JURNAL PERIKANAN DAN KELAUTAN
Volume 29 No. 2, June 2024: 266-274

e-issn : 2721-8902
p-issn : 0853-7607

Economic Valuation of Mangrove Ecosystem in Rempang Island, Batam City, Kepulauan Riau Province

Valuasi Ekonomi Ekosistem Mangrove di Pulau Rempang, Kota Batam, Provinsi Kepulauan Riau

Ladies Nikita Alamanda[1], Khodijah Ismail[1*], Wahyudin[1], Ani Suryanti[1], Sayyidah Nur Habibah[1]
[1]Department of Environmental Science, Postgraduate,
Universitas Maritim Raja Ali Haji, Tanjungpinang 29124 Indonesia
**email: khodijah@umrah.ac.id*

Received
05 April 2024

Accepted
25 May 2024

Abstract

This study aimed to determine and analyze the economic value of the mangrove ecosystem in Rempang Island, Batam City, Kepulauan Riau Province. The survey method used a quantitative approach to analyze the economic valuation with the calculation of Total Economic Value (TEV), which consists of the calculation of use value: direct use value, indirect use value, option value, and non-use value: existence value and bequest value. There were 44 respondents determined by the Slovin method. The results showed that the total economic valuation of mangrove ecosystems on Rempang Island with an area of 2,813.18 ha which is IDR 75,082,590,695/ year, consisting of a total use value which is IDR 74,739,030,695/year and total non-use value which is IDR 343,560,000/year. The use value is obtained from direct use value which is IDR 2,059,200,000/year from fish, shrimp, and crab utilization activities, indirect use value which is IDR 72,004,878,483/year from breakwaters and abrasion, preventing seawater intrusion, nursery ground, feeding ground, spawning ground, and an optional value which is IDR 674,952,212/year from the value of biodiversity. Then, the total non-use value is obtained from the willingness to pay IDR 137,640,000/year and bequest value IDR 205,920,000/year. These findings indicate that the current ecological condition of the Rempang Island mangrove ecosystem has provided excellent economic value, so efforts are needed to maintain this condition with sustainable management.

Keywords: Economic Valuation, Mangrove, Sustainable Management

Abstrak

Tujuan dari penelitian ini adalah untuk mengetahui dan menganalisis nilai ekonomi dari ekosistem mangrove di Pulau Rempang, Kota Batam, Provinsi Kepulauan Riau. Metode yang digunakan adalah metode survei dengan pendekatan kuantitatif untuk menganalisis valuasi ekonomi dengan perhitungan Nilai Ekonomi Total (NET) yang terdiri dari perhitungan nilai guna : nilai guna langsung, nilai guna tidak langsung, nilai pilihan dan nilai non guna : nilai keberadaan dan nilai warisan. Terdapat 44 responden yang ditentukan dengan metode Slovin. Hasil penelitian menunjukkan bahwa nilai ekonomi total ekosistem mangrove di Pulau Rempang dengan luas 2,813.18 ha adalah sebesar Rp. 75.082.590.695/tahun yang terdiri dari total nilai guna sebesar Rp. 74.739.030.695/tahun dan total nilai non guna sebesar Rp 343.560.000. Nilai guna diperoleh dari nilai guna langsung sebesar Rp 2.059.200.000/tahun dari aktifitas pemanfaatan ikan, udang dan kepiting, nilai

guna tidak langsung sebesar Rp. 72.004.878.483/tahun dari pemecah gelombang dan abrasi, pencegah intrusi air laut dan *nursery ground, feeding ground, spawning ground* serta nilai pilihan sebesar Rp 674.952.212/tahun dari nilai biodiversitas. Kemudian, total nilai non guna diperoleh dari nilai keberadaan *willingnes to pay* sebesar Rp 137.640.000/tahun dan nilai warisan sebesar Rp 205.920.000/tahun. Temuan ini menunjukkan kondisi ekologis ekosistem mangrove Pulau Rempang saat ini telah memberikan nilai ekonomi yang sangat baik, sehingga perlu upaya untuk mempertahankan kondisi tersebut dengan pengelolaan yang berkelanjutan.

