

## **Rehabilitasi Ekosistem Mangrove Melalui Proyek Berbasis Masyarakat dan Arus Nilai Ekonomi: Studi Kasus Proyek Rehabilitasi di Desa Lubuk Kertang, Kabupaten Langkat, Sumatera Utara**

### **Rehabilitation of Mangrove Ecosystem Through Community-Based Project and the Current Economic Value: A Case Study of Rehabilitation Project in Lubuk Kertang Village, Langkat Regency, North Sumatera**

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#### **Abstrak**

Ekosistem mangrove berperan sangat penting bagi kepentingan lingkungan dan manusia, namun keberadaannya terus terancam. Penelitian ini bertujuan untuk mengetahui potensi, pemanfaatan dan pengelolaan ekowisata mangrove berbasis masyarakat serta menganalisis total nilai ekonomi (*total economic value*) dari masing-masing macam pemanfaatan sumberdaya hutan mangrove Desa Lubuk Kertang. Penelitian menggunakan sensus terhadap seluruh responden diantaranya yaitu nelayan, pembuat atap dari daun nipah, wisatawan serta pengelola ekowisata mangrove Lubuk Kertang. Studi ini menunjukkan bahwa keberhasilan masyarakat dalam penanaman kembali hutan mangrove pada ekosistem mangrove disebabkan oleh berbagai faktor, termasuk tingginya kemauan masyarakat untuk berpartisipasi dalam proyek rehabilitasi, batas-batas fisik yang jelas dan penegakan aturan, sistem pemantauan yang efektif dan mekanisme resolusi konflik yang lebih baik. Hasil penelitian menunjukkan bahwa nilai total ekonomi di kawasan mangrove tersebut adalah sebesar Rp 1.057.343.654/tahun, yang terdiri dari nilai manfaat langsung sebesar Rp 601.077.437/tahun, nilai manfaat tidak langsung adalah sebesar Rp 395.786.267/tahun, nilai manfaat pilihan sebesar Rp 22.279.950/tahun dan nilai keberadaan sebesar Rp 38.200.000. Pengelolaan mangrove berbasis masyarakat telah menjaga potensi nilai manfaat sehingga tidak mengancam perubahan tata guna lahan hutan mangrove.

**Kata kunci: Ekosistem mangrove; Lubuk Kertang; valuasi ekonomi**

#### **Abstract**

Mangrove ecosystem plays an important role for socio-economic and environmental services. However, the rapid expansion of agricultural and industrial plantation activities challenged the sustainability of such ecosystem in Lubuk Kertang Village. This research aims to describe the potential of community-based to rehabilitate the degraded mangrove ecosystem and the economic benefit of such project for Lubuk Kertang villagers. The research was conducted using census methods for all respondents, including fishermen, handicraft makers, tourists, and the manager of the eco-tourism activity. The study showed that the successful of community on replanting the mangrove on mangrove ecosystem led by various factors, including the high willingness of community to participate on rehabilitation project, clear physical boundaries and rule enforcement, effective monitoring system and better conflict resolution mechanism. The total economic value in the mangrove area is Rp 1.057.343.654/year, comprising of Rp 601.077.437/year direct use value, Rp 395.786.267/year indirect value, Rp 22.279.950/year option use value, and Rp 38.200.000 existence value. The society-based mangrove management has preserved the benefit potential value of not to endanger the change of mangrove ecosystem.

**Keywords: Mangrove ecosystem; Lubuk Kertang; economic valuation**

#### **Introduction**

Mangrove ecosystem plays an important role for environment and human beings. The ecosystem provides variety of services contributing in human welfare, including the provision of woods and charcoals, control of flood, storm, salt intrusion prevention, the habitat of marine biotas, and cultural services such as recreation (Brander *et al.*, 2012). However, the sustainability of mangrove ecosystem

is challenging because of the anthropogenic activities such as heavy exploitation of the resources and the changing of land use. Mangrove ecosystem in Indonesia experienced a significant declining during 1980-2005, in which 78,500 hectares of the ecosystem was reported lost. The main cause were due to rural population, particularly in Asia have traditionally utilized mangrove as a source of wood and non-wood

forest production. In addition, Indonesia is also well known as one of the countries that exploit mangrove for export commodities such as for charcoal (FAO, 2007). The rapid destruction of mangrove ecosystem were also caused by rapid expansion of aquaculture industry (Baderan, 2017), provoked by the society in fulfilling their own necessities (Kumi *et al.*, 2016), sedimentation (Pramudji, 2000), and tobacco woods logging to cook bloaters or herrings (Feka *et al.*, 2011). In the meantime, the observation in Lubuk Kertang village indicated that the loss of mangrove ecosystem was due to the massive development of palm oil plantation and the growing of paddy field. Such problem has been named in many ways such the tragedy of the commons (Hardin, 1968), the commons dilemma (Edney & Harper 1978), or the problem of collective action (Ostrom, 2009).

