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Amount Stock of Blue Carbon in Mangrove on the Area of Pt Arutmin Indonesia Kintap Mine Mekarsari Village, Tanah Laut Regency, South Kalimantan

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Abstract— *Mekarsari Village is located in the Kintap sub-district, Tanah Laut district, South Kalimantan Province, which is an area that has a 1.83 ha mangrove ecosystem. Mangrove ecosystem is one form of forest ecosystem that is unique and distinctive, found in tidal areas of coastal areas, beaches, and several small islands. In addition to the mangrove ecosystem, there is also a coral reef ecosystem with the condition of coral reefs around the marine waters of Kintap District ranging from low to moderate based on coral reef assessment criteria according to the Indonesian Environment Ministerial Decree, No. 4/2011, (Tony. F, et al 2021). The purpose of this study was to determine the amount of biomass and the amount of blue carbon stock in the mangrove ecosystem in Mekarsari Village. Data was collected by plotting the area and taking the upper sample to determine the amount of blue carbon stock through the results of laboratory analysis. The results of the study based on data collection in the field, namely the mangrove ecosystem in Mekarsari Village has a total biomass value of 98.52 tons/ha and the total amount of blue carbon stock is 84.72 tons C/ha.*

Keywords— ***Mekarsari Village, Mangrove, Biomass, Blue Carbon Stock.***

I. INTRODUCTION

PT Arutmin Indonesia Kintap Mine Area is a company operating in the coal mining industry located in Mekarsari Village, Tanah Laut Regency, South Kalimantan Province. In the company's activity area, there is a mangrove ecosystem which has an area of 1.83 ha, it is known that before the existence of mangroves this place was a community shrimp pond that had been converted into mangroves in 2014. Presidential Regulation of the Republic of Indonesia number 73 of 2012 concerning the national strategy for managing mangrove ecosystems it is necessary to use the conservation of mangrove ecosystems.

The South Kalimantan Mangrove Ecosystem covers an area of 67,008,659 hectares of mangrove forest in the coastal area of South Kalimantan (South Kalimantan DKP, 2018). Based on data from the One Map Policy (KSP) or the One Map Policy (OMP) 2016, South Kalimantan has a mangrove area of only 55,556.13 ha. According to

Baharuddin (2020), the coastal area of South Kalimantan is a coastal ecosystem, especially the mangrove ecosystem. This is due to the many activities carried out in the area. For example the construction of public and special ports, cultivation of mangrove land, plantations, agriculture, industry and conversion into settlements.

The mangrove ecosystem is one of the potential parameters to determine the presence of blue carbon stocks. The role of mangroves in blue carbon is more emphasized as an effort to use CO2 in the photosynthesis process and store it in biomass and sediments to mitigate climate change. The existence of the mangrove ecosystem provides benefits, among others, for coastal water ecosystems as a place for foraging for food, spawning grounds and animal husbandry. Rapid developments have a negative impact on the environment, including the conversion of mangrove forests into ponds and tourist destinations, as well as the disposal of organic waste into coastal waters.

Based on the above that the mangrove ecosystem is one of the ecosystems that is rich in benefits and functions from an ecological, biological and economic perspective, therefore it is necessary to conduct research related to blue carbon stock estimation and vegetation analysis in mangroves in the PT Arutmin Indonesia area. Kintap Mine, Mekarsari Village, Tanah Laut Regency, South Kalimantan Province.

II. RESEARCH METHODS

TIME AND LOCATION

The mangrove blue carbon stock study was carried out in March-April 2022. The research location was in the area of PT Arutmin Indonesia Tambang Kintap, Mekarsari Village, Tanah Laut Regency, South Kalimantan Province.

DATA ACQUISITION METHOD

DETERMINING THE SAMPLING LOCATION

Determination of the location of field data collection based on the research location of PT Arutmin Indonesia Kintap Mine for company data purposes, because at that location there is no research related to the mangrove ecosystem so that the company can achieve the specified target. At station 1 with coordinates 3° 52' 39.78” S 115° 19' 41.86” it has the characteristics of more types of mangroves found in the location because it is close to the sea, the ecosystem condition at station 1 is better in terms of substrate and mangrove growth. . At Station 2 with coordinates 3° 52' 35.25” S 115° 19' 43.17”, the density level and the types of species found at the location and the condition of the substrate are mud mixed with sand are lower. Then at station 3 with coordinates 3° 52' 33.75” S 115° 19' 41.36” E, the condition is more dominating than station 2, the density level is also higher.

