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Atmospheric carbon dioxide uptake by mangrove trees

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ABSTRACT
Background:. This study was written in the aim of knowing how to calculate the carbon uptake by mangrove using steps that had been done by previous study, also knowing which type of mangrove that absorbs most of the carbon. **Methods**: This paper is compiled by collecting related data from various library sources, such as online articles and other scientific journals. Most of the similar papers are quantitative methods where calculation is needed and previous data study. **Results**: The result of this research is that mangrove has the ability to absorb carbon dioxide based on the diameter of the tree as a factor of the value of carbon uptake. In Indonesia, Rhizophora mucronata is the best mangrove species to carbon sequestration in forest with 43.130,21 kg C/ha, which is followed by Bruguiera gymnorhiza, Soneratia alba, and Avicenia alba.

KEYWORDS: absorption; carbon; mangrove.

1. Introduction

Climate change and global warming is the main problem that has been faced by all humans on any side of the world. Some people have tried to mitigate the cause of it. There are a lot of things to do, but still can not stop global warming. One of the factors is greenhouse gases (GHG). Greenhouse gases (GHG) are consist of carbon dioxide (80%), methane (10%), nitrous oxide (7%), fluorinated (3%). Based on the data, carbon dioxide (CO2) has a big role in the cause of global warming, it is able to cause the higher temperature in the atmosphere. The act that should be done now is to reduce the amount of carbon dioxide (CO2) in the atmosphere. It is a role to everyone and every aspect. From maritim aspect, there are roles of ocean and coastal areas.

Mangrove is one of the plants in coastal areas that can absorb carbon dioxide and store it for photosynthesis in a big amount. Various types of mangrove have different values in absorbing the carbon in the atmosphere. There are several reasons that affect absorption which will be learned through this study.

In this study, the aim is to know how many carbon uptakes by mangrove with the calculation that has been known from previous study. This study hopes to help others any further study in gaining the data and the method of how to calculate the carbon uptakes by living trees, the most especially mangrove.

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2. Methods

This paper is compiled by collecting related data from various library sources, such as online articles and other scientific journals. Most of the similar papers are quantitative methods where calculation is needed and previous data study. Based on the Winrock International, calculating the carbon stock in the live tree used the steps:

a. Calculating the horizontal area and the scaling factor for each plot or subplot (if the slope has been made during the research, this step could be skipped.)
b. Calculating the aboveground biomass using the selected allometric equation and weight of average sapling for each tree in the plot.
c. Multiplying the tree biomass by the exact scaling factor based on the size of the plot.
d. Converting biomass in kilograms to biomass in tons (if capable). Kg dry biomass is often used as the units of biomass in allometric equations, which case conversion to tons requires multiplying by 0.001.
e. Summing the biomass per hectare of all trees across all nests in each plot.
f. Applying appropriate equation or R/S ratio for calculation of belowground biomass.
g. Converting estimates of biomass to carbon by using the equation

$$C_p = DM \times CF \quad \text{(Eq. 1)}$$

Where:

$C_p = carbon\ stock\ in\ plot\ \left(t\frac{C}{ha}\right)$
$DM = dry\ biomass\ in\ plot\ t\frac{drymatter}{ha}$
$CF = carbon\ fraction\ (t\frac{C}{t}dry\ matter)$

h. Calculating the mean and confidence interval of aboveground and belowground carbon pools for the stratum.

Carbon uptake in mangrove tree started from calculating the biomass and proceeded with calculating the carbon dioxide uptake by the mangrove.

2.1 Biomas calculation

Biomass calculation used stem diameter and height of the mangrove. Mangrove's diameter could be calculated by calculating the diameter breast height (DBH) which is more or less than 1.3 meters.

$$Biomass = 0.25 \times \rho D \quad \text{(Eq. 2)}$$

Where:

$\rho = wood\ specific\ gravity$

2.2 Carbon in biomass

$$Biomass = 0.25 \times \rho D \quad \text{(Eq. 3)}$$

Where:

50% is the known percentage value of carbon content in biomass

2.2 Carbon content

$$CO_2 = \frac{Mr\ CO_2}{Ar\ CO_2} \quad \text{(Eq. 4)}$$

or

$$CO_2 = 3.67 \times carbon\ content \quad \text{(Eq. 5)}$$

3. Results and Discussion

The method was used by knowing the species of mangrove itself. In Indonesia, there are several types of carbon.

Table 1. Type of Mangrove in Indonesia

Type of Mangrove in Indonesia	Specific Type
Avicennia	*A. alba, A. eucalyptifolia, A. lanata, A. marina, and A. officinalis*
Bruguiera	*B. cylindryca, B. exaristata, B. gymnorrhiza, B. haenessii, B. parviflora, and B. sexangula*
Ceriops	*C. decandra and C. tagal*
Rhizophora	*R. apiculata, R. mucronata, and R. stylosa*
E. Sonneratia	*S. alba, S. caseolaris, and S. ovata*

Analysis of carbon uptake can be done by converting carbon dioxide molecules then diverting carbon content in mangrove tree biomass. Iksan, et all has taken data in the fieldwork about some carbon that has been taken from some species of mangrove in Indonesia in 2019.

Table 2. Carbon absorption values

Species of Mangrove	Carbon Uptake (Kg C/ha)
Bruguiera gymnorhiza	27.185,44
Avicenia alba	9.606,99
Soneratia alba	13.670,29
Rhizophora mucronata	43.130,21

Carbon is a component that is absorbed from the atmosphere and stored in the form of biomass through the process called photosynthesis. Climate, geography, land features, age and density of vegetation, species composition, and quality of growth sites all impact the amount of carbon sequestration in forest.

Based on the table 2., *Rhizophora mucronata* has the highest value of carbon uptake with 43.130,21 kg C/ha. It is followed by *Bruguiera gymnorhiza* with 27.185,44 kg C/ha, *Soneratia alba* with 13.670,29 kg C/ha, and *Avicenia alba* with 9.606,99 kg C/ha. The variation in stored carbon stocks is related to the changes in tree diameter, which the wider the diameter of the trees that make up a land, the higher the weight of tree biomass on the land. The quantity of carbon stock in a land is affected by biomass weight. Instead, a high density does not ensure a high capacity for carbon absorption and storage. However, the ability of enzymes in photosynthesis to convert CO2 into biomass is impacted by the work of photosynthesis enzymes, since each kind has a distinct photosynthesis capacity.

Species with a high density and ability to store carbon are better equipped to adapt to changing climatic circumstances, increasing the success of climate mitigation initiatives.

4. Conclusions

Mangrove has the ability to absorb carbon dioxide based on the diameter of the tree as a factor of the value of carbon uptake. In Indonesia, *Rhizophora mucronata* is the best mangrove species to carbon sequestration in forest with 43.130,21 kg C/ha, which is followed by *Bruguiera gymnorhiza, Soneratia alba*, and *Avicenia alba*.

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