To improve the mangrove ecosystem condition, there needs a cooperation among the resource users. Berkes *et al.* (1989) and Ostrom (1990) stated the possibility of community-based resources arrangement to deal with the tragedy of the commons, including in the mangrove ecosystem arrangement. Therefore, one of the efforts to manage the ecosystem is to apply community based management (Pamudji, 2000). Community-based conservation (CBC) is the most important tool and has been widely used recently in natural resource management, especially in the protected area, restoring ecosystem and reducing poverty in rural areas (Abdullah, 2014). Mangrove rehabilitation in this case is a strategy to

rehabilitate mangrove damages caused by humans (Griffin, 2013). This study will depict the successful case of community-based mangrove rehabilitation project in Lubuk Kertang Village, the factors lead to such success and valuating the economic benefit of current rehabilitated mangrove ecosystem. The economic valuation in this case is an effort to provide a quantitative value of goods and services produced by natural resources and the environment.

**Methods**

The research was conducted in Lubuk Kertang village, Hamlet V during March 2017. It is basically a descriptive research, which applied combination of observation, census, and interviews with those who received benefits from the mangrove. At the early stage, data collection was conducted through identification on mangrove utilization, followed by interviews with respondents who utilized the mangrove ecosystem. Interviews to the managers were also conducted to collect data and information on various norms and rules in the management of mangrove resources such as operational and collective rules, the facts that occur, the level of understanding and observance of the norms and rules that exist. Total of respondents for this research were 26 people, consisting of fishermen, mangrove handicraft makers, local leader and eco-tourism manager, and tourists. The research site is depicted on Fig. 1. Data analysis was conducted using the combination of descriptive qualitative methods, as well as quantitative methods