SAMPLING PROCEDURE

The sampling is use stratified systematic sampling, meaning that the entire part of the mangrove ecosystem will be utilized as much as possible, the part that is predicted to be able to absorb carbon using concepts that are in accordance with the IPCC (Intergovernmental Panel on Climate Change) 2003. sampling as many as 3 stations and at each station took 3 sampling to take the upper biomass consisting of leaves, twigs, stems, main stem.

In the production of mangrove biomass, it can be seen from the measurement of trunk diameter, tree density, and tree age (Darusman, 2006). To determine a biomass, that is by selecting a minimum of 30 trees for sampling in each plot area. All stands in the plots were taken, but only leaves, twigs, and branches to determine their wet weight were weighed at the observation site. Sub samples were taken weighing 100 grams of each tree that had been sampled. In order to obtain constant sampling results, the sampling process was carried out in an oven at a temperature of 80oC for ± 24 hours.

Biomass Measurement Procedure

Aboveground

Aboveground or above-ground biomass, and the used parameters are leaves, twigs, branches and also the main stem. It is these parts that make a major contribution to the calculation of biomass and carbon stocks in primary (land) forests. All data from the four will be aboveground data and then further analyzed to obtain predictions of stored carbon content

Tree Volume

Tree Volume Analysis of the data in this study is to calculate the biomass based on the volume of the tree without calculating the canopy (branches, leaves, flowers and fruit) using the equation of Heriyanto et al. (2012) as follows:

$$V = 1/4.\ \pi . d^2 .t.f$$

Description:

V : Tree Volume (cm3)

π : 3,14

d : Tree diameter (cm)

t : Total height (cm)

Wood Density Measurement

The density of wood is measured by weighing the wet weight of the wood sample that has been taken. After weighing the wet weight, the wood sample was then placed in an oven at 100°C for ±48 hours. Furthermore, the samples that have been put in the oven are weighed dry (Hairiah et al., 2011). Irregular volume measurement can be done by inserting the object into a measuring cup filled with water. The volume of the object can be known from the change in the volume of water that is read in the measuring cup or by using the formula:

Object Volume (ml) = Final volume (ml) - Initial volume (ml)

According to Hairiah et al. (2011), the density of wood can be calculated by the formula:

Density (g/cm^3) = dry weight (g)/volume (cm^3)

Biomassa

The amount of biomass was obtained from the results of measuring the volume of trees and measuring the density of wood. According to Bismark et al (2008) the formula used to calculate biomass is as follows:

B = V x

Description:

B : Biomass (kg)

V : Tree volume (m^3)

Blue Carbon Stock

The next step is to calculate or measure the carbon content of parts of the mangrove ecosystem with known biomass. It includes three main parts, namely carbon accounting from aboveground biomass.

Cb = B x % C organic

Description:

Cb : Combined carbon and biomass (kg)

B : Total biomass (kg)

% C organic : 0.47 resulting from the measurement of the results of laboratory analysis

- This formula can be used to calculate individual or total biomass from aboveground and belowground, so it will be possible to know the contribution of each part (leaves, twigs, branches, main stem, main roots and also branch roots).

- Regarding organic % C, because this activity did not calculate the organic % C content in the laboratory, it was agreed to use a value of 0.47 as a constant.

III. RESULTS AND DISCUSSION

Biomass Content

The calculation of above-ground biomass includes the main stem, twigs, branches, and leaves. Field sampling showed that no branches were found because the entire sample tree experienced branching of the main trunk at a height of less than 1.3 m (DBH limit). In the context of vegetation analysis, this condition refers to the technical calculation of DBH and it is stated that the 'branches' still include the main stem. Therefore, as a result, the definition of a branch which is a branch of a branch is considered a 'branch'. However, in technical calculations, aboveground biomass is still considered as a twig, and branches on the main stem before a height of 1.3 m are considered as part of the main stem.

Tree Volume

Volume can be calculated which can then be used for biomass calculations using variables such as density, tree diameter, tree height which can be seen in table 1.

