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Research Article

Flora Fauna Biodiversity and CSR Implementation in the Mangrove Ecosystem of Bagan Serdang Village, North Sumatra Province.

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Abstract

Information about mangrove and fauna biodiversity in Bagan Serdang Village is essential to be studied as a basis for assessing the management and utilization potential of mangrove. This information could be used as a reference in sustainable mangrove management. This study aims to determine the biodiversity of flora and fauna in the mangrove ecosystem of Bagan Serdang Village. The research location is divided into three areas, with three observation points. The study was conducted in August-September 2019. The sampling of mangroves was carried out using the Spot Check Method. The results showed that the types of mangroves found were 18 species from 12 families consisting of 14 species of true mangrove and four types of associated mangroves while the fauna found in the mangrove ecosystem of Bagan Serdang Village was 16 species of fish, nine species of crustaceans, 13 species of mollusks, four species of birds, one species of reptile, one species of mammal and one species of horse shoe crab. The results of the mangroves analysis in the Bagan Serdang Village's mangrove ecosystem, including in moderate heading to damage condition. This could be seen from the death of several trees and the flourishing of A. ilicifolius species as a marker of mangrove, which tends to be damaged. The diversity of mangroves in the Bagan Serdang Village is lower (1.63) compared to aquatic organisms that reach 2.09 - 2.44. Corporate responsibility or CSR that PT Pertamina (Persero) TBBM Medan Group carried out in the village of Bagan Serdang with mangrove planting activities and ecotourism, as well as the development of processed mangrove products, could increase the value of diversity and increase the economy of the surrounding community.

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1. Introduction

The existence of mangroves is very important as a life support system for various aquatic and terrestrial organisms, either as a feeding ground, nursery ground, or as a spawning ground. On the other hand, socio-economically, mangrove ecosystems are source of livelihood for coastal communities. In addition, mangrove ecosystems contribute to controlling the global climate through carbon sequestration (Rangkuti *et al*., 2017). Damage to mangrove ecosystems will have an impact on the loss of habitat of various organisms in coastal and estuary ecosystems. This will have a direct impact on the loss of various flora and fauna species associated with mangrove ecosystems (Giessen *et al*., 2012; Rangkuti *et al*., 2017). Moreover, it will also have an impact on the economy of the surrounding community (Muhtadi *et al*., 2015).

Mangrove was one of the mega biodiversity in Indonesia. Giessen *et al*. (2012), reported that there were at least 202 species of mangroves found in Indonesia. These mangroves spread on the coast of Indonesia, both on the main island and on small islands (Rangkuti *et al*., 2017). The area of Indonesian mangroves is the largest mangrove in the world. Indonesia has 23% of the world's mangroves, with an area of 3.4 million Ha (KLHK, 2017). This area is slightly higher than the results of the mapping of the Center for Marine Natural Resource Survey (PSSDAL) -Bakosurtanal by analyzing Landsat ETM image data (accumulation of image data in 2006-2009), stating mangrove area in Indonesia around 3,244,018.46 Ha (Hartini *et al*., 2010). Mangroves in North Sumatra are mostly found in the East Coast region, parts of the west coast of Sumatra, and small islands on the west coast of North Sumatra (Anonimous, 2018a). The east coast region of North Sumatra itself has a 545 km long coastline with an area of 74,417.80 ha (KLH, 2012a; North Sumatra DKP, 2015). The mangrove stretches from the east coast of Langkat Regency to the South Labuhan Batu District with varying thickness (Anonimous, 2018a).

However, mangroves in North Sumatra are only 8.16% in the good category, and the rest are in bad condition (KLH, 2012). This is not much different from the conditions in Indonesia where mangroves have been damaged a lot, which is only around 57.90% of mangroves are in good condition, and the rest are damaged (KLHK, 2017). The mangroves damaged, especially on the east coast of North Sumatra is caused by land clearing or conversion of forests to fishponds, settlements, industries, and plantations (especially oil palm) (KLH, 2012; Rangkuti *et al*., 2017). In addition to conversion, destruction of mangrove forests as cattle fodder, as well as mining of sea sand along the coast in front of the mangrove forest area (Rangkuti *et al*., 2017).

PT Pertamina (Persero) Fuel Terminal Medan Group, as it is responsible for environmental sustainability, holds a role in protecting and preserving the environment, especially the mangrove area in North Sumatra, through Corporate Social Responsibility (CSR). One of the programs is the Community Empowerment of Bagan Serdang Mangrove Village, Deli Serdang Regency, North Sumatra Province, which began in 2018. The mangrove forest area of Bagan Serdang Village has an area of around 26.10 Ha (Anonimous, 2018b) with the condition of mangrove that is quite apprehensive with the damaged forest and land coverage which is getting lower. This program is one of PT Pertamina's efforts in protecting the environment (mangroves) and to improve the welfare and community awareness of the environment. This is in line with the Biodiversity Park Program, which was rolled out by the Ministry of Forestry and the Environment. Biodiversity itself has a goal as a reserve area for local biological natural resources outside the forest area that has an in-situ and/or ex-situ conservation function and to save a variety of native/local plant species that have a very high level of threat to its preservation or threats that result extinction (Minister of Environment Regulation No. 3 of 2012). To date, there have been 73 parks built throughout Indonesia (KLHK, 2015).

