# ESTIMATION OF CARBON STOCK IN MANGROVE FOREST

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## ABSTRACT

*Pagatan Besar mangroves can be considered as a $CO^2$ buffer system in Tanah Laut regency. This study aims to find out the carbon content stored on Pagatan Besar mangrove stands. The method used in this study is a survey method with purposive sampling techniques. The results showed that the degree of dominance of mangrove species in Pagatan Besar is Avicennia marina. The potential biomass in mangrove stands in Pagatan Besar is 40.10 tons / ha, with carbon stocks of 18.85 tons / ha. Based on the potential of biomass and carbon obtained shows that the ability of mangrove ecosystems to absorb carbon in Pagatan Besar is still low.*

**Keywords:** Biomass, Carbon Stock, Mangroves, Pagatan Besar

## INTRODUCTION

Carbon stocks in mangrove forests are thought to come mostly from the wet tropics [1],[2],[3]. Annual rainfall and air temperature are important drivers of carbon stocks in tropical and sub-tropical mangrove forests[4],[3]. Increased rainfall is associated with higher productivity of mangroves, which can be stored in the soil[5]. Mangrove forests in humid tropical regions can store most of their carbon reserves in biomass above and below ground[6],[7].

Indonesia's emissions represented 4.8% of total global emissions in 2015. Emissions that occur in Indonesia are mostly caused by forest conversion and forest burning. Carbon dioxide sinks are closely related to standing biomass. The amount of biomass in an area is obtained from the production and density of biomass, which is thought to be derived from measurements of diameter, height, specific gravity and density of each tree species. Biomass and carbon sinks in tropical forests are forest services beyond other biophysical potentials. The large potential of forest biomass means that it absorbs and stores carbon in order to reduce CO2 levels in the air. The direct benefit from forest management in the form of optimal timber products is only 4.1%. While the optimal function on carbon absorption reaches 77.9% [8]

Based on this, a study of the potential for biomass and carbon contained in mangrove forest vegetation needs to be carried out to determine the capacity of the environmental service function that the mangrove forest ecosystem can play in Pagatan Besar Village in helping to reduce carbon dioxide emissions.

The mangrove forest area in Tanah Laut district continues to suffer damage caused by the opening of ponds, coastal erosion and lack of public awareness, one of which is the mangrove forest in Pagatan Besar village. The existence of intense population activities on mangrove forests has a significant potential to trigger the rate of carbon emissions. Mangrove forests in this context then become very important related to their role as carbon sinks and stores. The amount of carbon stored in the body of vegetation (biomass) can describe the amount of carbon dioxide in the atmosphere that is absorbed by the vegetation. The amount of mangrove vegetation biomass in Pagatan Besar Village can illustrate how much capacity the


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mangrove forest has in reducing or suppressing the amount of carbon emissions produced by human activities, which is an aspect of environmental services that plays a very crucial role, especially related to the presence of human activities that are there. . Efforts to determine the potential of mangrove forests to become carbon sinks and their role in mitigating climate change can be done through research on the estimation of carbon stored in mangrove forests. The purpose of this study is to estimate the carbon stored in mangrove stands in Pagatan Besar Village, Takisung District, Tanah Laut Regency.

## METHOD

### Data retrieval

Sampling was carried out on the mangrove forest ecosystem in Pagatan Besar Village, Takisung District, Tanah Laut Regency, South Kalimantan Province (Figure 1).

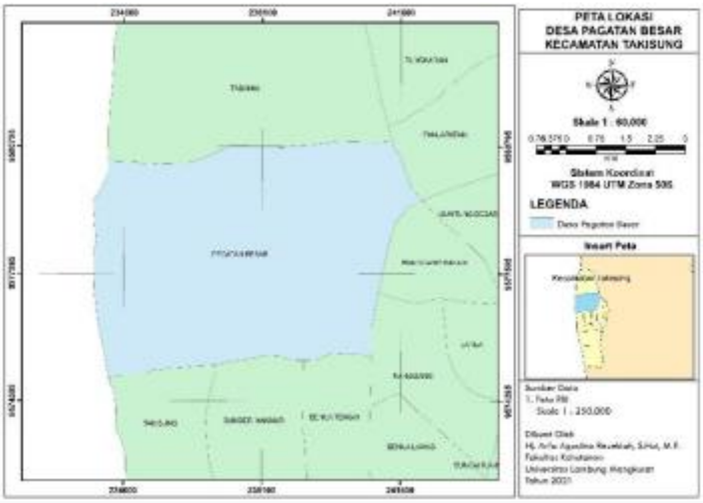


Figure 1. Research Location Map

The method used in this study is the survey method, which is to conduct observations and sampling directly in the field and analysis in the laboratory. Determination of sampling stations is done by purposive sampling method, which determines the location of the study intentionally by considering and paying attention to the condition of the surrounding research area. The research location is divided into 3 stations that are considered to represent the mangrove ecosystem area in the Pagatan Besar. Station 1 is located in a natural or relatively good mangrove forest area, Station 2 is located in a mangrove forest area that is between the natural mangrove forest area and the forest area that is adjacent to the settlement of the population. Station 3 is located in a mangrove forest area that is affected by human anthropogenic activity because it is adjacent to the settlement of residents.