Kata kunci: Valuasi Ekonomi, Mangrove, Pengelolaan Berkelanjutan

1. Introduction

The mangrove ecosystem is one ecosystem in coastal areas with ecological, social, and economic functions (Sambu et al., 2018). The environmental functions of mangrove ecosystems include protecting beaches, preventing seawater intrusion, preventing abrasion, and biodiversity centers. Socially, it consists of a field school, research, marine tourism, and conservation locations. According to (Karminarsih, 2007), mangrove ecosystems can preserve social relations with local communities while improving socio-economic conditions. This is because the mangrove ecosystem is a sustainable source of livelihood as a place to find fish, shrimp, and mangrove crabs. In addition, economically, the mangrove ecosystem at large will be a source of income and can protect the value of the maritime economy.

The magnitude of the various functions in mangrove ecosystems can have consequences for the mangrove ecosystem itself. The high rate of illegal logging to exploit resources in mangrove ecosystems can reduce mangrove ecosystems. An example is the reduction in mangrove areas yearly, such as what happened on Rempang Island. Rempang Island, with an area of approximately 165.83 km^2 (16,583 ha), is the second central island in the Batam City Government area, Kepulauan Riau Province. Most of the people of Rempang Island live in the coastal area and work as fishermen. Therefore, they are very dependent on the existence of the mangrove ecosystem. The people of Rempang Island utilize the mangrove ecosystem for fish, crabs, shrimp, etc. According to sustainability, the sustainability of fishermen's household livelihoods is very dependent on nature, as is the case with the Rempang community (Khodijah, 2014). This is also reinforced by the research by Febriannaningsih & Khakhim (2015), which found that mangroves in Batam Island, Rempang, Galang, and surrounding areas experienced changes that tend to decline. From 1990 to 2015, there has been a decrease in mangrove area of 40.23 km^2 (33.17%) and changes in mangrove density. The dominant cause of mangrove change is the human factor.

Based on data from the Environmental Agency of Batam City (DLH, 2023), the causes of mangrove ecosystem degradation in Batam Island, Rempang, and Galang are the impact of shipping industry development and reclamation activities along the coast, illegal logging, mangrove utilization activities for charcoal making, mangrove ecosystem damage due to oil spills, and illegal sand mining activities. Damage to mangrove ecosystems will affect the economic life of coastal communities on Rempang Island, such as decreased fish catches and reduced fishermen's income. Sustainable management of mangrove ecosystems is needed, one of which is to carry out mangrove ecosystem management based on the economy of natural resources and the environment, namely economic valuation.

Economic valuation is an effort to measure the value of goods and services produced by natural resources and the environment based on market and non-market values. The contributions that the ecosystem's services and functions offer to human well-being represent the economic value of resources and ecosystems (Freeman, 2003).

The purpose of economic valuation is to provide economic value to the resources used by the actual value from society's point of view. There are several types of value of goods and services produced by natural resources, but in general, they can be divided into two, namely, use value and non-use value. Use value includes direct use value, indirect use value, and option value. Meanwhile, non-use value is divided into existence use value and bequest value.

2. Material and Method

2.1. Time and Place

This research was conducted from January 2024 - March 2024, and the research location was in Rempang Island, Batam City, Kepulauan Riau Province. Based on image data from 2021, the area of mangrove ecosystems on Rempang Island is 2,813.18 ha. The research area can be seen in Figure 1.

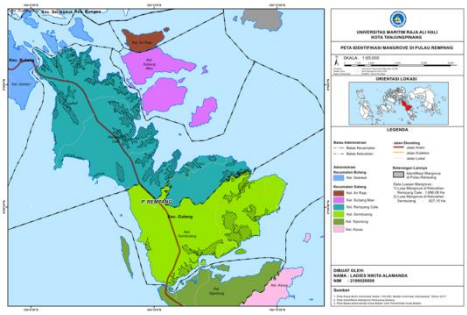

Figure 1. The map of the research location

2.2. Methods

This research analyzed the economic value of the mangrove ecosystem on Rempang Island. This research uses quantitative survey methods to assess this ecosystem's potential value comprehensively. Total economic assessment covers various aspects, including use value and non-use value. Use value is further divided into direct use value, indirect use value, and option value, while non-use value includes existence value and inheritance value.

2.3. Procedures

The determination of respondents in this study uses the Slovin method, where the determination of respondents is intentionally based on specific considerations. The consideration in question is respondents who utilize the mangrove ecosystem on Rempang Island. The number of respondents interviewed as a whole was determined based on the formula from the Slovin method:

$$n = \frac{N}{1+(N.e^2)}$$

Description:

n = number of samples
N = Total population
e^2 = Error tolerance limit (15%)

Based on the formula from the Slovin method, with a population (N) on Rempang Island of 2,294 families, the n value of 43,60 was obtained, rounded up to 44 respondents. This study's primary and secondary data are primary and secondary. Primary data is obtained from direct interviews and the results of filling out questionnaires to respondents. In contrast, secondary data is obtained through literature studies such as information from related agencies, journals, research results, and other sources that strongly support primary data.