Therefore, the presence of the Bagan Serdang mangrove area is expected to have a greater role in the form of environmental conservation and community institutional strengthening through community involvement in area management. The existence of the Bagan Serdang mangrove area is also expected to have an impact on improving the community's economy through ecotourism services and fishing (fish, shrimp, and crab) and mangrove culinary (mangrove processed food) businesses. The management of the Bagan Serdang mangrove area is also expected to open opportunities for developing partnerships with various parties. This study will provide information on the biodiversity of flora and fauna in mangrove ecosystems and the role of an overview of the implementation of PT Pertamina (Persero) Fuel Terminal Medan Group CSR program in mangrove management efforts in North Sumatra, specifically in Bagan Serdang mangrove area, Deli Serdang Regency, North Sumatra Province.

2. Materials and Methods

2.1 Place and Time

This research was conducted in Bagan Serdang Village, Deli Serdang Regency, North Sumatra Province, in August - September 2019.

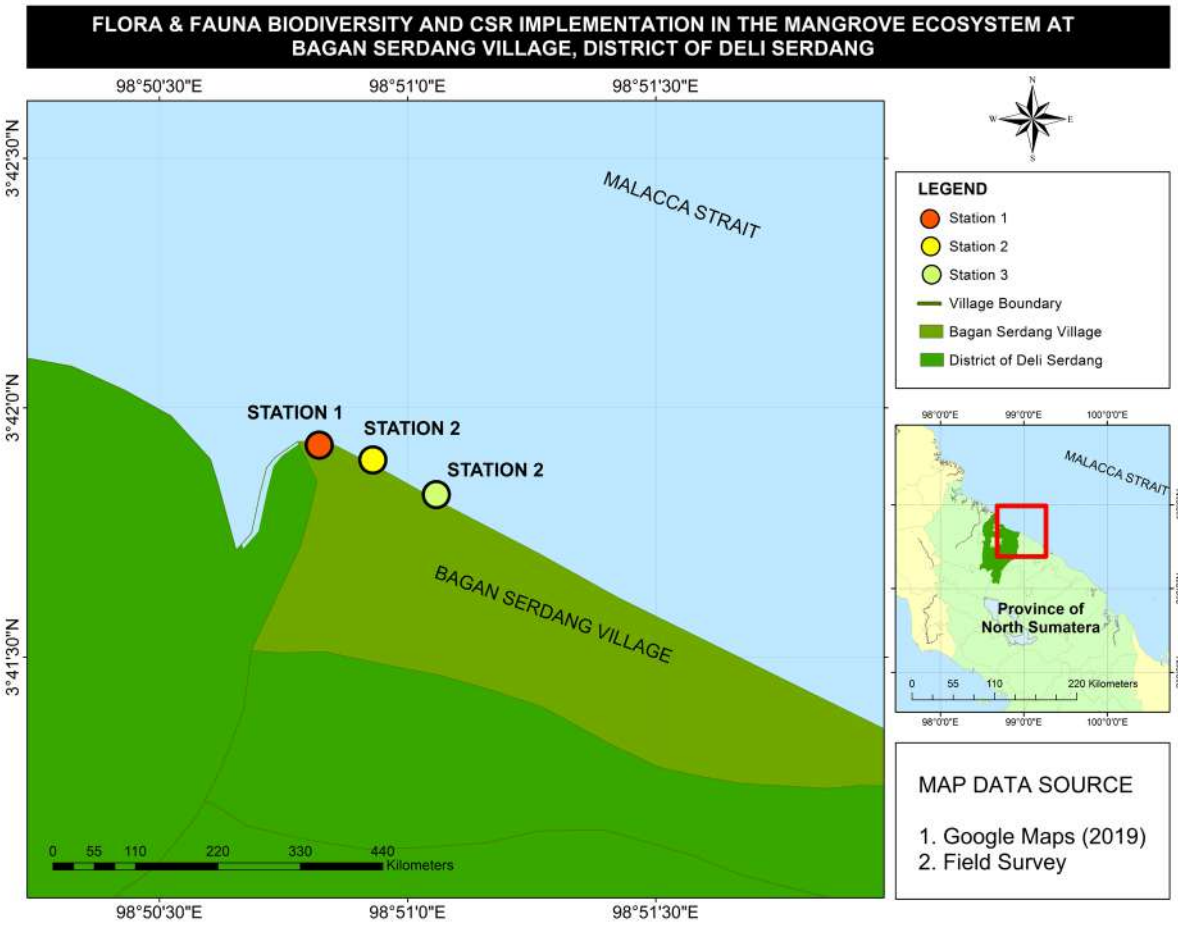

Figure 1. The map of research location

The instruments used in this study were Oregon 65 Garmin GPS with accuracy up to 3 m, fabric meter to measure mangrove's trunk, roll meter for transects measurement, and stationery and questionnaires for community interviews. Map of data collection presented in Figure 1.