The collection of rod biomass data is done by measuring chest-high diameter in an observation plot of 20 m x 20 m. Diameter measurements are only done on rods that are ≥ 5 cm in diameter using a meter band [9]. The collection of waste biomass data was carried out on a sub-plot of observation of litter measuring 0.5 m x 0.5 m on each plot. All the litter in the sub-plot is taken, cleaned of mud then weighed to get a total wet weight. Litter taken, then used as a sub-example weighing 100 gr. If the weight of all examples of a plot does not reach 100 gr then all the litter from the sample plot is considered a sub-example. Litter in the oven at $800^{C}$ until the weight is constant [10].



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## Amount of Carbon stock

Determination of carbon stock is done using conversion rates, which is 46% of the total biomass because the concentration of carbon in organic matter is usually 46%[10]. Mangrove biomass calculations in this study use allometric equation methods. Allometrics is defined as the study of a relationship between the growth and size of one part of an organism with the growth or size of the whole organism.

The density that gives an idea of the number of individuals per hectare is calculated by a formula that refers to [12]. As follows:

$$K = \frac{I}{Lplot} x\ 1000$$

Description:
K = Density of a species (Individual/ha).
I = Number of individuals
Lplot = Area of the entire plot ($m^2$)

Mangrove carbon restoration models can be built on the similarity of biomass values with diameters. Calculating biomass and carbon from mangrove ecosystems can be done with the following formula: Carbon potential and Biomass

$$= \sum_{i=1}^{n} \frac{yi}{luas\ plot}\ x \text{ luas mangrove}$$

Description:
Yi = biomass potential per species
i = i-th type

Biomass and carbon estimation model of mangrove ecosystem for Avicennia spp. Species
$Wtop = \rho * 0.1848 DBH^{2.3524}$ [13]
Description:
Wtop = Tree biomass or dry weight (kg)
ρ= Density of wood or Density of wood (mg $m^{-3}$, kg $dm^{-3}$ or g $cm^{-3}$)

Calculation of carbon from biomass uses a formula that refers to (National Standardization Agency [12], is:
Cb = B x %C organic
Description:
Cb = carbon content of biomass, expressed in kilograms (kg);
B = total biomass, expressed in (kg);
%C organic = percentage value of carbon content, 0.47

## RESULTS AND DISCUSSION

Pagatan Besar village is bordered by Tabanio Village to the north, Takisung Village to the south, Ranggang Village to the east, and Java Sea to the West. Bordering the sea causes the topography in The Village of Pagatan Besar varies with a stretch of area consisting of a beach / coastal area of 25 ha, lowland area of 32,114 ha, swamp area of 1,150 ha and river flow of 25 ha [14].

Mangrove conditions in Pagatan Besar are relatively thin, and the condition of the soil is dry to wet and around the mangrove forest there are crossed by the trench so that the association biota can live. The association biota that lives on the observation station is glodok fish,




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mangrove crab, gastropod, and fish cubs and the position of the first station close to the soka crab pond while at the second station on the beach or on the beach. The biota-biota live in relation to mangrove forests, so that if the mangrove forest is damaged then the biota will be reduced..

The mangrove forest that grows in Pagatan Besar can be said to be damaged because there are already many association plants, because the associated plants in the mangrove forest are an indicator that the mangrove forest can be said to be damaged. Associated plants are hibiscus trees, ketapang and other forest trees which are indicators of damage to a mangrove forest ecosystem.

Mangrove forests in The Village of Pagatan Besar are a type of Api-apian (*Avicennia marina*, *Avicennia alba*, in addition there are types rambai (*Sonneratia alba*), and bakau (*Rhizophora apiculata*). This type of mangrove usually grows on the beach because it requires high salinity in addition to the type of mangrove is in the front zoning.

Observations made at 3 stations showed that at this time there were no tree-sized plants. The highest level is the pole level which is dominated by the type of *Avicennia marina*. *Avicennia* sp is found at all levels of vegetation. There are only 4 types of mangrove plants found at the observation site, namely *Avicennia marina*, *Avicennia alba*, *Acanthus* sp and *Cerbera manghas*. Overall, the type of biodiversity diversity in the area is still low with the showing of at least the type of vegetation found. In Table 1 can be seen the density of mangrove plant species found at all stations..

