17950

[8] Kariada, N. T. & Irsadi, A. 2014. Role of mangrove as water pollution biofilter in milkfish pond, Tapak, Semarang. *Jurnal Manusia dan Lingkungan*. 21(2): 188-194. https://doi.org/10.22146/jml.18543

[9] Hendrajat, E. A., Ratnawati, E., & Mustafa, A. 2018. Penentuan pengaruh kualitas tanah dan air terhadap produksi total tambak polikultur udang vaname dan ikan bandeng di Kabupaten Lamongan, Provinsi Jawa Timur melalui aplikasi analisis jalur. *Jurnal Ilmu dan Teknologi Kelautan Tropis*. 10(1): 179-195. https://doi.org/10.29244/jitkt.v10i1.21675

[10] Syah, A. F. 2020. Penanaman Mangrove sebagai Upaya Pencegahan Abrasi di Desa Socah. *Jurnal Ilmiah Pangabdhi*. 6(1): 13-16. https://doi.org/10.21107/pangabdhi.v6i1.6909

[11] Suriawanto, N., Fadhli, W. M., Syahril, M., & Gabrela, N. N. 2022. Pemberdayaan Usaha Garam Rakyat dalam Meningkatkan Kualitas Garam Menggunakan Teknik Geomembran LDPE di Kelurahan Talise Kota Palu. *Abdikan: Jurnal Pengabdian Masyarakat Bidang Sains dan Teknologi*. 1(1): 57-63. https://doi.org/10.55123/abdikan.v1i1.102

[12] Maulida, G., Supriharyono, S., & Suryanti, S. 2019. Economic Valuation of Mangrove Ecosystem Utilization in Kandang Panjang Village, Pekalongan City, Central Java Province. *Management of Aquatic Resources Journal (Maquares)*. 8(3): 133-138. https://doi.org/10.14710/marj.v8i3.24247

[13] Kusumastanto, Tridoyo. 2002. *Ekonomi Sumberdaya dan Lingkungan*. Program Studi Pascasarjana Pengelolaan Pesisir dan Laut. Institut Pertanian Bogor.

[14] Apriyanti, A. D., Saputra, S. W., & A'in, C. 2021. Valuasi Ekonomi Ekosistem Mangrove di Dusun Bedono dan Dusun Morosari, Kabupaten Demak, Jawa Tengah. *Maspari Journal: Marine Science Research.* 13(1): 51-64. https://doi.org/10.56064/maspari.v13i1.12040

[15] Amiruddin, U. & Duwila, M. D. 2022. Analisis Ekonomi Potensi Kawasan Hutan Mangrove di Desa Kipai Kecamatan Patani. *Jurnal Ilmu Pendidikan, Sains, dan Humaniora*. 1(2): 52-62.

[16] Hamuna, B., Rumahorbo, B. T., & Keiluhu, H. 2018. People's Perception for the Existence of Seagrass Ecosystem in Youtefa Bay, Jayapura (Willingness to Pay Approach). *EnviroScienteae*. 14(2): 86-93.

[17] Sungkawa, I. 2013. Penerapan analisis regresi dan korelasi dalam menentukan arah hubungan antara dua faktor kualitatif pada tabel kontingensi. *Jurnal Mat Stat.* 13(1): 33-41.