2.2. Mangrove data collection

Determination of transect observations carried out by the Spot Check Method (Bengen, 2004). The observation point consists of three points along the coastline. At each point, the transect is pulled perpendicular from the direction of the sea to the land along 50 meters by three lines with a distance between the tracks 50-100 meters. At each transect, vegetation data is sampled in 10 m x 10 m transects plot. In each plot, measure the mangrove's trunk diameter of each tree on the transect. Identification of mangrove plants based on Giesen *et al.* (2012) guidelines.

2.3 Retrieval of Fauna Data

For Mollusca data, sampling is done by observing the 1m x 1m transect inside the observation mangrove spot. Sampling of fish and crustaceans were done by observing fishermen's catches around the observation point. Furthermore, bird sampling was carried out in the morning and evening with the help of the Nikon B700 long shoot camera. Fish identification refers to Kottelat *et al*. (1993) and Carpenter and Niem (1998). Further identification of crustaceans and molluscs refers to Carpenter and Niem (1998) and Dharma (2005).

2.4 Retrieval of CSR Implementation Data

CSR implementation data, especially the economic improvement of the surrounding community, was carried out with in-depth interviews with economic actors that had been formed and fostered by PT Pertamina (Persero) Fuel Terminal Medan Group in 2018. The fostered groups were the Tourism Awareness Group (Darwis), the Environmental Awareness Group (Darling), Family Welfare Empowerment (PKK), and community

surveillance group (P2WK) with each groups consisting of four people (16 respondens).

2.5 Data Analysis

Data analyss used to determine the condition of mangrove forests by analyzing species density, species frequency, land coverage, and species importance value (Bengen, 2004). Mangrove status refers to the Ministry of Environment regulation No. 201 of 2004 concerning Standard Criteria and Guidelines for Mangrove Damage Determination (KLH, 2004). Related to the biodiversity index analyzed consists of diversity index (H'), uniformity (E), and dominance (C), which refers to Odum (1996) and Krebs (2014). Relating to economic data and CSR implementation is carried out descriptively from the findings in the field.

Flora and fauna diversity was calculated using the diversity index of Krebs (2014) with the following formula:

$H' = - (\sum pi \log_2 pi)$

Where:

H ' = species diversity index,
ni = Number of individuals of each species,
N = Number of all individuals
Pi = Important Probability for each species = ni/N,

The equitability index (E) was calculated by following the equation (Krebs, 2014):

$E = H'/H` max$

Where:

E = Shannon-Wienner uniformity index,
H = Species balance,
H`max = maximum diversity index ($\log_2 S$),
S = Total number of species

The dominance index is calculated according to the Simpson index in Odum (1996).

$C = \sum ($²

Where:

C = Index of dominance,
ni = Number of individuals of each species,
N = total individual community

Mangrove Importance Index is calculated by the formula (Bengen, 2004):

$MII = RD + RF + RC$

Where:

MII = Mangrove Importance Index
RD = Relative density
RF = Relative frequency
RC = Realitve covering

Relative density calculated by:

$$DR = \frac{\text{(tree density to-i)}}{\text{(density of entire tree)}} \times 100\%$$

$$\text{with Density (D)} = \frac{\text{(the number of trees to-i)}}{\text{(sample plot area)}}$$

Relative frequency calculated by:

$$FR = \frac{\text{(the frequency of the i-th species)}}{\text{(total number of tree frequencies)}} \times 100\%$$

$$\text{with Frequency (F)} = \frac{\text{(}\sum\text{ the number of plots found in the i-th species)}}{\text{(total number of observation plots)}}$$

Relative covering calculated by:

$$C = \frac{(\sum BA)}{A}$$

where :

C = covering
BA = Tree base area
A = sample plot area

(1/4 πd^2) with the value of π =3,1416

$$CR = \frac{\text{(the relative area of the i-th tree)}}{\text{(covering of entire tree)}} \times 100\ \%$$

3. Results and Discussion

3.1 Mangrove Species Composition

There are 18 mangrove species from 12 families found in the Mangrove Ecosystems in Bagan Serdang Village. These mangroves consist of 13 true mangroves and five associated mangroves (Table 1). The Rhizophoraceae family is the most common mangrove species found. The observation of mangroves in the Bagan Serdang Village mangrove ecosystem found that the Rhizophoraceae family had more species, as many as four species. Muhtadi *et al*. (2016; 2020a) found seven species of the Rhizophoraceae family in the Sambilan