**Table 1. Mangrove Density in Pagatan Besar Mangrove**

| Station | Type Mangrove | Density(trees/ha) | | |
|---|---|---|---|---|
| | | Pole | Stake | Seedling |
| I | *Avicennia marina* | 433.33 | 666.67 | 9167 |
| | *Avicennia alba* | - | 666.67 | |
| | *Acanthus sp* | | | 3333 |
| II | *Avicennia marina* | 233.33 | 266.67 | |
| | *Cerbera manghas* | | 400 | |
| III | *Avicennia alba* | | 800 | |

The dominance of *Avicennia marina* is because at all three observation stations have entered the open mangrove zone, namely mangroves that are directly opposite the sea, according to [15] the type of *Avicennia marina* tends to dominate more muddy areas this is in accordance with conditions in the Pagatan Besar area.

**The Potential of Carbon stock in Mangrove Vegetation in Pagatan Besar**

Mangrove ecosystems in coastal areas are very effective and efficient in reducing the concentration of carbon dioxide (CO2) in the atmosphere, because mangroves can absorb CO2 through the process of photosynthesis by diffusion through stomata and then store carbon in the form of biomass [16] Therefore, most of the biomass in mangrove vegetation is carbon and the carbon value contained in mangrove vegetation is the potential of mangroves in storing carbon. One way to find out the value of carbon stock possessed by mangrove vegetation is to estimate it[17].

The net production value produced by mangrove ecosystems in its ability to absorb carbon according to the data [18] as follows: total biomass (62.9-398.8 tons / ha), litter fall (5.8-25.8 tons / ha / year) and per volume (9 m3 / ha / year) in the mangrove ecosystem stands aged 20 years. The bio-time potential of a good mangrove ecosystem in Southeast Asia ranges from 250-275 tons/ha, while the lowest biomass potential is less than 7.9 tons/ha[19].

The total potential of mangrove ecosystem biomass at the research site is 40.10 tons / ha, it shows the potential for biomass in the Pagatan Besar mangrove ecosystem area is still low. According to [10] and [13], the high biomass potential of a mangrove ecosystem is due to the diversity, soil fertility rate and tree density and the way of management of existing ecosystems in the region.

The carbon potential stored on mangrove stands in Pagatan Besar is able to absorb carbon of 18.85 tons / ha. The ability of carbon sequestration is still low, it is necessary to do mangrove conservation activities in Pagatan Besar so that the ecological benefits of mangroves as carbon sinks can reduce the impact of global warming that occurs in the coastal region.

The value of biomass in addition to being influenced by the density of the tree is also influenced by the size of the diameter of the tree itself, this is because the larger the diameter of a tree, the greater the biomass value. This state corresponds to the diameter of the tree at the research site, where the average diameter is only 13.51 cm. The effect of the high value of the diameter of the trunk on the biomass value of a tree stand is very large compared to the density in line with the opinion [20] that there is a close relationship between the dimensions of the tree (diameter and height) with the biomass especially with the diameter of the tree. Along with the growth of a tree stand it will produce a large value of biomass and carbon stock also because there is absorption of $CO^2$ from the atmosphere through the process of photosynthesis produces biomass which is then allocated to leaves, branches, stems and roots which results in the addition of the diameter and height of the tree.

The value of biomass that has been obtained can indicate how much carbon content is available or stored on a stand. Nearly 50% of a plant's biomass is composed of carbon [21]. For that, the greater the value of biomass, the greater the content of carbon stock will also be greater. If a forest is converted into agricultural land, plantations, and industrial areas, then the amount of carbon stored will decrease or decrease and even disappear so that carbon is released or carbon emissions that if it occurs continuously will lead to an increase in the amount of carbon dioxide in the air causing global warming.

The Mangrove Area of Pagatan Besar still requires intensive management. But at least, if in 1 ha of land in the area is able to produce biomass of 40.10 tons / ha and store as much as 18.85 tons of C / ha, then the area of only 10.5 ha is able to produce biomass of 421.05 tons or able to store carbon reserves as much as 197.93 tons. So that mangroves in the region are able to reduce the content of CO2 in the atmosphere by absorbing and storing in the form of carbon reserves, especially carbohydrates through the process of photosynthesis.

The results of total biomass calculations in the Pagatan Besar Area are still relatively low, showing that efforts are needed to maintain the integrity of natural forests, and replant the original trees of mangrove forests.

## CONCLUSION

The highest density is obtained in the type of *Avicennia marina* and the lowest in the type of *Cerbera manghas*. Biomass potential on mangrove stands in Pagatan Besar which is 40.10 tons / ha, with carbon stock of 18.85 tons / ha. Based on the potential of biomass and carbon produced, it shows that the ability of mangrove ecosystems to absorb carbon in Pagatan Besar is still low.



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