Table 1. Tree Volume per Station

Station	Type	Average Diameter (cm)	Height (m)	Volume (m^3/ha)
1	*Avicenia alba*	5.96	6.4	3.76
	Rhizophora mucronata	6.55	6.71	3.32
	Sonneratia alba	9.55	8.57	9.70
	Total	7.35	7.23	16.78
2	*Rhizophora mucronata*	7.76	5.37	14.69
	Avicenia alba	6.05	6.5	0.77
	Total	6.91	5.93	15.46
3	*Avicenia alba*	5.77	5.70	5.67
	Rhizophora mucronata	8.60	5.07	10.98
	Total	7.19	5.38	16.65

(Source : Primary Data 2022)

From the calculation of the average diameter and height of mangrove stands can be determined volume. At station 1 the total volume is 16.78 m3/ha which is the highest volume, at station 2 is 15.46 m3/ha, and at station 3 16.65 m3/ha. According to Bismark et al (2008) the factors that affect the volume are tree diameter, tree height, density level, and age of mangrove trees.

Wood Density

The density of wood can be seen or known by taking wood samples directly, then the samples are dried using an oven at 80oC for 48 hours and the dry weight can be determined by weighing the dried samples. The results of the analysis of the density of wood can be seen in Table 2. below:

Table 2. Wood Density

No	Type	Dry Weight (g)	Vol (ml)	Density (g/ml)	Density (kg/l)
1	*Avicenia alba*	4.7	8	0.588	588
2	*Avicenia alba*	5	6	0.833	833
3	*Avicenia alba*	6.2	8	0.775	775
		Average Density		0.730	730
4	*Rhizophora mucronata*	4.8	5	0.960	960
5	*Rhizophora mucronata*	5.2	7	0.743	743
6	*Rhizophora mucronata*	6.3	8	0.788	788
		Average Density		0.830	830
7	*Sonneratia alba*	5.2	8	0.650	650
8	*Sonneratia alba*	5.8	9	0.644	644
9	*Sonneratia alba*	6.5	11	0.591	591
		Average Density		0.630	630

(Source : Primary Data 2022)

The results of laboratory research showed that the density of wood of the Avicenia alba species was 730 kg/l, then the density of Rhizopora mucronata was 830 kg/l, and the density of Sonneratia alba was 630 kg/l. The difference between the results of laboratory analysis and previous research is thought to be due to differences in the place or geographic location of sampling. According to Marsoem et al (2014) that can cause the effect of value on wood density is tree age, tree diameter circumference, soil fertility.

Biomass Estimation

Biomass is the total amount of living matter above the surface of each tree species in tons of dry weight per unit area. Estimation or estimation of biomass can be done after knowing the volume of trees and wood density at each observation station. Further biomass estimation can be seen in Table 3. below:

Table 3. Biomass Estimation

No	Type	Leaf Biomass (ton/ha)	Twig Biomass (ton/ha)	Branch Biomass (ton/ha)	Stem Biomass (ton/ha)	Biomass Total (ton/ha)
1	*Avicennia alba*	4.87	12.12	21.93	6.83	45.75
2	*Rhizopora mucronata*	2.56	5.90	10.13	24.06	42.64
3	*Soneratia alba*	0.44	1.48	2.10	6.11	10.13
	Total (ton/ha)	7.86	19.49	34.16	37	98.52

(Source : Primary Data 2022)

If depicted in a bar graph is shown as follows, then each type can be known the contribution of its biomass in more detail. Trunk is the highest biomass compared to other structures, this is because there are differences in wet weight and dry weight which greatly affect the amount of biomass in the mangrove ecosystem. Differences in the amount of biomass in tree species along with the addition of tree age and density. Density or stands is a factor that can affect trees because of competition for sunlight which is used in the photosynthesis mechanism.