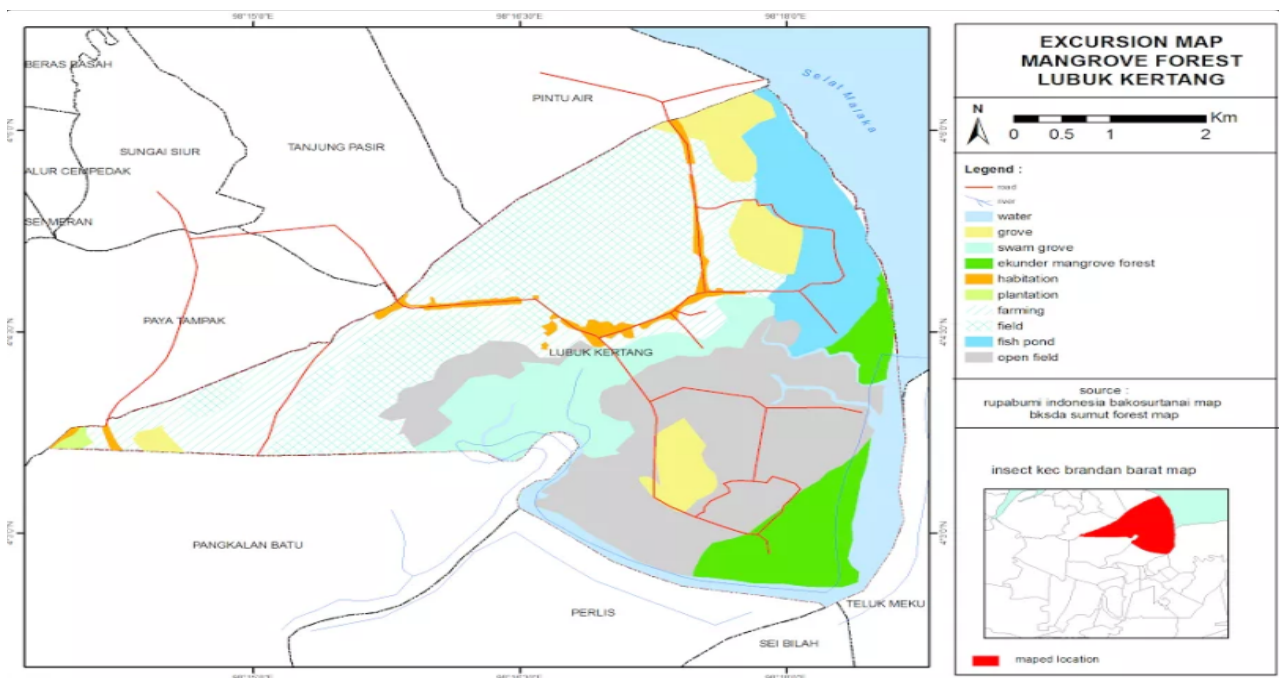


Figure 1. Mangrove Forest Lubuk Kertang Map.

to find out the economic value of mangrove resources. Economic valuation was measured through total economic value from the economic value in the resources use value and non-use value. The use value includes direct use value, indirect use value, and option value. The non-use value consists of existing value (Barbier, 1994).

## Results And Discussion

### *The Current State and Management of Lubuk Kertang Mangrove*

Lubuk Kertang village has good potentials, it has various of mangrove and fauna species. One of which is the beautiful view in the coastal areas. The research site was located in hamlet V Kelapa Enam, which is famous with its mangrove management as well as its mangrove ecotourism (Fig. 1). The mangrove forest comprising of *Rhizophora* sp., *Avicennia* sp., *Sonneratia* sp., and *Nypa* sp. *Rhizophora* is the most dominant mangrove species, covers almost 70% of mangrove in the village. The fauna living in the mangrove area include birds, lizards, monkeys, mangrove snakes, and various fish species. Nevertheless, the mangrove ecosystem has changed significantly in the last few decades due to the anthropogenic activities, particularly the expansion of agriculture related activities. The mangrove area has shifted significantly to palm oil plantation and it was clearly occurred since year 2000, and is still expanding (Fig. 2). It is a challenge the sustainability of the ecosystem. Therefore, the villager's effort to rehabilitate the ecosystem through community-based mangrove rehabilitation project has been significant to ensure the existence of the ecosystem as their main livelihood resources. Total mangrove area in the village was 1200 ha, in which 61,6% depleted and only 19,5% of total area in good condition. The ground check that was conducted by the NGO called Yagasu and villager team found that it was only 660.97 ha mangrove left and since 2012 until today there was about 300 ha mangrove was successfully rehabilitated. In this case study, the total rehabilitated mangrove area reached 105 ha and this mangrove ecosystem becoming an important ecotourism site in Lubuk Kertang.

The Lubuk Kertang case indicated the potential of community to resolve their environmental problems. This group was called *Mekar*, the group was established on January 2016 with the support from non-governmental organization (NGO), which is called Yagasu. This NGO started to work in mangrove rehabilitation program two years (2014) before the group formally established. As they work together and having good progress in rehabilitation project, the local community started to discussed for the

establishment of community organization to organize themselves. Such organization is important for the local community, not only for the conservation project, but also to advocate themselves from the rapid growing of palm oil plantation. The people that lived outside of the village mainly invested the plantation. In same time, the high concern of the community, particularly the fishers who earn a living every day in the mangrove area, supports *Mekar* Group develop. From such social awareness, the mangrove rehabilitation project was initiated, with helpful programs of planting by related institutions including in the initiation of supporting economic activities such as making tooth pick from local resources (bamboo).

There are various study indicated the important role of local institutions to conserve forest ecosystem, but the debate about the type of institutions and coherence arrangement occurred (Suharti, 2016). One of the key factors for the success of community in the study site was the willingness of community to participate to protect and rehabilitate the left mangrove ecosystem. Davenport *et al.* (2000) stated that participation maximize the benefit and minimize the uncertainty in resources arrangement. To further understand the key factor for the success of such community-based arrangement, the criteria that were purposed by Ostrom (2009) were used, as further explained below:

#### Clear boundaries of mangrove area

The success in managing mangrove rehabilitation is supported by a number of conditions; the mangrove ecotourism area is not quite large, so there needs clear managerial area borders to eliminate conflicts between local people and outsiders. In the mean time, some studies indicated that community cooperation increases as user groups gain assurance of rights in resource management and have exclusion right (the authority to ban outsiders entering their governance areas) (Ostrom, 1990). The border of the manageable mangrove area was clearly defined through face-to-face discussions, involving the *Mekar* group and external entities. The local authority (government) also releases permission for community to manage the area, through partnership letter from the government office. This boundary clarity ultimately eliminates conflicts between local communities and outsiders.