Table 1. Mangroves species found in mangrove ecosystem on Bagan Serdang Village

No	Family	Species	Indonesia name	Local name	Annotation
1	Acanthaceae	*Acanthus ilicifolius*	Jeruju	Jeruju	-
2	Arecaceae	*Nypa fruticans*	Nipah	Nipah	1
3	Asteraceae	*Wedelia biflora*	-	Beluntas	mangrove
4	Avicenniaceae	*Avicennia lanata*	Api –api	Api-api	-
5	Combretaceae	*Lumnitzera littorea*	Teruntum	-	-
6	Combretaceae	*Lumnitzera racemosa*	Teruntum	Teruntum	-
7	Combretaceae	*Terminalia catappa*	Ketapang	-	Associate mangrove
8	Gentianaceae	*Fagraea crenulata*	Ketapang	Birah –birah	
9	Lecythidaceae	*Barringtonia asiatica*	Putat	Putat	True
10	Euphorbiaceae	*Excoecaria agallocha*	Mata buta/ Garu	Buta-buta	mangrove
11	Malvaceae	*Thespesia populnea*	Waru laut	-	Associate mangrove
12	Pteridaceae	*Acrostichum aureum*	Paku laut	Piai	-
13	Rhizophoraceae	*Bruguiera hainessii*	Tancang	Tanjang	-
14	Rhizophoraceae	*Ceriops tagal*	Tengar	-	1
15	Rhizophoraceae	*Rhizophora mucronata*	Bakau besar	Bako	mangrove
16	Rhizophoraceae	*Rhizophora stylosa*	Bakau merah	Bako kurap	-
17	Sonneratiaceae	*Sonneratia caesolaris*	Pedada	Berembang	-
18	Sonneratiaceae	*Sonneratia ovata*	Pedada	Pedada	-

Island and Central Tapanuli Conservation Area. The most frequently found mangrove species are *A. lanata, B. hainessi*, and *A. ilicifolius*.

There are some mangroves and coastal vegetation which are rarely found elsewhere but are found in Bagan Serdang Village, namely *B. asiatica* and *F. crenulata*. Based on a search of several studies on the east coast of Sumatra including Indonesia, the two species were not found (Onrizal and Kusmana, 2010; Sitompul *et al*., 2014; Hutabarat *et al*., 2015; Muhtadi *et al*., 2016). Both species have only been discovered by Muhtadi *et al*. (2020b) in the tidal lake ecosystem in Medan Marelan. *B. asiatica* is a true mangrove while *F. crenulata* is a secondary mangrove (coastal vegetation) which is similar to ketapang (*T. catappa*). The difference between *T. catappa* and *F. crenulata* is the presence of a bulge (thorn in sapling) in *F. crenulata* while in *T. catappa* there is none.

Mangrove species found in the Mangrove Ecosystem of Bagan Serdang Village are quite a lot compared to other areas based on several existing reports. This shows that mangroves in the Mangrove Ecosystem of Bagan Serdang Village have a relatively high species compared to other places. As reported by Sitompul *et al*. (2014) found eight species of mangroves in Bali Beach, Batubara Regency, Hutabarat *et al*. (2015) found five types. In other regions, Samsumarlin *et al*. (2015) in Umbele, Morowali, with 17 species.

Table 2. Mangroves Important Index

Species	Density (tree/ha)	Covering (cm^2/ha)	Relative density	Relative Frequency	Relative Covering	IVI
Acanthus ilicifolius	153	2.65	12.03	10.71	10.23	**32.97**
Acrostichum aureum	63	2.85	5.2	8.95	8.56	22.72
Avicennia lanata	217	12.98	18.25	11.68	11.18	**41.1**
Barringtonia asiatica	7	0.23	0.57	1.33	1.28	3.19
Bruguiera hainessii	187	2.65	14.5	10.71	10.23	**35.44**
Ceriops tagal	13	0.47	1.17	1.33	1.28	3.79
Excoecaria agallocha	53	2.52	4.68	5.44	5.23	15.36
Fagraea crenulata	17	0.78	1.42	1.33	1.28	4.04
Lumnitzera littorea	23	0.44	1.87	3.14	3	8.02
Lumnitzera racemosa	137	0.99	10.95	7.62	7.28	25.85
Nypa fruticans	77	1.72	6.51	4.48	4.28	15.27
Rhizophora mucronata	47	2.09	3.98	7.2	6.9	18.08
Rhizophora stylosa	80	3.34	6.69	8.95	12.85	**28.48**
Sonneratia caesolaris	27	2.99	2.2	4.48	4.28	10.96
Sonneratia ovata	33	1.53	2.91	2.72	2.62	8.25
Terminalia catappa	13	1.3	1.17	4.11	3.95	9.23
Thespesia populnea	53	5.59	4.47	4.48	4.28	13.23
Wedelia biflora	17	0.33	1.42	1.33	1.28	4.04
Total	**1217**	**45**	**100**	**100**	**100**	**300**

Akbar *et al*. (2015) in Manomadeha island and Domretu Island, North Maluku found 11 species, and Akbar *et al*. (2016) found five species of mangroves on Mare Island, Tidore Islands, Karnanda *et al*. (2016) only found six species of mangroves on the coast of Pidie, Aceh Province.

