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Carbon Stock Estimation Due to Changes in Mangrove Labuhan Maringgai District, East Lampung Regency

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ABSTRACT
The damage to the mangrove ecosystem in Margasari Village District of Labuhan Maringgai, East Lampung Regency was predicted to reduce the estimated carbon stocks in the ecosystem. This research aims to determine the influence of the functioning of the mangrove ecosystem on the total biomass, estimated stored carbon, organic carbon, sediment and leaf litters in the mangrove of Margasari Village, District of Labuhan Maringgai, East Lampung Regency. The method used in this research was field collection from observation plot, carbon data collection was non-destructive, data retrieval for carbon were from leaf litters and sediment and were analyzed for organic carbon content with spectrophotometer. The results showed that there was a decrease in the carbon deposits in the mangrove stand (stem) and leaf litters in year 2020 compared those calculated in 2016 with the estimated carbon deposited in the mangrove stand (stem) as much 144.142 tons/ha, for the value of estimated carbon stored in the leaf litters was 1.35 tons/ha and stored carbon in the sediment of 3.390 tons/ha. While the average content of C-organic (%) of sediment was 5.33% and of leaf litters was 5.49%.

Keywords: *Mangrove, Carbon* stock, *ecosystem, spectrophotometer, Margasari, Labuhan Maringgai*

1. INTRODUCTION

High concentrations of CO_2 in the Earth's atmosphere resulting from the burning of fossil fuels, forest clearing and deforestation cause rising greenhouse gases, so that the surface temperature of the earth will increase, while the ability of forest plants to absorb CO_2 from the air decreases. Forests are the most important CO_2 gas absorbent in addition to phytoplankton, algae and seaweed. One type of forest that is important in the absorption of carbon is mangrove forest. The ability of mangrove forest in absorbing carbon as other forest formation has a big role. Generally, chlorophyll plants through the process of photosynthesis with the help of sunlight able to absorb CO_2 gas from the air and produce carbohydrates and O_2. A community of plants with an overall breadth of leaves about 5 hectares can absorb approximately 900 kg of CO_2 from the air and reuse 600 kg O_2 in a period of 2 hours [1].

One of the areas of Lampung Province with mangrove forest area is quire spacious namely East Lampung Regency. Due to the damage of the existence mangrove ecosystem in the area of Margasari village of Labuhan Maringgai District, the estimated carbon stock of the ecosystem is reduce as depicted in Figure 1.

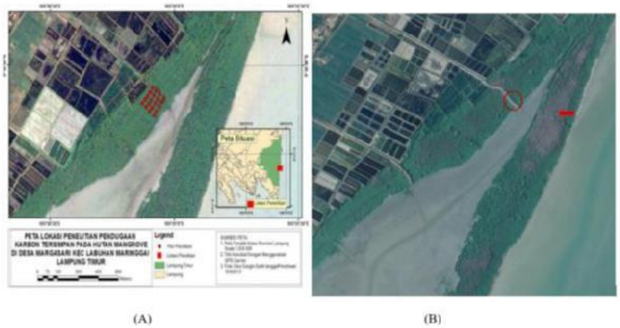

Figure 1 (A) Map of Labuhan Maringgai Mangrove in 2016 [3] (B) Map of Labuhan Maringgai Mangrove 2020

Based on the background above, it is necessary to evaluate on changing the mangrove condition to the carbon stock estimate in Margasari village. Research on the estimation of carbon stored in mangrove vegetation is important to know how large mangrove forest area is able to absorb CO_2 from the air. So it can support the management of mangrove areas. sustainably in relation to the reduction of atmospheric CO_2 concentration [2].

2. MATERIAL AND METHOD

2.1. Sample Preparation

This research has been conducted in February - March 2020 at the Mangrove Forest Margasari village, Labuhan Maringgai District, East Lampung Regency. The tools used in this study were rope mines, compass to determine plot straightness, meter tape for measuring diameter, GPS (Global Positioning System), plastic bag to put leaf litters and sediment, digital scales with precision ± 0.0001 g, oven to reduce moisture content or dry weight, tally sheet, stationery, glassware volume 100 ml, 5 ml volume pipette, UV-Vis Spectrophotometer, calculator and camera. Materials or objects in this research are mangrove, leaf litters, sediment, H_2SO_4 pa. 98%, $K_2CR_2O_7$ 1N, and ion-free water.

