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Estimation of Absorption and Carbon Stock of *Rhizophora mucronata* and *Avicennia alba* in the Mangrove Conservation Area of Puntondo Village Laikang Village, Mangarabombang Sub-District, Takalar District

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Abstract
Takalar as one of the regencies in South Sulawesi Province has a large enough coastal area so that it is one of the biggest contributors to fishery and shopping potential in South Sulawesi. One of the quite strategic coastal areas in Takalar Regency is the coastal area of Puntondo Hamlet. This study aims to determine the level of density of mangrove ecosystems. In addition, this study also aims to determine the estimated value of carbon stocks in the types of Rhizophora mucronata and Avicennia alba as well as to determine mangrove carbon uptake. Research data were analyzed in a quantitative descriptive manner. The carbon content is calculated based on the carbon value which is the result of laboratory measurements and the full area. Mangrove forests are able to absorb CO_2 for processing waste materials, spawning grounds, and others. The results of the research on estimating carbon stocks and absorption of Rhizophora mucronata and Avicennia alba are for an average mangrove carbon stock of 0.0151 ton/ha. For carbon uptake, an average value of 0.0857 tons/ha was obtained.

Keywords: Carbon Stock Estimation, Carbon Uptake Estimation

Introduction
Mangrove forests have the potential to bind CO_2 from the atmosphere which is commonly called blue carbon which has a very important ecological function for coastal ecosystems as a carbon sink and store so that it can reduce the increase in carbon emissions in nature (Mcleod, 2011) [6]. Puntondo Hamlet is one of the hamlets in Takalar Regency which has a mangrove ecosystem.

The decline in the number of mangrove forests due to human or other activities has an impact on the absorption of carbon in the earth. The decline in mangrove forests in the world by 30-50% in the last half century is due to coastal development, expansion of ponds and tree felling (Donato, 2011) [3].

Mangroves can absorb CO_2 from the atmosphere through the photosynthesis mechanism. The absorbed CO_2 will be stored in the form of above-ground biomass, below-ground-biomass and accumulates in sediments (Kauffman, 2011) [3]. The results of this study are expected to provide information about the uptake and estimated value of carbon stocks from the mangrove species Rhizophora mucronata and Avicennia alba so that they can assist in carbon dioxide mitigation efforts, mangrove conservation efforts and have a positive influence on minimizing global warming that occurs such as sea level rise (sea level). (Rise level).

Research Purposes
Based on the description of the problem formulation, this study has several objectives as follows:

1. What is the density level of the mangrove ecosystem in the Mangrove Conservation Area of Puntondo Hamlet, Laikang Village, Mangarabombang District, Takalar Regency?
2. What is the estimated value of carbon stock in the types of Rhizophora mucronata and Avicennia alba in the Mangrove Conservation Area of Puntondo Hamlet, Laikang Village, Mangarabombang District, Takalar Regency?

Research Methods
The research was conducted in December 2022 – January 2023. Located in the Mangrove Conservation Area of Puntondo Hamlet, Laikang Village, Mangarabombang District, Takalar Regency, South Sulawesi.

Fig 1: Sample Research Location Map Image

Tools and Materials

The tools and materials used in this study are roll meters for transect line measurements, GPS, Plastic Ziplock Clips / Sample Bags to store samples taken from the field, Measuring Ropes to measure the circumference of mangrove tree trunks, stationery, duct tape, mobile phone cameras, hand saws to cut small parts of trunks and roots to be collected and converted with predictions of conditions in the field, Scales to determine the weight of leaves and also other sampling are weighed using this tool.

Sampling Method

Mangrove sampling on the types of *Rhizophora mucronata* and *Avicennia alba* was taken from sub-samples of stems, leaves, roots. The data collected consists of primary data and secondary data. Primary data collected directly from the place where the object of study was conducted. Secondary data is sourced from literature from related agencies or institutions such as the Ministry of Environment, National Standards Agency and other literature that supports research.