While the results of the study of Muhtadi *et al*. (2020a) found 17 species in the Central Tapanuli Conservation Area, the number of these species is only lower than reported by Onrizal and Kusmana (2010) found 20 species of mangroves in Asahan Regency, Batubara Regency, and Serdang Bedagai Regency and Muhtadi *et al*. (2016) in Sambilan Island with 28 species. This is still possible where the east coast of Sumatra is more suitable for mangrove habitat with mud substrate and slow streamflow.

3.2 Mangrove Importance Index (MII)

Mangrove density in the Mangrove Ecosystems

of Bagan Serdang Village is 1,217 ind /Ha on average. The highest mangrove density in Bagan Serdang Village is *A. lanata* and *B. hainessi* (Table 2). This density lower compared to other locations. Sitompul *et al.* (2014), obtained the density of mangroves in the Bali Beach, Batubara Regency with a range of 1,233 -1,400 ind / Ha. Hutabarat *et al.* (2015) obtained the density of mangroves in Labu Beach, Deli Serdang, with a value of 400 – 3,294 ind / Ha. Muhtadi *et al.* (2020a) found mangrove densities in Tapian Nauli Bay ranged from 2,425 - 3,820 ind / Ha with an average of 3,120 ind / Ha and Mursala island ranged from 1,367 - 3,233 ind / Ha with an average of 2,356 ind / Ha. Likewise, the study results of Muhtadi *et al.* (2016) on The Sambilan island were much higher which reached 5,935 ind / Ha. The main environmental factors that affect mangrove density are tidal fluctuations and the average sea level height (Rangkuti *et al*., 2017).

Mangrove cover in Bagan Serdang Village is very low at 45 cm^2 / Ha. Although the density is classified as moderate, the land coverage is classified as very low. This shows that the mangrove trees in Bagan Serdang Village are not thick. Not all high density makes the land coverage high. This is related to the age (height) of the trees. The results of the study of Muhtadi *et al.* (2016) in Sambilan island found that even with a high density on the west coast, it did not make the land cover of mangroves on the west coast high. This is because although mangroves on the west coast are tight, the types of mangroves found were smaller (trunk diameter) than those in the east. Although the numbers are small and the density is low, but the diameter of tree trunks found in the east is much bigger than in the west. This is why the land coverage of mangroves in the east is greater than in the west. A larger trunk diameter will be found with a greater height and thicker leaves so that the coverage becomes larger (Muhtadi *et al*., 2016).

The highest average MII of *A. lanata* species which reached 41.10 was followed by *B. hainessi* at 35.44 and *A. ilicifolius* at 32.97. These three species dominate the mangroves of Bagan Serdang Village. *A. lanata* is very dominant on the front area (sea), while *B. hainessii* and *A. ilicifolius* dominate land areas. The smallest IVI is owned by *B. asiatica*, *C. Tagal*, *F. crenulata*, and *W. biflora* species with values below 5. However, despite their small influence each species contributes to the mangrove ecosystem of Bagan Serdang Village.

In general, the results of the importance value analysis of mangrove species indicate that *A. lanata, B. hainessi* and *A. ilicifolius* have an important influence and role in the mangrove community in Bagan Serdang Village, Deli Serdang Regency. The three species are the main mangrove species that are always found and have a high density compared to other mangrove species. *A. ilicifolius* although categorized as shrub mangrove but has a quite large role compared to *Ceriops* mangroves species, for example, because it also has a large distribution in almost all observation points. Even at a certain point it is forming a kind of large carpet of *Ceriops* in the village of Bagan Serdang. Meanwhile *C. decandra* and *E. agallocha* have little influence in the community. This relates to the lack of trees and uneven distribution. Thus, the three species have a major role and big influence on the community and the mangrove ecosystem of Bagan Serdang Village.

3.3 The Species Richness of Fauna

The results of fauna identification in the mangrove ecosystem of Bagan Serdang Village were found 16 species of fish, nine species of crustaceans, 13 species of molluscs, four species of birds, one species of reptile, one species of mammal and one other species namely horseshoe crab (Table 3). Thus, as a complete ecosystem, organisms from producers (mangroves), consumers one and shredder (crustaceans and molluscs), consumers two (fish) to top predators are monitor lizards and birds. These organisms consist of aquatic (fish, molluscs and crustaceans) and terrestrial (birds, mammals, and reptiles).

The number of fish found is slightly more than those found on the east coast of North Sumatra, namely in Belawan (Medan) as many as 18 species from 17 families (Simbolon, 2014) and Jaring Halus (Langkat) as many as 19 species from 14 families (Puteri *et al*., 2017). In addition, it is lower than the Segoro Anak Area of the Alas Purwo National Park, 10 species (out of 10 families) (Latupapua, 2011), and 10 fish families in the Mangrove Ecosystem in Kedungmalang, Jepara (Redjeki, 2013). However, fewer than other locations, which is 20 families (32 species) in the mangrove waters of Ujung Kulon National Park (TNUK), (Wahyudewantoro and Haryono, 2011), 19 families in the Mangrove and Estuary Ecosystems in the Mangunharjo-Semarang and Morosari-Demak Areas (Suwartimah *et al*., 2013). Meanwhile, Rajpar and Zakaria (2014) recorded at least 106 species of fish that live around the mangrove area.