2.2. Methods

2.2.1. Observation Plot Determination

Determination of the number of plots based on Windarni [3], by using as many as 20 plots. The plot was created using the outline of five lines, each of which consisted of four tiles. Tree observation plots were made of 20 m x 20 m with the distance between the plots on the 20 m line, while the distance between the lines/lines of 50 m. In each tile was made of sub-plot and sediment measuring 0.5 m x 0.5 m (see Figure 2.)

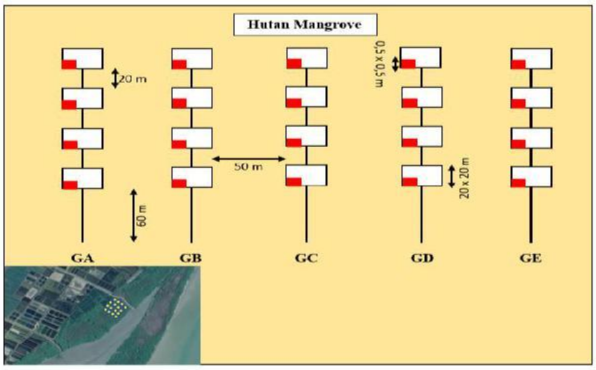

Figure 2 Path plot of research point in mangrove forest Margasari Desa of Labuhan Maringgai District, East Lampung Regency [3]

2.2.2. The biomass stands (Stem).

Data collection was done by retrieving all the data on the mangrove that was on the observation plot (plot 20 m x 20 m) with a non-destructive approach. Data retrieval only on trees that have a diameter of at least 5 cm according to the characteristics of mangrove trees [4]. The determination of biomass tree (stem) uses the allometric equations B = 0,1848D2.3624.

2.2.3. Biomass Leaf Litters

The collection of the leaf litters biomass data was carried out on a subplot of 0.5 m x 0.5 m in each tile. From the leaf litters obtained, then selected sub sample weighing 100 g. If the wet weight obtained does not reach 100 g then the whole leaf litters from the tile of the sample was considered sub sample. The leaf litters were baked in the temperature of 80^0C until the weight was constant. Total dry weight was determined using the equation [5]:

$$Total\ DW = \frac{DW\ sub\ sample\ (g)\ x\ total\ wet\ weight\ sample}{WW\ sub\ sample\ (g)}$$

DW= dry weight
WW= wet weight

2.2.4. Organic Carbon Sediment

Analysis of organic carbon content using the method of loss on ignition (LOI). LOI method was done by drying the sediment sample for 48 hours with a temperature of 60^oC to get the bulk density [6]. Carbon estimation was sought by using the formula [6], [7]:

$$Carbon\ estomation = \frac{dry\ weight\ (g)}{Sample\ volume\ (cm^3)}$$

Soil C density (g cm^{-3}) = % C x *bulk density*

Soil C (Mg ha^{-1}) = *Bulk density* x *soil deep interval x % C*

Results then was projected in MgC units equivalent to tons of carbon in hectares of acres and a one-year period.

2.2.5. Estimation of Stored Carbon

Once obtained biomass stem, leave litters, and sediment mangrove then the determination of the stored carbon was done using the conversion number, which was 46% of the total biomass [5]:

$$Carbon\ stored\ = Total\ Biomass\ x\ 0.46$$

2.2.6. Organic Carbon Analysis with Spectrophotometers

0.5g of sediment weigh and leaf litters which had been powdering or fine into the volume notch flask 100 ml. Add consecutive 5 ml of K2CR2O7 1N solution and 7 ml H2SO4 Pa. 98%, after a homogeneous solution leave for 30 minutes. Then diluted with the aquadest until the boundary sign. Prepare also Blanko as standard 0 ppm C. After 24 hours the sample solution was filtered before the absorbance with a spectrophotometer at a wavelength of 561 nm. To determine the C-organic value on the sample, the following formula is used [8]:

C-organik (%) = curve ppm x 100/mg sampel x100 ml/1.000 ml x cf

In which:

Curve ppm = Concentration obtaining from spectrophotometer
100 = conversion to %
Cf = correction factor of water content = 100/(100-% water content)

3. RESULTS AND DISCUSSION

3.1. The Carbon is Stored on the Avicennia Marina Mangrove Stem

Result of carbon stored in the stem of Mangrove *Avicennia marina* in Margasari village of Labuhan Maringgai District East Lampung District can be seen in Figure 3.