Data Analysis

Knowing the level of density of mangrove ecosystems adjusted to the Standard Criteria for Mangrove Damage (Kepmen LH No. 201 of 2004). Knowing the value of biomass by calculating stem biomass and root biomass, then knowing the estimated value of carbon stock by calculating carbon content and calculating carbon uptake to obtain carbon dioxide absorption value.

Data processing and statistical tests in this study use the help of statistical data processing programs. Statistical tests and data analysis used are:

a. Mangrove Type Density Analysis

Specific density (*Di*) is the number of stands of the type to -in a unit area. To determine the density of mangrove species using a formula. (English *et al*, 2994):

$$Di = \frac{Ni}{A}$$

Di: Type density to- I (ind/m^2)
Ni: Total number of individuals of the -i (ind)
A: The total sampling area (m^2).

Table 1: Standard Criteria for Mangrove Damage

Criterion		Density (tree/ha)
Good	Very dense	≥ 1.500
medium	medium	≥1.000-< 1.500
broken	rarely	< 1.000

Source: (Kepmen LH No. 201 Year 2004)

b. Tree Biomass Estimation

1. Rod Biomass Value

To calculate the value of stem biomass using the following formula (Komiyama *et al*, 2008).

$$BK = 0{,}251 \times \rho \times D^{2,46}$$

Information:
B: Biomass (kg)
ρ: Specific Gravity of Wood (gr/m^3) (*Rhizophora mucronata* 0,701 dan *Avicennia alba* 0,506)
D: Tree diameter (cm).

2. Calculating Biomass Value (root)

To calculate the value of biomass (roots) using the following formula (Komiyama, 2008).

$$BK = 0{,}199 \times \rho^{0,899} \times D^{2,22}$$

Information:
B: Biomass (kg)

ρ: Specific Gravity of Wood (gr/m^3) (*Rhizophora mucronata* 0,701 dan *Avicennia alba* 0,506)
D: Tree diameter (cm)

3. Calculating Total Biomass

To calculate the total biomass, the following formula is used (Pamudji, 2011).

B total (Tree Biomass) = BAP (Trunk) + BBP (Root)

c. Carbon Stock Analysis

To determine the carbon stock in mangrove tree stands can be done by converting biomass data obtained from the field into a formula for measuring/ estimating carbon content. The formula for calculating carbon in mangroves refers to the formula of the National Standard Agency (2011) [1], namely:

Kc = B x %C Organic

Information:
Kc: carbon content of mangrove biomass (kg)
B: Total Biomass (kg)
%C Organic: Presentation value of carbon content, amounting to 0.47 or using the percent value of carbon obtained from laboratory measurements

Results and Discussion

Analysis of Mangrove Ecosystem Density

Mangrove vegetation found at the study site consisted of 2 species, namely Rhizophora mucronata and Avicennia alba. The density of mangrove tree stands is an indicator in determining the size of the biomass value. Thus, density will also affect carbon content and CO2 uptake. It is suspected that there is a relationship between density to biomass, carbon content and CO2 uptake (Asbar, 2022).

Mangrove density is one of the analyses used to determine the size of biomass value and estimate carbon stocks in mangroves. The results showed that Station 1 has a higher density than Station 2 and is classified as very dense with good criteria by referring to the Decree of the State Minister of Environment No. 201 of 2004 that the quality standard criteria for mangrove density, density is very dense ≥ 1,500 ind / ha, while ≥ 1,000 - 1,500 ind / ha and rarely < 1,000 ind / ha.

Table 2: Density of Mangrove Species in the Mangrove Conservation Area of Dusun Puntondo

Station	Species	PLOT				Average	Density
		I	II	III	Total	(Ind/100m^2)	Di (Ind/ha)
1	*Rhizophora mucronata*	20	5	24	49	16,33	1633
	Avicennia alba	6	5	6	17	5,67	567
	Amount	26	10	30	66	22,00	2200
2	*Rhizophora mucronata*	14	25	23	62	21	2067
	Amount	14	25	23	62	20,67	2067

The type of *Rhizophora mucronata* is found in the Puntondo Hamlet Mangrove Conservation Area because this type is a type of mangrove whose growth is tolerant of environmental conditions and can spread widely and can grow upright in various places.