2.4. Data Analysis

equation of direct use, indirect use, option, existence, and bequest values is then applied to the collected data for analysis. The technique put out by (Ruitenbeek, 1992) is the economic valuation method that is applied:

2.4.1. Direct Use Value (DUV)

Direct use value is obtained from the value generated from the direct utilization of mangrove ecosystems on Rempang Island, from fish, shrimp, and crabs, calculated using the equation:

$$DUV = DUV\ 1 + DUV\ 2 + DUV\ 3$$

Description:

DUV = Direct use value
DUV 1 = Fishing benefit
DUV 2 = Benefits of shrimp fishing
DUV 3 = Crab fishing benefit

Each of these benefits can be calculated by multiplying the amount of annual catch with the selling price using the equation:

$$\text{Value of Fish, Shrimp, Crab} = (T \times H)-B$$

Description:

T = Fish catch (kg/ha/year);
H = Selling price (IDR/kg);
B = Operating cost (IDR)

2.4.2. Indirect Use Value (IUV)

Indirect use value results from the indirect utilization of mangrove ecosystems, namely breakwaters, and abrasion, preventing seawater intrusion, and as a nursery ground, feeding ground, and spawning ground. Calculation of indirect use value using the replacement cost approach.

$$IUV = IUV\ 1 + IUV\ 2 + IUV\ 3$$

Description:

IUV	= Indirect use value
IUV 1	= Benefits of breakwaters and abrasion
IUV 2	= Benefits of preventing seawater intrusion
IUV 3	= Benefits of nursery ground, feeding ground, spawning ground

2.4.3. Breakwaters and abrasion

The value of breakwaters is calculated using the replacement cost approach, namely the costs incurred for constructing breakwater embankments to replace the mangrove ecosystem function sourced from Standard Unit Price (SSH) within the Kepulauan Riau Provincial Government (2023).

$$IUV\ 1 = Bpo \times Pgp$$

Description:

IUV 1	= Breakwaters and abrasion
Bpo	= Production cost
Pgp	= length of coastline

2.4.4. Preventing Seawater Intrusion

Mangrove value data as a barrier to seawater intrusion is calculated through a cost approach or community expenditure to fulfill clean water for household needs. The price spent on the fulfillment of clean water and how much the price of 1 gallon of water, if purchased later, is calculated based on the number of households associated with the indirect benefits of mangroves.

$$IUV\ 2 = JKK \times JKbtA \times HA \times HR$$

Description:

IUV 2	= Preventing seawater intrusion
JKK	= number of family heads
JkbtA	= Total water demand (gallon/day)
HA	= price of water (IDR/gallon)
HR	= number of days in 1 year

2.4.5. Nursery Ground, Feeding Ground, Spawning Ground

The value of the benefits of mangrove ecosystem nursery ground, feeding ground, and spawning ground by area is US $ 146.62/ha/year, so the following formula is obtained:

$$IUV\ 3 = L \times US\$\ 146.62$$

Description:

IUV3	= Nursery ground, feeding ground, spawning ground
L	= Mangrove area (ha)
IDR exchange rate US $15	= IDR 2,345,187 (May 22, 2024)

2.4.6. Option Value (OV)

The option value was calculated regarding the biodiversity value of mangrove forests in Indonesia, which is US$1,500/km/year or US$15/ha/year (Ruitenbeek, 1994). The value was calculated based on the average exchange rate of US$ against Rupiah at the time of the study with the following equation:

$$OV = US\$\ 15\ ha/year \times L$$

Description:

OV	= Option Value
L	= Mangrove area (ha)
Rupiah exchange rate US$ 15	= IDR 240,600 (May 22, 2024)

2.4.7. Existence Value (EV)

Existence Value is the benefit the community perceives from the existence of mangrove ecosystems. Data was collected using the Contingent Valuation Method (CVM) technique, where respondents were asked whether they would be willing to pay for mangrove ecosystem goods and services. The equation is as follows:

$$EV = \sum_{i=}^{n} 1\ (EVi) / n$$

Description:

EV	= Benefits of existence
EVi	= The benefits of the existence of the i-th respondent

N = Total respondents

2.4.8. Bequest Value (BV)

Bequest value is the economic value obtained from mangrove ecosystem benefits that can be used for future generations. The calculation of the bequest value of mangrove ecosystems uses an estimated bequest value of not less than 10% of the direct benefit value of mangrove ecosystems.

$$BV = DUV \times 10\%$$

Description:
BV = Bequest value
DUV = Direct use value

2.4.9. Total Economic Value (TEV)

Total Economic Value is obtained from the sum of direct use value (DUV), indirect use value (IUV), option value (OV), existence value (EV), and bequest value (BV), calculated using the equation:

$$TEV = DUV+IUV+OV+EV+BV$$

Description:
TEV = Total economic value
DUV = Direct use value
IUV = Indirect use value
OV = Option value
EV = Existence value
BV = Bequest value

The data obtained were then analyzed using the quantitative descriptive analysis method. The results obtained will be entered into a table.

3. Result and Discussion

3.1. Direct Use Value

Direct use value is directly felt by the Rempang Island community around the mangrove ecosystem. Based on the study's results, the people of Rempang Island often utilize mangrove ecosystems to look for fish, shrimp, and crabs. The results of direct use value can be seen in Table 1.

Table 1. Direct use value

No	Direct use value	Production/ year (kg)	IDR/year	%
1	Fish	34.320	686.400.000	33
2	Shrimp	13.728	343.200.000	17
3	Crab	20.592	1.029.600.000	50
	Total		2.059.200.000	100,00

The fish's economic value amounted to IDR 686,400,000 from the data processing results. This value is obtained from catching several different types of fish at different prices. Fish that are often seen by the community are mullet fish with a selling price of IDR 35,000/kg, lebam with a selling price of IDR 40,000/kg, reef fish with a selling price of IDR 25,000/kg, sembilang with a selling price of IDR 25,000 / kg, and selar with a selling price of IDR 25,000/kg. Fishing in one week as many as three trips with an average catch of 5 kg of fish/respondent/trip with operational costs of IDR 50,000/respondent/trip. Thus, the value of fish is (5kg x IDR 30,000) - IDR 50,000 = IDR 100,000/respondent/trip. The shrimp collection season for one year (52 weeks) is 156 trips with a value of IDR 15,600,000/year for each respondent.

In addition to fish, the second benefit is the utilization of shrimp. From the data processing results, the economic value of shrimp is IDR 343,200,000. This value is obtained from the selling price of 1 kg of shrimp on Rempang Island of IDR 50,000. Taking shrimp in 1 week, as many as three trips with an average catch of 2 kg/respondent/trip and operational costs of IDR 50,000/respondent/trip. So the value of shrimp is (2 kg x IDR 50,000) - IDR 50,000 = IDR 50,000/respondent/trip. The shrimp collection season for one year (52 weeks) is 156 trips with a value of IDR 7,800,000/year for each respondent.

The third benefit is crabs. From the data processing results, the economic value of crabs is IDR 1,029,600,000. The selling price of 1 kg of crabs on Rempang Island is IDR 100,000. Crab collection in 1 week was three trips with an average catch of 2 kg/respondent/trip with operational costs of IDR 50,000/ respondent/trip. Thus, the crab's value is (2 kg x IDR 100,000) - IDR 50,000 = IDR 150,000/respondent/ trip. The crab collection season for one year (52 weeks) is 156 trips with a value of IDR 23,400,000/year for each respondent.

From the three direct benefits, the total direct use value of the mangrove ecosystem on Rempang Island was IDR 2,402,400,000/year. Of the three values, the economic value of crab utilization has the highest percentage

of 50% compared to other types of direct utilization. Meanwhile, fish obtained a rate of 33%, and shrimp obtained 17%. This shows that the potential of mangrove ecosystems is rich in valuable natural resources and can be utilized to increase community income.

3.2. Indirect Use Value

The indirect use value is used as a breakwater and abrasion, preventing seawater intrusion, nursery ground, feeding ground, and spawning ground. The value of the mangrove ecosystem as a breakwater and abrasion is calculated through a sea dike construction cost approach based on the Standard Unit Price (SSH) within the Riau Islands Provincial Government (Keputusan Gubernur Kepri, 2023). The cost of 1m of sea dike construction with an estimated strength or durability of 10 years costs IDR 1,736,000/m. The length of the coastline on Rempang Island is 106,671 m, as obtained from satellite image data in 2021. From the calculation results, the indirect use value of the mangrove ecosystem as breakwater and abrasion is IDR 185,180,856,000/10 years or IDR 18,518,085,600/ year.