The mangrove area is a habitat that is a habitat suitable for the life of various types of aquatic invertebrates, including crustaceans and molluscs (Rajpar and Zakaria, 2014; Rangkuti *et al*., 2017). Crustaceans found in Bagan Serdang Village consist of shrimp groups from the Harpiosquillidae and Penaidae families and crab groups from the *Portunidae* and *Ocypodidae* families (Table 4). Shrimp found are important economic commodities

Table 3. Fauna species found in mangrove ecosystem on Bagan Serdang Village

No	Family	Species	Indonesia Name	Local Name
Fish				
1	Ariidae	*Arius Thalassinus*	Manyung	Manyung
2	Engraulidae	*Stolephorus indicus*	Ikan teri pinggir	-
3	Gobiidae	*Boleophtalmus boddarti*	Belodok	Tembakul
4	Gobiidae	*Periophthalmus gracilis*	Belodok	Tembakul
5	Gobiidae	*Periopthalmonodon schlosseri*	Belodok	Tembakul
6	Hemiramphidae	*Zenarchopterus buffonis*	Julung-julung	-
7	Latidae	*Lates calcarifer*	Kakap	-
8	Leiognathidae	*Leiognathus decorus*	Peperek	-
9	Leiognathidae	*Leiognathus splendens*	Peperek	-
10	Lutjaniidae	*Lutjanus johnii*	Kakap	-
11	Megalopidae	*Megalops cyprinoides*	Bulan-bulan	-
12	Mugiliidae	*Valamugil engeli*	belanak	-
13	Oryziidae	*Oryzias javanicus*	Lunjar	-
14	Paralichthyidae	*Pseudorhombus arsius*	Ikan sebelah	-
15	Sciaenidae	*Johnius trachycephalus*	Gulama	-
16	Teraponidae	*Terapon jorbua*	Ikan terapon	-
Crustacean				
17	Grapsidae	*Metopograpsus frontalis*	Kepiting	-
18	Grapsidae	*Varuna litterata*	Kepiting	
19	Portunidae	*Scylla paramamosain*	Kepiting bakau	-
20	Portunidae	*Scylla serrata*	Kepiting bakau	-
21	Penaeidae	*Penaeus indicus*	Udang putih	-
22	Penaeidae	*Penaeus merguiensis*	Udang jerbung	-
23	Ocypodidae	*Uca annulipes*	-	-
24	Ocypodidae	*Uca coarctata*	-	-
25	Squillidae	*Harpiosquilla raphidea*	Udang mantis	-

No	Family	Species	Indonesia Name	Local Name
Mollusk				
26	Corbioculidae	*Polymesoda expansa*	Kerang totok	Korang
27	Potamiidae	*Cerithidea obtuse*	-	Keong
28	Potamiidae	*Cerithideopsilla alata*	-	-
29	Potamiidae	*Telescopium telescopium*	Keong bakau	-
31	Arcidae	*Anadara inaequivalvis*	Kerang bulu	Korang
32	Arcidae	*Anadara gubernaculum*	Kerang bulu	-
33	Littorinidae	*Littorina scabra*	-	-
34	Neritidae	*Nerita balteata*	-	-
35	Neritidae	*Nerita undata*	-	-
36	Strombidae	*Strombus luhuanus*	-	-
37	Strombidae	*Strombus* sp.	-	-
38	Naticidae	*Natica tigrina*	-	-
Bird				
39	Accipitridae	*Ardea alba*	Kuntul besar	-
40	Accipitridae	*Egretta intermedia*	Kuntul perak	-
41	Ardeidae	*Haliastur indus*	Elang bondol	-
42	Corvidae	*Convus enca*	Gagak hitam	-
43	Hirundinidae	*Hirundo tahitica*	Layang-layang	-
Reptile				
44	Varanidae	*Varanus salvator*	Biawak	Biawak
Mammals				
45.	Cercopithecidae	*Macaca fascicularis*	Monyet ekor panjang	Kera
Shoe horse crab				
46.	Limulidae	*Carcinoscorpius rotundicauda*	Belangkas	Belangkas

for mangrove inhabitants. Indian prawn and Banana shrimp are types of shrimp that are mostly found in estuarine waters and near mangrove areas (Pratiwi, 2009). Basically, the shrimp group spawns and nurtures in mangrove areas, and after they grow, they return to the sea (Katiresan, 2012; Igulu *et al*., 2014). Thus, a good mangrove condition will have an impact on shrimp production (Muhtadi *et al*., 2015). Other research results related to the presence of shrimp in the mangrove area include: Latupapua (2011) only found two types of shrimp, namely tiger shrimp (*P. monodon*), sweet/white shrimp (*P. merguiensis*) in the mangrove area of Segoro Anak Alas Purwo National Park. While Muhtadi *et al*. (2015) found *P. penicillatus* and *P. semisulcatus* in the silvofishery area of Subang, West Java. Yulianda *et al*. (2020a) found 18 crustaceans in the Siombak Lake mangrove ecosystem.