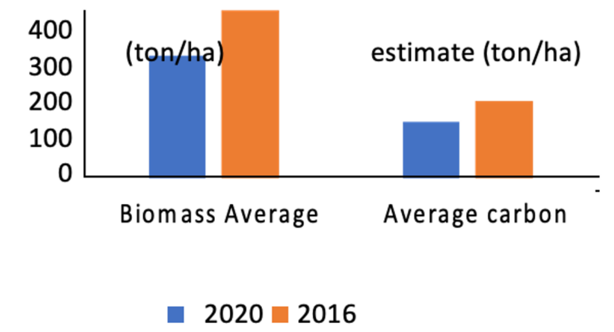

Figure 3 Estimation of carbon stored in the mangrove stem of *Avicennia marina*

As shown in In figure 3, it indicated that the average result of biomass on the mangrove stem of 313.3 tons/ha and the average estimated carbon saved was 144.142 tons/ha, when compared with the study results of the 2018 [3], the amount of carbon stored in the mangrove Stem *Avicennia marina* has a higher value of 429.06 ton/ha and the average of stored carbon estimated 197.36 ton/ha. It can be concluded that the mangrove ecosystem in Margasari village in 2020 has a decrease in the number of biomass compared to the research results of 2018 [3].

The low potential of biomass of a mangrove ecosystem was caused by the level of soil fertility and tree density existing in the region [9]. If viewed from Figure 1 (B), map Mangrove Labuhan Maringgai year 2020 Mangrove area damaged, marked with brown color and water channel widening and field verification of ± 4736.7 m^2. The damage that occurs in the mangrove area is a factor that causes a decrease in the carbon level stored in the mangrove ecosystem.

The largest value of carbon estimation on the *Avicennia marina* mangrove stem was the GE line of 172.26 tons/ha. While the smallest value is on the line of GB, 92.45 tons/ha. The difference and the comparison of the total carbon in each line can be seen in Figure 4.

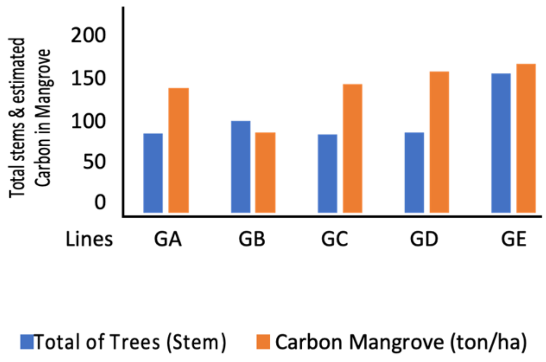

Figure 4 Comparison of number of trees (stem) with carbon stored on each lines

Figure 4 indicated a comparison of the number of trees (rods) with the amount of carbon stored on each stripe in Margasari Village. The lowest number of trees (stem) was owned by the GC, but the carbon stored on the GC had a relatively large amount compared to some of the other lines that have a larger number of trees (stem). Mangrove trees that have larger diameter stems have greater biomass and carbon reserves, which are stored at most in the stem. The percentage of carbon stocks increases in line with the increase in biomass. The larger the biomass content, the more the stored carbon will also be [10].

3.2. Stored Carbon in the Leaf Litters of Avecennia Marina Mangrove

Result of the carbon stored in the leaf litters Mangrove *Avicennia marina* in Margasari village of Labuhan Maringgai District East Lampung District can be seen in Figure 5.