The value of mangrove ecosystems as a deterrent to seawater intrusion is calculated through the cost or expenditure approach of the Rempang Island community to meet clean water needs. The number of households on Rempang Island based on profile data from Kelurahan Rempang Cate (2023) and Kelurahan Sembulang (2023) amounted to 2,294 families. Each family needs an average of 8 gallons of freshwater/day or 152 L/day with a gallon price of IDR 7,000 or IDR 368/L. The calculation results showed that the Rempang Island community's costs for clean water needs amounted to IDR 46,889,360,000/year or IDR 20,440,000/family.

The value of mangrove ecosystems as a nursery, feeding, and spawning ground is obtained by multiplying the mangrove area on Rempang Island, which is 2,813.18 ha, with the value of mangroves as a nursery ground, feeding ground, and spawning ground US $ 146.62 per ha or IDR 2,345,187 (May 22, 2024). So, a value IDR 6,597,432,883/year or IDR 2,345,187/ha/year was obtained; the indirect use value can be seen in Table 2.

Table 2. Indirect use value

No	Indirect use value	IDR/year	%
1	Breakwaters and abrasion	18.518.085.600	26
2	Preventing seawater intrusion	46.889.360.000	65
3	Nursery ground, feeding ground, spawning ground	6.597.432.883	9
	Total	73.557.110.000	100

3.3. Option Value

Options value in the mangrove ecosystem on Rempang Island uses a benefit transfer approach. According to (Fahrudin, 1996), Indonesian mangrove forests have a biodiversity value of US$1,500 per km^2 or US$15/ha/ year. This value can be applied to all mangrove forests throughout Indonesia if the mangrove forest ecosystem is ecologically important and naturally maintained. The total value of this biodiversity benefit is obtained by multiplying the value of the benefit of US$15/ha/ year by the rupiah exchange rate against the US dollar of IDR 15,995 (on May 22, 2024), resulting in a value of IDR 239,925. This result is multiplied by the total area of the mangrove ecosystem on Rempang Island, which is 2,813.18 ha. Thus, the value of biodiversity benefits in the mangrove ecosystem on Rempang Island is IDR 674,952,212/year or IDR 239,925/ha/year.

Table 3. Option value

US$1 (IDR May 22, 2024)	US$15/ha (IDR May 22, 2024)	Mangrove Area (ha)	Biodiversity value (IDR)
15.995	239.925	2.813,18	674.952.212

3.4. Existence Value

Existence value is obtained from the willingness of the respondent community to pay (Willingness to Pay) for the care and management of mangrove ecosystems. In this study, the availability to pay is divided into three bidding values: IDR 5,000, IDR 10,000, and IDR 15,000. The results of the existence value can be seen in Table 4.

Table 4. Existence value

No	WTP (IDR)	Frequency	WTP Value (IDR/Month)
1	5.000	32	160.000
2	10.000	9	90.000
3	15.000	3	45.000
	Total	44	295.000
Median WTP Value / Month (IDR)			5.000
Median WTP Value / Year (IDR)			60.000
Total Population in Rempang Island (KK)			2.294
Total WTP Value / Year (IDR)			137.640.000
Mangrove Area on Rempang Island (ha)			2.813,18
Total WTP Value/Ha/year (IDR)			48.927

From the calculation, the total monthly WTP value from 44 respondents was IDR 295,000, and the median or middle value of the monthly WTP value is IDR 5,000, then accumulated per year so that the amount of mangrove conservation program that the community could subsidize for one year was Rp. 60,000. This value is then multiplied by the number of families on Rempang Island, which is 2,294, so the total WTP value per year can be obtained in IDR137,640,000 or equivalent to IDR48,927/ha/ year. According to (Kurniawati & Pangaribowo, 2017), one of the influential factors in calculating WTP (Willingness To Pay) is the lack of knowledge of the wise use of mangrove ecosystems. This resulted in respondents' indifference to the value of mangrove ecosystems, which could affect the calculation of different WTP values.