Shrimp are generally found in the waters (the front area), while mangrove crabs and uca in the back. This is in accordance with the findings of Pratiwi (2009) that crustaceans have a preference on the front part (sea). While *S. paramamosain*, *S. olivacea* and *S. tranquebarica* have preferences in the back and middle zone of the forest. *S. serrata* has preferences in the forest front zone, and the sea zone, and the uca group has preferences in the middle and rear area.

Molluscs are a group of macrozoobenthos that are mostly found in mangrove ecosystems either submerged in the substrate, on the surface of the substrate, attached to the roots of mangroves, attached to the trunk and even attached to the mangrove leaves, especially mangrove seedlings or saplings (Rangkuti *et al*., 2017). Molluscs found in the mangrove area in the village of Bagan Serdang are 12 species from seven families, consisting of six gastropod types and six types of bivalves. Other research results in the mangrove area include Irma and Sofyatuddin (2012) found in 14 Gastropod species and five Bivalva species in mangrove rehabilitation ecosystems in Aceh Besar and Banda Aceh. Syahrial *et al*. (2019) found only four species in the Mangrove Reforestation Area of Pramuka, Island and Karya Island, Seribu Island, DKI Jakarta. Yulianda *et al*. (2020b) found nine molluscs in the tidal lake mangrove area in Medan.

3.4 Diversity

The diversity of mangroves in the Bagan Serdang Village mangrove ecosystem is categorized moderate, with a value of 1.63. The moderate value of diversity affects the high similarity value (> 0.68) and with low dominance value (<0.13). Although *A. lanata, B. hainessi*, and *A. ilicifolius* have a large role in the community (highest MII), it is not so dominant in the mangrove community in the mangrove ecosystem of Bagan

Table 4. Ecology index of flora and fauna in mangrove ecosystem on Bagan Serdang Village

Organism group	H'	E	C
Mangrove	1.63	0.68	0.13
Fish	2.44	0.88	0.12
Crustacean	2.09	0.95	0.13
Mollusc	2.32	0.93	0.11
Bird	1.07	0.66	0.46

Tabel 5. Activity achievements of the segmented project

Group	Type of production	June	July	August	September
Darwis	Nugget, fish shredded, fish ball	110	130	130	130
Darling	Mangrove syrup	120	120	125	125
PKK	Mangrove candy, Dodol Mangrove	140	130	145	150
P2WS	Dried shrimp dim sum, dried shrimp noodle	125	130	140	140

Serdang Village. This is because, in fact, if examined further, type *A. lanata* is only dominant in the front (near the sea). While on the back (near the mainland), nothing dominant. This is related to the presence of zoning in mangrove communities where certain types will grow according to the substrate and flooded frequency.

Meanwhile, the diversity of aquatic organisms in the Mangrove Ecosystems of Bagan Serdang Village is higher than the mangrove, namely 2.44 (fish), 2.32 (mollusc), and 2.09 (crustaceans). Therefore, although the diversity of mangroves is low, the diversity of aquatic organisms is quite high. Therefore, according to the statement of Rangkuti *et al*., (2017), mangroves are habitats of various aquatic organisms either as a place to look for food, spawning, and as a nursery area. While bird diversity is lower at 1.07. The low diversity of birds could be due to already beginning to damage of the mangrove ecosystem and/or associated with the season. At certain times, the birds migrate to take shelter or find food.

3.5 Mangrove ecosystem status

Based on the standard criteria for mangrove damage, according to KLH (2004), showed that mangroves in the Mangrove Ecosystems of Bagan Serdang Village categorized in the medium category. This is due to the existence of some mangrove trees being cut down by a few people living in the location. In addition, many mangrove trees have experienced natural death, especially *A. lanata* due to freshwater supply and seawater failure entering the site.

Based on searches from various studies in Indonesia, it was found that the condition of mangroves was in the category of damaged to moderate, very few were found in good category and with abundant species. The results of Sitompul *et al*. (2014) on the Coast of Bali, Batu Bara Regency with a moderate category, Akbar *et al*. (2015) on the coast of Sidangoli, West Halmahera Regency, North Maluku obtained mangrove conditions in the damaged category, on Mare Island in Tidore islands found mangroves with moderate conditions (Akbar *et al*., 2016). It is not surprising that mangrove conditions in Indonesia suffered a lot of damage as reported by KLH (2012b), mangroves in Indonesia only 56% are still in good category, and the rest are medium. Even in North Sumatra, 55.77% were damaged, and only 8.16% mangrove categorized good (KLH, 2012b). Mangrove conditions that are still good, as reported by Muhtadi *et al*. (2016; 2020a), were found in Sambilan Island and the Central Tapanuli Conservation Area (Tapian Nauli Bay and Mursala Island).