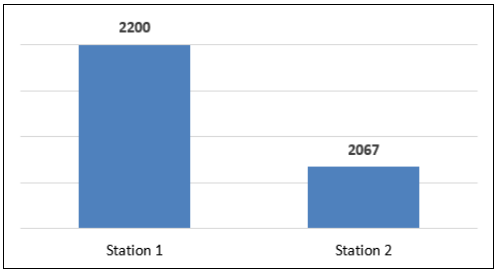

Fig 2: Density Graph at Station 1 and Station 2 (Ind/ha)

Carbon Stock Estimation Analysis

By using the formula of the National Standard Agency (2011) [1], calculations can be made to obtain carbon stock values in mangrove biomass. Below are the results of carbon stock calculations from mangrove biomass samples obtained in the Puntondo Hamlet Mangrove Conservation Area. Carbon stocks contained in mangrove forests are obtained by multiplying total biomass x C- Organic.

Table 3: Carbon stock of *Rhizophora mucronata* and *Avicennia alba* mangrove biomass

Station	Species	Part	Carbon Stock (Kg/m^2)	Carbon Stok (Ton/ha)
1	*Rhizophora mucronata*	Akar	0,0007	0,0068
		Batang	0,0008	0,0083
		Daun	0,0004	0,0036
		Total	**0,0019**	**0,0187**
	Avicennia alba	Akar	0,0005	0,0051
		Batang	0,0006	0,0056
		Daun	0,0004	0,0037
		Total	**0,0014**	**0,0144**
2	*Rhizophora mucronata*	Akar	0,0005	0,0046
		Batang	0,0004	0,0042
		Daun	0,0005	0,0049
		Total	**0,0014**	**0,0136**
Averange			**0,0015**	**0,0151**

The results showed that the carbon stock content of the Rhizophora mucronata mangrove species was 0.0255 tons/ha, while the Avicennia alba mangrove species had a carbon stock of 0.0144 tons/ha.

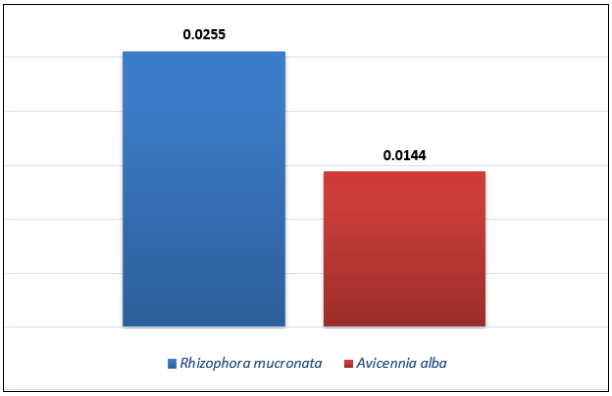

Fig 3: Comparison of carbon stock values *in Rhizophora mucronata* and *Avicennia alba* mangroves at each station (tons/ha)

Conclusion

Based on the results and discussion of the research, it is concluded that:

1. The density level of the mangrove ecosystem in the research location is classified as medium to dense. The

carbon stock content of the *Rhizophora mucronata* mangrove species is 0.0255 tons/ha while the *Avicennia alba* mangrove species has a carbon stock of 0.0144 tons/ha. With an average of around 0.0151 ton/ha.

2. As for the suggestions in this study, it is suggested that there be further research regarding the potentials of carbon stocks and absorption in every other type of mangrove found in the Mangrove Conservation Area of Puntondo Hamlet, Laikang Village, Mangarabombang District, Takalar Regency.

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