3.5. Bequest Value

According to Ruitenbeek (1992), the bequest value of mangrove ecosystems is obtained by calculating an approximate approach to market value. The formula for calculating the bequest value is approximately 10% obtained from the direct benefit value of the mangrove ecosystem. Based on the analysis of the above calculations, it can be seen that the value of direct benefits amounted to IDR 2,059,200,000/year. In determining the value of bequest, the result of 10% of the value of direct benefits is the bequest value of the mangrove ecosystem. The bequest value of the mangrove ecosystem amounted to IDR 205,920,000/year or equivalent to IDR 73,198/ha/year.

3.6. Total Economic Value

The total economic value of the mangrove ecosystem on Rempang Island is the sum of use and non-use values. Use value consists of direct use, indirect use, and option values, while non-use values consist of existence and bequest values. The economic total value of the mangrove ecosystem on Rempang Island is IDR 75,082,590,695 (75 billion Rupiah). This value is summarized in Table 5.

Table 5. Total Economic Value

No	Value	IDR/ year	%
1	Direct use value	2.059.200.000	2,74
	a. Fish	686.400.000	
	b. Shrimp	343.200.000	
	c. Crabs	1.029.600.000	
2	Indirect use value	72.004.878.483	95,90
	a. Breakwaters and abrasion	18.518.085.600	
	b. Preventing seawater intrusion	46.889.360.000	
	c. Nursery ground, feeding ground, spawning ground	6.597.432.883	
3	Option value	674.952.212	0,90
	Use Value	74.739.030.695	
4	Existence value	137.640.000	0,18
5	Bequest value	205.920.000	0,27
	Non-Use Value	343.560.000	
	Total Economic Value	75.082.590.695	100

Based on Table 5, the total economic value produced by mangrove ecosystems in Rempang Island is IDR 75.082.590.695, consisting of direct use value, which is 2.059.200.000 (2,74%), indirect use value, which is IDR 72.004.878.483 (95,90%), the option value which is IDR 674.952.212 (0,90%), existence value which is IDR 137.640.000 (0,18%) and bequest value which is IDR 205.920.000 (0,27%). The largest contribution came from indirect use value, with an of 95.90%, while the smallest contribution came from the value of the existence of mangrove ecosystems, which amounted to 0.18%. The overall rate of the total economic value of the mangrove ecosystem shows that the value of each mangrove ecosystem benefit has a very important role in the environment.

These results show the value of the contribution of mangrove ecosystems in maintaining the stability of the coastal environment that the community and the flora and fauna around it can feel. After knowing the total economic value of mangrove ecosystem benefits through economic valuation studies, the Batam City government can consider determining the right management strategy for mangrove ecosystems on Rempang Island. Based on the results of the total economic value of the benefits, it is also expected to reduce the conversion of mangrove ecosystems into residential or industrial land, considering that mangrove ecosystems have an important contribution to human life, biota, and the surrounding environment, both now and in the future. If mangrove conditions continue to degrade, the government and local communities are ready to lose mangrove ecosystem services. According to Haga & Siburian (2016), the destruction of mangrove areas will have a negative impact on life in coastal areas. The destruction of mangrove ecosystems results in the loss of fish, shrimp, and other economic biota, thus reducing community income from utilization activities. It is known that mangroves are a place to live and a source of food for several types of animals that have high economic

value that fishermen can catch. Thus, these natural assets have a very important role in maintaining the continuity of human life (Ismail & Habibah, 2023)

Different results were obtained based on comparing the total economic value of mangrove ecosystems from several studies. According to Khairunnisa et al. (2022), the total economic value of the mangrove ecosystem in Kawal Village, Bintan District, Kepulauan Riau Province is IDR 762,567,136/year, which consists of an option value of IDR 345,502,950 year (45%) and a existence value of IDR 417,064,186/year (55%). Then, according to Purnamasari et al. (2022), the total economic value of the mangrove ecosystem in the district of Tanjung Tedung Central Bangka Regency is 14.565.990.100/year, which consists of a direct use value of IDR 5.987.588.750,-/year, indirect use value IDR 3.780.569.250/year, option value IDR 376.532.100/year, and exsistence value IDR 4.421.300.000/year. If we compare with the results of these two studies, the total economic value of the mangrove ecosystem on Rempang Island is quite high. The differences in each similar study include changes in the exchange rate of the IDR against the dollar (US$), the area of mangrove ecosystems, price differences, and the diversity of utilization carried out in mangrove ecosystems. According to Setiyowati et al. (2016), the value of benefits obtained in economic valuation studies may change in the future due to changes in the type of utilization, especially the value of direct benefits whose calculation is based on the extractive use of biological resources that take place at the research site to date. According to Ariftia et al. (2014), if the contribution of indirect value is high, proving that mangrove forests have very high intangible benefits (value of services and the environment), the importance of estimating the economic value of mangrove forests into rupiah value so that people know how much the ecological value of mangrove forests has been ignored because it is considered to have no market value.