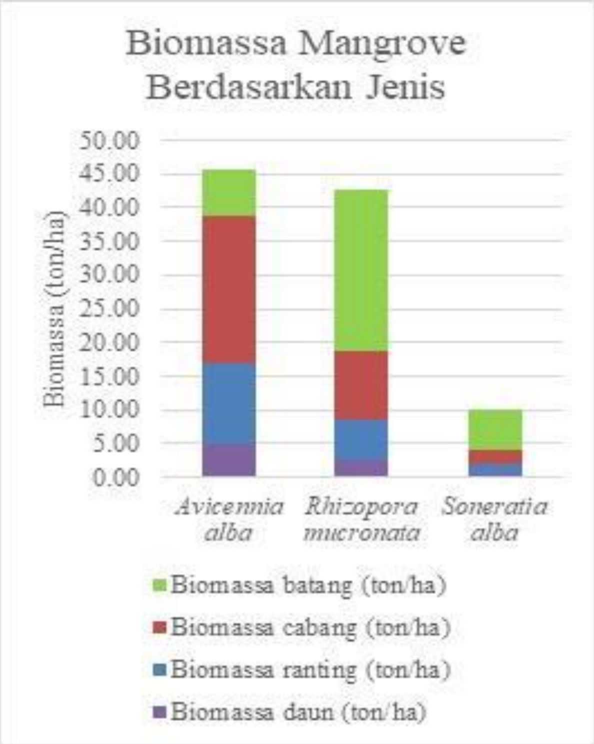

Fig. 1: Mangrove Biomass Bar Chart by Type (ton/ha)

Shows that Avicennia alba has the largest biomass in contributing to the mangrove ecosystem in Mekarsari Village, then Rhizopora mucronata contributes quite a lot, and Sonneratia alba is a species that contributes lower than other species. While the plant organs that contributed the highest biomass were stems, branches, twigs, and leaves.

Blue Carbon Stock

Blue carbon stock is carbon found in marine and coastal ecosystems, one of which is found in mangrove ecosystems. The mangrove ecosystem is a plant that absorbs carbon from the air to carry out the photosynthesis process, the carbon is stored in the structure of the mangrove tree where the most storage is in the trunk, branches, and in the soil substrate. The larger the diameter of the stem of a species, the more it can store the blue carbon stock. The blue carbon stock in Mekarsari Village can be seen in Table 4. Below

Table 4. Blue Carbon Stock by Station

Station	Type	Biomass (ton/ha)	Carbon (ton/ha)
1	*Avicenia alba*	16.66	7.83
	Rhizophora mucronata	5.07	2.38
	Sonneratia alba	10.13	4.76
	Total	**31.85**	**14.97**
2	*Rhizophora mucronata*	21.73	10.21
	Avicenia alba	11.56	5.43
	Total	**33.29**	**15.65**
3	*Avicenia alba*	17.53	8.24
	Rhizophora mucronata	15.85	7.45
	Total	**33.38**	**15.69**
	Total Ton (C/ha)		46.30

(Source : Primary Data 2022)

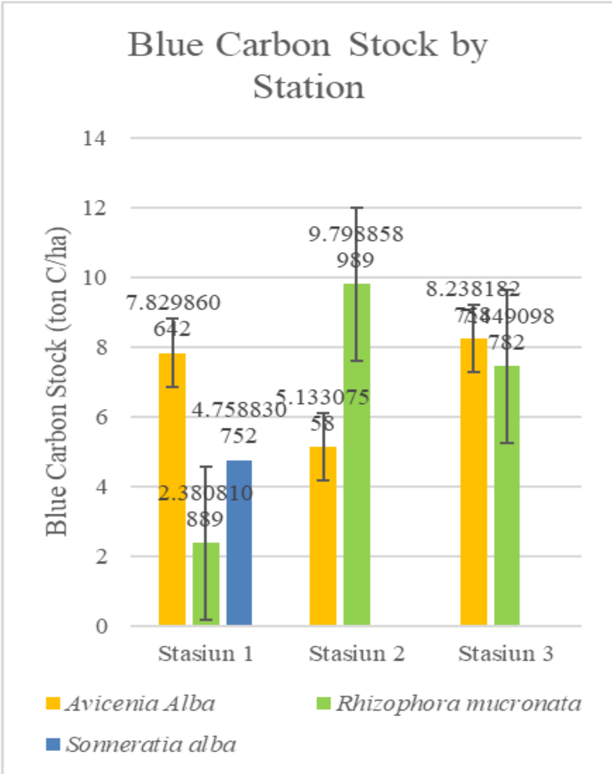

Fig. 2: Blue Carbon Stock by Station

It can be seen in table 4 above that the carbon potential at each level of vegetation on its biomass. According to (Rachmawati, et al. 2014) at the top of the surface the amount of carbon content depends on the amount of total biomass. The greater the biomass, the greater the potential for trees to store carbon. Based on the research conducted, it was found that the potential for biomass content in the mangrove ecosystem in Mekarsari Village with the results of the blue carbon stock estimation analysis showed that the carbon stock at station 1 was 14.97 tons/ha, then at station 2 was 15.65 tons/ha, and at station 3 is 15.69 tons/ha.