3.6 CSR Implementation in Bagan Serdang Village

Based on field observations, the mangrove ecosystem in the area of the mangrove ecosystem of Bagan Serdang Village has received threats from the activities of local residents. Therefore, through Pertamina's CSR, community-based, mangrove management efforts have been made. The focus of the community empowerment activities of Bagan Serdang mangrove village was as an ecotourism area in detail consists of five series of activities as follows:

1. Realization of the preservation and rehabilitation of mangrove plants by the local community in the Mangrove Village of Bagan Serdang
2. The realization of waves and abrasion retaining buildings to preserve and rehabilitate mangrove plants in Bagan Serdang Mangrove Village,
3. Diversification of processed mangrove products
4. The realization of buildings/kiosks as a place for marketing mangrove processed products, and
5. The realization of the mangrove's track pathway in Kampung Mangrove Bagan Serdang.

This conservation activity involves people who are joining in environmental awareness, tourism awareness, youth groups, and school students, by planting 3,000 mangrove trees in a land area of 13.47 Ha (Figure 2). Out of the total planned planting of 7,000 mangrove trees, for the entire mangrove area to be rehabilitated, and continued planting of 20,000 mangroves in 2020. The area of land that has been conserved in the form of mangrove trees planting covering 13.47 Ha is a land area of moderate level of damage, with 3,000 mangrove trees planted that have been able to cover the damaged land area. Based on land area data that have not been conserved in the area of Bagan Serdang mangrove forest, it covers an area of 12.64 Ha, which is a coastal area and tidal area. Based on satellite imagery and ground facts, this area is a very badly damaged area, so more mangroves need to be planted. This activity will be carried out in the next.

Therefore it is hoped that the mangrove conditions in Bagan Serdang Village will be better. Thus through this CSR, it is hoped that this program will continue as part of the company's responsibility towards environmental sustainability. CSR is one of the efforts of funding from companies for the preservation of the natural environment (Regulation number 40, 2007). In addition, CSR is also expected to improve the economic condition of the community with assistance from the company (Firmansyah *et al*., 2018).

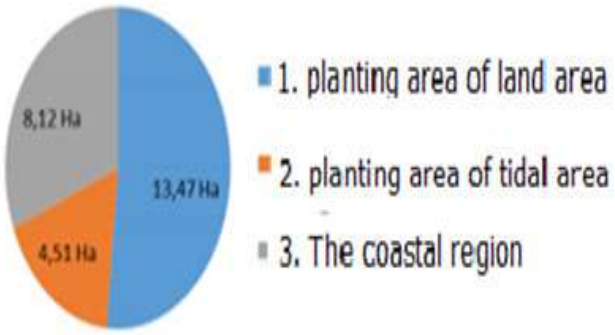

Figure 2. The area of mangrove conservation activity

3.7 Economic impact

Community empowerment activities in the village of Bagan Serdang, Pantai Labu sub-district through the mangrove ecotourism program, slowly had an impact on the community's economy. In the implementation of economic empowerment, skills development has been carried out for community groups as seafood and fruit processing, and mangrove leaves, these groups have produced various types of products including fish balls, nuggets, shredded fish, mangrove dodol, mangrove syrup, mangrove candy, ebi (dried shrimp) dimsum, ebi noodles, and others. From this production, there was an increase in community income of 10% (Figure 2) on average compared to before the assistance activities since carried out in June 2018. Thus mangroves can provide added value for improving the economic community, both processed mangrove, fisheries, and ecotourism (Rangkuti *et al*., 2017).

4. Conclusion

The results of the analysis of mangroves in the Bagan Serdang Village mangrove ecosystem are moderately damaged headed to damage. The diversity of mangroves in Bagan Serdang Village is lower (1.63) compared to aquatic organisms that reach 2.09 - 2.44. Therefore, it needs better management of mangroves, especially the need for mangrove rehabilitation and establishment of the chart area Serdang into Park Biodiversity is essential for sustainable management. For CSR programs, the achievement of this activity becomes a strong foundation for the development and implementation of other relevant activities to make the Bagan Serdang Village an integrated ecotourism, icon especially in the Deli Serdang Regency. PT Pertamina (Persero) Fuel Terminal Medan Group maintains the mandate given by the community of Pantai Labu Sub-District, Deli Serdang Regency, by proposing a further program that makes the Bagan Serdang Mangrove Village as the first community-based mangrove ecotourism model in the Sumatra region. Pertamina's CSR activities have an impact on environmental sustainability (as a habitat for various fauna) and improving the community's economy.

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Authors' Contributions

All authors contribute to the process of data collection and writing of the manuscript. The contributions of the authors are: Muhtadi contributed to the idea, ecological data collection, data processing and draft writing of the manuscript. Leidonald contributed to ecological data collection and scriptwriting. Triwibowo and Azmi contribute to funders and economic data collection.

Conflict of Interest

The authors declare that they have no conflict of interest

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