#### Effective monitoring

Effective monitoring is absolutely necessary in the community-based management. Lubuk Kertang villagers who manage *Mekar* Mangrove ecotourism lives and works in the area around the mangrove forest either as fishermen, collectors of aquatic biota, and other related activities. This condition facilitate them to effectively monitor the rehabilitated mangrove. In addition, *Mekar* group also make a routine tasks

for daily monitoring activities. Willingness to conduct joint monitoring and high community dependence on the mangrove resources for their livelihood raises a

strong sense of ownership of the mangrove resources.

Rules making, practices and sanctions

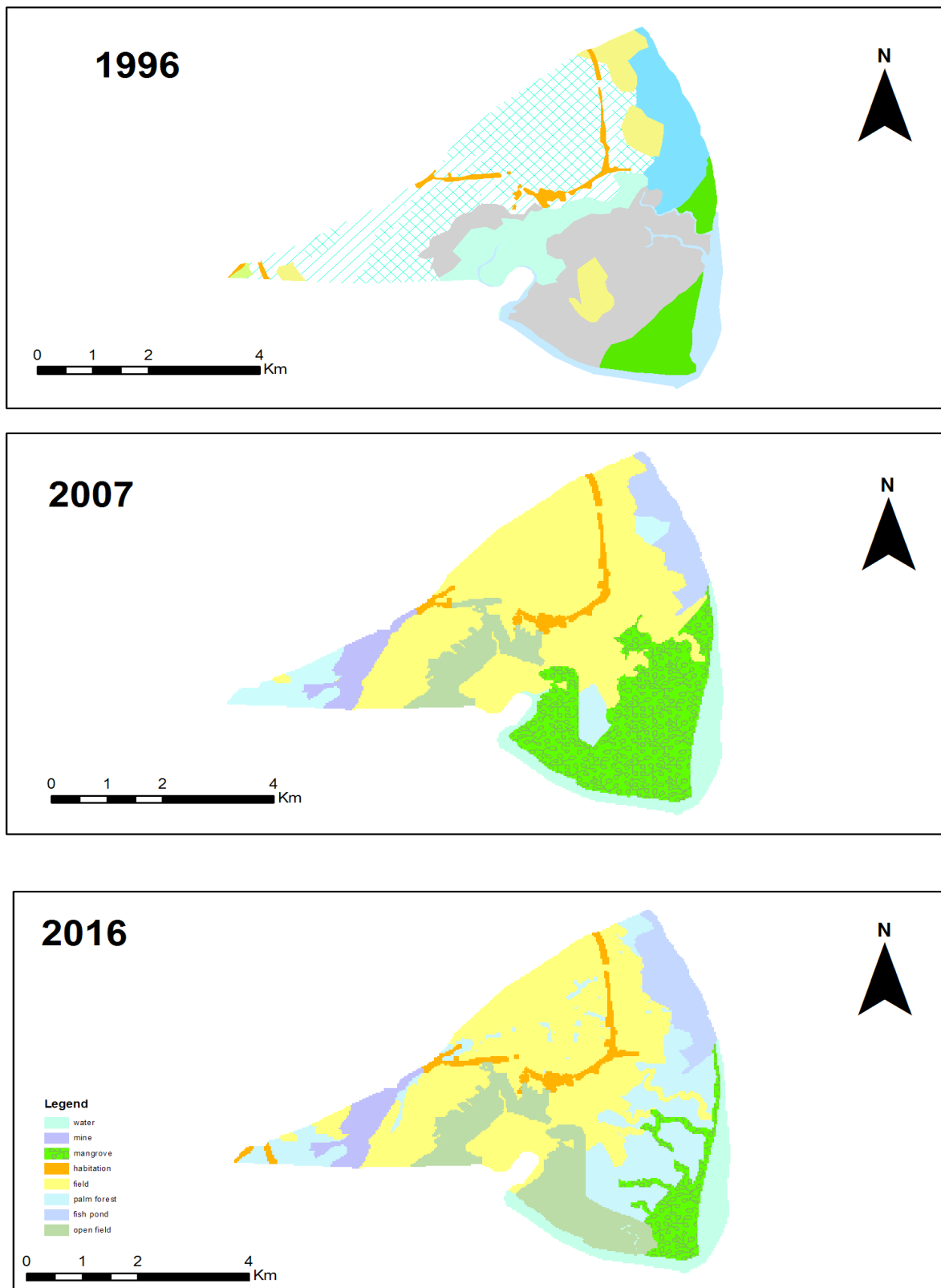


Figure 2. Map of utilization area.

The rules in the utilization and management of mangrove resources are formulated by the *Mekar* group and based on deliberative process in making decision. Such rules may be also changed based on the consensus among group members of *Mekar* Group. In the *Mekar* mangrove management, there are rules constituted by the manager. Rules in use are the rules directly affecting daily decisions, which are based on the deals made between the group members. In addition, the principle developed by the local institution in Lubuk Kertang is the stipulation of strict sanctions against every violation in the utilization and management of mangrove resources. According to Ostrom (1990), the determination of sanctions is necessary because each member of the group has been given an understanding to be obliged to obey the rules set together and any breach done repeatedly will reap sanctions. The violation examples include logging and diversion of mangrove areas that may damage the ecosystem inside, catching fish and crabs with explosives or toxins, and dumping waste in mangrove areas. In such cases, there were leveling of sanctions. The first sanction level is in the form of an apology by the offender, the second level of sanction in the form of a fine of Rp 100,000 per case, and the third level of sanction, that may occur due the offender committed a continuous violation of more than three times, it will be subject to sanctions in the form processed to the law.