Table 5. Blue Carbon Stock by Type

No	Type	Leaf Carbon (ton C/ha)	Twig Carbon (ton C/ha)	Branch Carbon (ton C/ha)	Stem Carbon (ton C/ha)	Total Carbon (ton C/ha)
1	*Avicennia alba*	2.29	5.70	10.31	3.21	21.50
2	*Rhizopora mucronata*	1.20	2.77	4.11	11.31	19.39
3	*Soneratia alba*	0.21	0.69	0.99	2.87	4.76
			Total			**46.30**

(Source : Primary Data 2022)

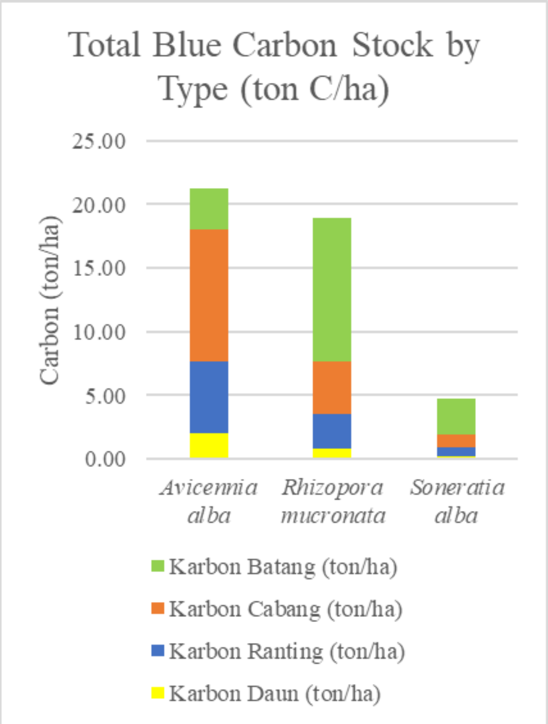

Fig.3: Blue carbon stock bar chart

Based on Table 5. the value of blue carbon stock in mangroves in Mekarsari Village, Tanah Laut Regency for Avicenia alba species is 21.50 tons C/ha, then for Rhizopora mucronata is 19.39 tons C/ha, and for Sonneratia alba is 4.76 tons C/ha. When compared with the results of Ananda Fitrian Anshary's research (2020), the value of carbon storage owned by Rhizopora mucronata in Bunati Village, Tanah Bumbu Regency has a carbon value of 370.32 tons C/ha. Therefore, the size of carbon storage in a vegetation is thought to depend on the amount of biomass contained in trees, soil fertility and the absorption capacity of the vegetation. It can be seen that there are differences in the number of 6 stations, and 81.17 ha in the mangrove area, and the sampling is done.

Amount of Blue Carbon Stock in Mekarsari Village

Table 6. Blue Carbon Stock Quantity in Mekarsari Village

Mangrove Area	Amount of Blue Carbon Stock	Total Carbon Store (ton C)
1,83 Ha	46.30	84,72

(Source : Primary Data 2022)

It can be seen from the data above, for the same type of prediction the amount of carbon stock can be different. This shows that the carbon stock is influenced by many things, including the amount that varies in each different location. This condition can be caused by limiting factors such as temperature and rainfall (Ariani, et al., 2016). In addition, it is suspected that temperature and water quality are factors that can cause differences in the amount of biomass and blue carbon stock deposits.

This study also provides information about the contribution of the mangrove ecosystem which can store CO2 emissions in the air in order to reduce the level of pollution that makes the atmosphere layer thicker. Therefore, the mangrove ecosystem can reduce or minimize global warming.

IV. CONCLUSION

The total value of biomass in the mangrove ecosystem in Mekarsari Village, Tanah Laut Regency based on the analysis results is 98.52 tons/ha. The total estimated amount of blue carbon stock in Mekarsari Village is 84.72 tons C/ha.

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