4. Conclusions

The total economic valuation of mangrove ecosystems on Rempang Island is IDR 75,082,590,695 per year. The results of the economic valuation analysis that has been carried out illustrate that the value of ecological and socio-economic benefits of mangrove ecosystems on Rempang Island is quite significant for the community.

5. References

[DLH] Dinas Lingkungan Hidup Kota Batam. (2023). *Kerusakan lingkungan di Kota Batam*. Batam.

Ariftia, R.I., Qurniati, R., Herwanti, S. (2014). Nilai ekonomi total hutan mangrove Desa Margasari Kecamatan Labuhan Maringgai Kabupaten Lampung Timur. *Jurnal Sylva Lestari*, *2*(3): 19–28.

Fahrudin, A. (1996). *Analisis ekonomi pengelolaan lahan pesisir Kabupaten Subang, Jawa Barat*. IPB University. Bogor.

Febriannaningsih, B.A., Khakhim, N. (2015). Aplikasi citra Landsat TM (Thematic Mapper) dan Oli (Operational Land Imager) untuk pemetaan perubahan tutupan dan kerapatan mangrove tahun 1990-2015 di Pulau Batam dan sekitarnya. *Jurnal Bumi Indonesia*, 4(4): 1–10.

Freeman, A.M. (2003). *Economic valuation: What and why BT - A primer on non-market valuation* (P. A. Champ, K. J. Boyle, & T. C. Brown, Eds.). Dordrecht: Springer Netherlands

Haga, J., Siburian, R. (2016). *Konservasi mangrove dan kesejahteraan masyarakat*. Yayasan Pustaka Obor Indonesia. Jakarta

Ismail, K., Habibah, S.N. (2023). The low level of sustainability of fishing households livelihood assets around marine conservation areas. *Bio Web Conferences,06003*.

Karminarsih, E. (2007). The use of ecosystem mangrove in minimalize disaster impact in beach area. *Jurnal Manajemen Hutan Tropika*, 13(3): 182–187.

Kelurahan Rempang Cate. (2023). *Profil Kelurahan Rempang Cate*.

Kelurahan Sembulang. (2023). *Profil Kelurahan Sembulang*.

Keputusan Gubernur Kepri. (2023). *Standar satuan harga Provinsi Kepri tahun anggaran 2024*. Pub. L. No. 1103 tahun 2023, 1151. Republik Indonesia: Pemerintah Provinsi Kepulauan Riau.

Khairunnisa, K., Abdillah, Y., Wahyudin, W. (2022). Value of the mangrove ecosystem in Kawal Village, Bintan Regency. *Journal of Akuatik Lestari*, 5(2): 97–101.

Khodijah, K. (2014). Sustainable livelihoods of fishermen households headed by women (Case study in Riau Islands Province of Indonesia). *Asian Social Science*, 10(9).

Kurniawati, N.D., Pangaribowo, E.H. (2017). Valuasi ekonomi ekosistem mangrove di Desa Karangsong, Indramayu. *Jurnal Bumi Indonesia*, 6(2).

Purnamasari, F., Adi, W., Febrianto, A. (2022). Identification of the economic value of the mangrove forest ecosystem in the District of Tanjung Tedung Central Bangka Regency. *Journal of Tropical Marine Science, 5*(2): 111–120.

Ruitenbeek, H.J. (1992). *Mangrove management: An Economic analysis of management options with a focus on Bintuni Bay, Irian Jaya*. Canada.

Ruitenbeek, H.J. (1994). Modelling economy-ecology linkages in mangroves: Economic evidence for promoting conservation in Bintuni Bay, Indonesia. *Ecological Economics*, 10(3): 233–247.

Sambu, A H., Sribianti, I., Chadijah, A. (2018). *Model pengelolaan mangrove berbasis ekologi dan ekonomi*. Inti Mediatama. Makassar.

Setiyowati, D., Supriharyono, S., Triarso, I. (2016). Economic valuation of mangrove resources in the Mangunharjo Village Tugu Sub District, Semarang City. *Saintek Perikanan*, 12(1): 67–74