#### Conflict resolution mechanism

Conflicts in the utilization and management of natural resources will still occur in the field, although the rules have been formulated clearly and in detail. This may be due to the lack of transparency on the resources management or other factors. The *Mekar* group prioritizes deliberation process to achieve consensus that strengthen togetherness, cohesiveness and openness of group member. Suadi & Nakagawa (2009) also found the important of deliberation process to deal with the conflict over high economic value coastal resources in Bali. Through such deliberation process, community could share the benefit of the commons fairly among resource users.

#### Direct Benefits

##### Tourist Attraction

The direct benefit value of the mangrove area as a place of ecotourism is calculated based on the number of tourists visited, multiplied by the average cost incurred by travelers and the average of visits. The number of visits in 2016 is as many 147 people. The average cost incurred for tourism in the Lubuk Kertang mangrove forests is Rp 529.857/person/year, multiplied by the average number of visits 3 time a year. The value of the direct benefits of mangrove

forests as tourist attraction is Rp 233.666.979/year.

Travel expenses incurred by tourists include gasoline, entrance ticket and the cost of retribution. Travel costs multiplied by the cost of other incurred components include the cost of supplies and boat rental costs of Rp 3,005,000/year, the total incurred cost during one year is Rp 7,918,000/year (Table 1). The cost of supplies, among others, to buy food and drink multiplied by the frequency of visits by tourists of 3-5 times a year (Table 5).

Table 1. Average of Visitors Cost.

Cost Component	Value (Rp/year)
Trip cost	4,913,000
Supply cost	2,965,000
Tools/vehicles rent cost	40,000
Total	7,918,000

This is in the contrary with what Kurniawati (2017) reported, in which the direct use economic value from ecotourism activities obtained was Rp 2,182,757/ha/year. The differences of economic value occurred due to the varying types and trip costs paid by the tourists to visit the mangrove ecosystem, i.e., *Mekar* mangrove ecosystem is most visited by people outside Langkat Regency using private vehicles or rented vehicles, which costs more. The total costs paid by visitors to enjoy the mangrove area consist of trip and supply cost.