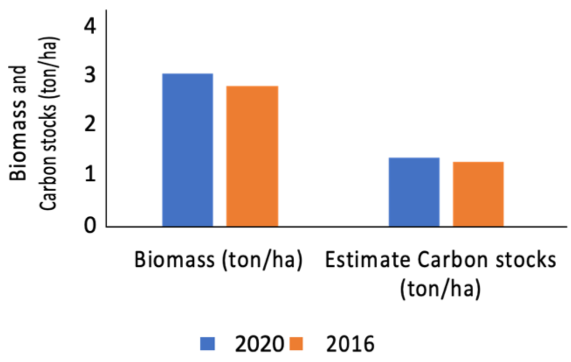

Figure 5 Estimated carbon stored on leaf litters of *Avicennia marina mangrove*

The average estimated carbon was deposited in the mangrove leaf litters was 1.35 ton/ha, when compared to 2018 [3]. The average estimated carbon stored in leaf litters was 1.25 ton/ha. Differences in carbon stored was due to the difference in mangrove capacity to produce leaf litters that affects carbon deposits in the mangrove leaf litters. If viewed in Figure 1, the area of mangrove covered in 2016 was better compared with the year 2020, but it was not a factor that causes high estimation of carbon deposited in leaf litters mangrove 2016. The high potential of carbon deposits was more influenced by the composition of the diameter and the weight of the tree type of land cover density [11].

The carbon content of the mangrove describes how large the mangrove can bind the CO_2 from the air, some of the carbon will be converted into energy for the process of mangrove physiology and some are in the structure of mangrove plants and become part of the plant, for example cellulose stored on the leaves, roots, stems and twigs [12].

3.3. Stored carbon in the sediment of Mangrove Avecennia marina

Based on the research done in Margasari village, Labuhan Maringgai District, East Lampung Regency obtained the result of sedimentary carbon content that can be seen in Table 1.

Table 1. Stored carbon on sediment mangrove *Avicennia marina*

Lines	Bulk Density (g/cm^3)	Carbon Density ($g\ C/cm^2$)	Total Carbon ($Mg\ ha^{-1}$)
GA	0.60	0.31	3.50
GB	0.58	0.39	3.38
GC	0.57	0.33	3.35
GD	0.48	0.28	2.82
GE	0.66	0.38	3.87
Sum	2.92	1.71	16.95
Average	0.58	0.34	3.39

Of the five lines of the highest value in the GE line was 3.879 ton/ha and the lowest value of the GD line was 2.824 ton/ha. The different values on each line were influenced by the number and density of trees, types of trees, environmental factors that include the illumination of the sun, moisture content, temperature, and fertility of the sediment affecting the rate of photosynthesis.

Total carbon stored in GE line had the highest value compared with other lines of 3.879 tons/ha and the lowest value was on the GD line of 2.824 tons/ha. The high total carbon deposits of sedimentary lines in GE were alleged because there were many different types of vegetation, as many mangrove vegetation are found, so the production of leaf litters in the region will also increase.

3.4. C-organic Content on Sediments and Leaf Litters of Avicennia Marina

Based on the results of the analysis using spectrophotometry obtained organic carbon data on the sediment and mangrove leaf litters in the village of Margasari district of Labuhan Maringgai East Lampung Regency as presented in table 2.

Table 2. C-organic sediment and leaf litters Mangrove

Sample	Lines	C-organic (%)	Average (%)
Sample Sediment	GA	5.33	5.33
	GB	5.34	
	GC	5.33	
	GD	5.32	
	GE	5.33	
Sample Leaf Litters	GA	5.49	5.49
	GB	5.48	
	GC	5.48	
	GD	5.47	
	GE	5.50	

The result of the study of C-organic content on mangrove sediment showed that the results were not much different in every line of the lines which was an average of 5.33%. The high content of C-organic in this study was due to the type of sediment in the form of mud. Mud was the result of the process of mixing dust, clay, and sand in the sedimentation process. Sedimentation in the mangrove ecosystem was the result of suspended solids entering the coastal area through the estuary of rivers, dredging materials, and re-suspention of sediment by wave [13].

C-Organic in the leaf litters also had a result that was not much different on each line of the lines, the highest value was on the line of GE with a value of 5.50% of its C-organic content due to the research location of the number of mangrove trees that were found more than the other lines so that the production of leaf litters was much more abundant.

4. CONCLUSION

The conclusion on this research was the presence of a decrease in the content of carbon contents stored in the Mangrove stand (stem) by 26% and the increase in the content of carbon contents stored in the leaf litters of 8% in Margasari village of Labuhan Maringgai District, East Lampung Regency compared in the year 2016 [3]. with the estimation of carbon stored in mangrove stands (stem) of 144.14 ton/ha for the value of carbon estimation stored in the Serasah of 1.35 ton/ha and carbon stored in the sediment of 3.39 $Mg\ ha^{-1}$. While the average content of C-organic (%) in sediment was 5.33% and at leaf litters was 5.49%.

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