#### Fish Catch

One of the direct use in mangrove ecosystem in Lubuk Kertang village is as fishery resources. The local fishermen catch crabs, shrimps, snappers, eeltail catfish, *lontok* fish or mud gudgeon (*Ophiocara porocephala*), reed fish, and mullet fish. The fishermen in Lubuk Kertang are mostly daily fishermen, which local people called "*bubu*" or trap. Their total income from their fishing activities in *Mekar* mangrove area is Rp 478,320,000 each year. This value is derived from the sale of fish, which is sold directly to the local people in Lubuk Kertang. Fishermen usually caught 720 kg-1000 kg fishes/year. Economic value from the direct use from the fishing activities is Rp 356.960.500/year (Table 4). It is different from the result of direct use value reported by (Trialfhianty, 2014), because Lubuk Kertang fishermen catch fishes in daily basis, so their supply cost is high.

#### Nipa Leaves for Roof

Nipa (*Nypa fruticans*) has important economic value for local people in the mangrove area. Nipa leaves are woven to be roofs, which can be sustained until five years. The creation of nipa roof contributes to the economic incomes in the fishermen's household, and it is also a leisure time job for the housewives. The

number of Nipa leaves produced by the fishermen is 9900 sheets per year. The total value of this benefit obtained from the sale of the roof of the palm leaf for Rp 1500/sheet, so the economic value for a year is Rp 14.950.000/year. The operational cost incurred in the form of transportation cost and the cutting of Nipa leaves is Rp 90.000. Thus, it means that the cost in one booking is Rp 4.500.000/year. The value of the benefits of Nipa leaves as roofing material is Rp 10.450.000/year (Table 4).

#### *Indirect Benefits*

##### Abration Prevention

The types of indirect use value from mangrove ecosystem in Desa Lubuk Kertang is as the break water, by using replacement cost approach through necessary cost quantification to build break water. The economic use value of mangrove as beach protector cannot be measured by market price. This research applied Unit Price of Work Analysis or *Analisis Harga Satuan Pekerjaan (AHSP)* which becomes the main reference to determine cost to pay to build break water.

The AHSP used came from Document of Ministry of Public Works No. 11/PRT/M/2013 about Guidelines of United Price of Work Analysis in Public Works year 2013. According to AHSP, the building of break water with length of 150 m, width of 20 m, and height of 5 m costs Rp 2.921.147.000 then the value of indirect benefits is Rp 389.486.267, in contrast to the results obtained Malik (2015) is 7436 USD/ha/year or Rp 10.060.908 (Table 2).

Table 2. Economic Value of Break Water.

Description	Value
Break water size	150x20x5
Concrete	2,921,147,000
Coastline (in meters)	2000
Durability (per year)	20
Break Water Use Value (Rp/Year)	389,486,267

##### Nursery Ground

Mangrove forests function as feeding places, places of care and enlargement spawning for other types of aerial animals such as fish, shrimp and other air organisms. Types of indirect benefits of mangrove ecosystem as nursery ground, using replacement cost that is done by using fish farming cost approach in Regency of Langkat. Calculation of economic value using fish farming cost approach in fishpond for 10.000 fish is Rp 3000/m<sup>2</sup> with conversion 1 Ha = 10.000 m<sup>2</sup>. The economic benefits of mangrove forests that remain intact as a nursery ground are Rp 30.000.000/5 = Rp 6.000.000/ha/year because the investment cost is issued every 5 years according to

the age of the pond. This value of mangrove economic benefit as a place of nursery ground can be calculated only for mangrove forest which is still intact only that is Rp 6.000.000 x 235 = Rp 6.300.000 (Table 3).

Table 3. Mangrove Forests as a Place of Nursery Ground.

Cost/Price	Value
Cost of Making Pond	Rp 2,000/m <sup>2</sup>
Frequency of Investment	5 tahun
Wide Conversion 1 ha	10,000 m <sup>2</sup>
Economic Benefits	Rp 6,000,000
Pond Area in Langkat District	1 Ha
Mangrove forest value as a place of nursery ground	Rp 6,300,000

##### Option Use Value

To count this function, benefit transfer methods are applied. According to Ruitenbeek (1992), the function of mangrove as biodiversity area is valued at US\$ 1500/km<sup>2</sup>/year. Based on the secondary data obtained from the mangrove forest area in Dusun V Desa Lubuk Kertang, there is 110 hectare or comparable with 1.10km<sup>2</sup>. From this approach, the mangrove forest amounting to 105 Hectare is valued at Rp 22,279,950/year, with the then dollar currency of Rp 13,503.

##### Existence Value

Existence value is counted from the cost paid by the managers for the mangrove area. The cost is the willingness-to-pay economic value of the managers. The detailed expense from the managers for development and maintenance of mangrove area is presented in Table 4.

Table 4. Management Expense Details in 2016.

Type of Expense	Value (Rp/Year)
Forest Border	2,300,000
Information Lodge	18,900,000
Tracking Board and Billboard	17,000,000
Total	38,200,000

##### *Total Economic Values for Mangrove Forest*

Based on the identification result on all ecosystem use values of mangrove forest in Dusun V Desa Lubuk Kertang, Kecamatan Brandan Barat, Kabupaten Langkat, which comprises of direct use, indirect use, option use, and existence use, it results in Total Economic Values of Rp 1.057.343.654/year. The data is presented in Table 5.

Table 5. Total Economic Values of Lubuk Kertang Mangrove Area.

Type	Use Value (Rp/Year)
Direct Use Value	
- Fisheries	356,960,500
- Tourist Attraction	233,666,937
- Nipa Leaves Roof	10,450,000
Indirect Use Value	
- Abrasion Prevention	389,486,267
- Nursery Ground	6,300,000
Option Use Value	22,279,950
Existence Use Value	38,200,000
<b>Total Economic Values</b>	<b>1,057,343,654</b>

The total economic values become the quantitative basic information to determine varying policy choices and mangrove ecosystem management, because it has impacts on the sectors which relying on natural resources. Similar research conducted by Setyowati (2016) acquired the mangrove ecosystem's total economic values of Rp 160,480,161/ha/year. The difference lies in the economic value in each of the similar researches is caused by the change of the dollar currency, price differences, and particular characteristics of each mangrove forest. Based on the obtained use value, it is possible for the value to fluctuate because of the changing usage type. Economic benefit value in mangrove area varies from that of in different locations. Some related studies conducted in three locations also varying at different time shows the different mangrove economic value. The details of each economic benefit value in different locations is shown in Table 6.

Communities residing in mangrove area should be able to implement awareness of the importance of the function of mangrove forest for the environment in order to maintain its quality. Calculation of the economic value of mangrove forest in Lubuk Kertang Village reflects the value of mangrove benefits for the community. If the mangroves are under pressure and are not well managed then it will cost a lot to repair the damaged resources.

## Conclusion

The condition of Lubuk Kertang village mangrove area experienced significant improvement each year. The mangrove area gave positive impacts for the society. The dominant breed of mangrove in Desa Lubuk Kertang is *Rhizophora* mangrove. The successful of community on replanting the mangrove ecosystem lead by various factors, including the high willingness of community to participate on rehabilitation project, clear physical boundaries and rule enforcement, effective monitoring system and better conflict resolution mechanism.

The variety of benefits from Hamlet V Lubuk Kertang Village mangrove ecosystem, consists of direct use in ecotourism, Nipa leaves roof, and provision of fisheries resources including shrimps, crabs, snappers, eel-tail catfish, *lontok* fish or mud gudgeon (*Ophiocara porocephala*), reed fish, and mullet fish; the indirect use includes creation of break water; option use in biodiversity as well as existing value of mangrove ecosystem.

The total result of economic values of mangrove ecosystem in Hamlet V Lubuk Kertang Village, Langkat Regency amounts to Rp 1.057.343.654/year. The quantification result of mangrove ecosystem in Hamlet V Lubuk Kertang shows that direct use value has the highest value, which indicates that the socio-economic function in the mangrove ecosystem is also high. However, the number of use value may change if a follow-up research is conducted.

## Suggestion

The role of government and society is needed in the management and utilization of mangrove ecosystem, considering the value of socio-economic and ecological benefits from mangrove ecosystem. Especially in local-level management communities or groups of managers must cooperate in managing ecotourism mangrove, because the success of a mangrove management depend with the group of managers themselves.

Table 6. The value of economic benefits at different locations.

Type of Benefit	Total Benefit Value (Rp/ha/year)			
	Lubuk Kertang	Bantul	Gorontalo	Indramayu
Direct	3,866,794	19,756,000	2,018,3079,000	3,493,798,174
Indirect	3,709,393	132,017,160	23,213,053,409	14,122,055
Optional	212,361	170,490	9,084,019,871	3,734,734
Existence	363,809	16,800,000	185,571,010	36,647

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