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CARBON STORAGE IN SEAGRASS BEDS IN THE LITORAL ZONE OF SANCANG BEACH, GARUT

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Abstract

The vast expanse of seagrass beds in coastal areas can provide many ecosystem services, one of which is the ability of seagrass beds to absorb and store carbon dioxide (CO2). Carbon dioxide gas (CO2) is one of the components of greenhouse gases that contribute to global warming. So the role of seagrass is very important in the ecosystem. This study aims to determine carbon storage in seagrass in the littoral zone of Sancang Beach, Garut Regency, which was carried out in April-June 2022. Determination of potential carbon storage was carried out by taking seagrass samples with a size of 20 cm x 20 cm, then drying to a constant weight. and calculated using a carbon conversion factor for seagrass biomass of 0.34. The results showed that the carbon content at Station 1 Cibako (145.9331 g C/m2) was higher than Station 2 Cikujangjambe (110.026 g C/m2) and Station 3 Ciporeang (117.771 g C/m2). The average carbon content at Sancang beach is 124,577 g C/m2. The conclusion is that in general the carbon storage below the substrate (below ground) in seagrass in the Litoral Zone of Sancang Beach has a greater value than the value of carbon storage above the substrate (above ground).

Keywords: Seagrass; Littoral zone; Carbon storage

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INTRODUCTION

One of the important ecosystems in the ocean is seagrass beds on the coast. Seagrass beds have many important roles on the coastline, including capturing sediment to prevent abrasion, as a place of upbringing, shelter, and foraging for marine life (Howard, et al., 2014). Another potential concern today is the ability of seagrass beds to absorb and store carbon through a process of photosynthesis known as blue carbon.

Globally, carbon emissions have increased at an unprecedented rate causing many negative impacts on individual species and natural ecosystems, as well as human health, infrastructure, and the economy (IPCC, 2021). One of the efforts to reduce carbon dioxide content, both in the atmosphere and in the oceans, is to use vegetation on land and in the sea to absorb and store carbon.

Vegetated coastal ecosystems, such as seagrass beds, mangroves, and tidal marshes, make a significant contribution globally to carbon storage in biomass and long-term absorption in sediment deposition (Duarte, et al., 2013).

The carbon dioxide absorbed will be converted into biomass in relation to the mechanism and metabolism of seagrass. As a primary producer seagrass fixates a certain amount of organic carbon and mostly enters the food chain, either hammering the decomposition process as litter or consumed directly by biota (Zurba, 2018). So seagrass beds play an important role in reducing the amount of CO2 in the atmosphere.

One of Indonesia's coastal areas that has the potential to store a lot of carbon is Sancang Beach, which is located in Garut Regency, because the seagrass beds on Sancang Beach are quite wide. In line with the research that has been carried out, 2 species of seagrasses from different families on Sancang Beach, namely Cymodocea rotundata and Thalassia hempricii, with a total cover value of 61.09% were found, which means that the seagrass cover conditions at the study site are included in the category of good or rich (Zulfadillah, et al., 2021). Seeing the condition of seagrasses on Sancang Beach which is still good or rich, and the absense of research on carbon storage Sancang Beach so this is possible to conduct studies on how much carbon storage is stored in seagrass beds. So far, Sancang Beach, which has begun to have human activities, it is feared that it can interfere with the existence of seagrasses. By therefore information about seagrass is very important because seagrass also has an important role in the ecosystem such as capturing sediment to prevent abrasion, as a place of upbringing, shelter, and foraging for marine life.

RESEARCH METHODS

The research was carried out at three stations, namely, Station 1 Cibako, station 2 Cikujangjambe and station 3 Ciporeang (Figure 1). Field observations and seagrass sampling were carried out in April 2022 while the carbon content test was carried out in May-June 2022 at the Biology Education Laboratory of Siliwangi University. Data collection was carried out by determining the density of vegetation at each station using a 50-meter t-line by dividing 3 sampling points, each point consisting of 6 plots measuring 50 x 50 cm (Rahmawati, et al, 2014).

Figure 1. Research location
Source. Google Earth

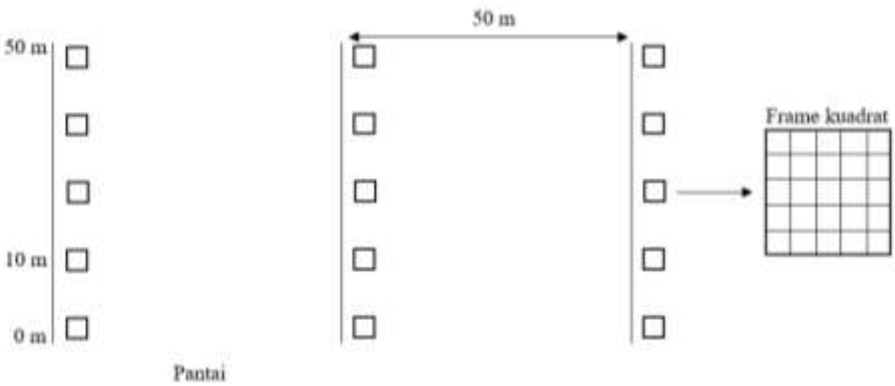

Figure 2. Research plots
Source. Personal documentation

Carbon deposits are obtained by taking the substrate as a sample of each stasiun measuring 20 cm x 20 cm. Seagrass separated top of the substrate (AS) (fronds and leaf blades) and the bottom of the substrate (BS) (roots and rhizomes). Then seagrass in the oven with a temperature of 60°C until the seagrass weight is constant. Dried seagrasses are weighed to determine the dry weight. The results of the dried seagrass sample were followed by an analysis of the carbon content in biomass using a carbon conversion factor for seagrass biomass of 0.34 (Agustin Rustam et al., 2019).

RESULTS AND DISCUSSION

Sancang Beach Conditions

Sancang Marine Nature Reserve has a coastline of ± 17 km. Because of its status as a Nature Reserve so that the state of the ecosystem is still well maintained, making mangroves, marine life such as coral reefs, macroalgae, echinoderms, and seagrasses can live and breed well at Sancang Beach.

Table 1. Environmental Parameter Measurement Results

Parameter	Unit	Average			Quality standards
		1st station	2nd station	3rd station	
Temperature	˚C	28,65±1,35	28,60±0,93	27,93±0,62	28-30
Salinity	‰	30,97±1,01	31,18±0,68	31,11±0,97	33-34
Kecerahan	%	100±0,0	100±0,0	100±0,0	-
Current speed	m/s	0,40±0,0	0,22±0,0	0,35±0,0	-
pH	-	7±0,0	7±0,0	7±0,0	7-8,5
DO	mg/L	5,40±0,16	5,36±0,13	5,34±0,0	>5

In general, the results of taking data on environmental parameters in the Sancang Beach seagrass ecosystem are in accordance with quality standards based on (PP RI Nomor 22 Tahun 2021, n.d.) concerning the implementation of Environmental Protection and Management.

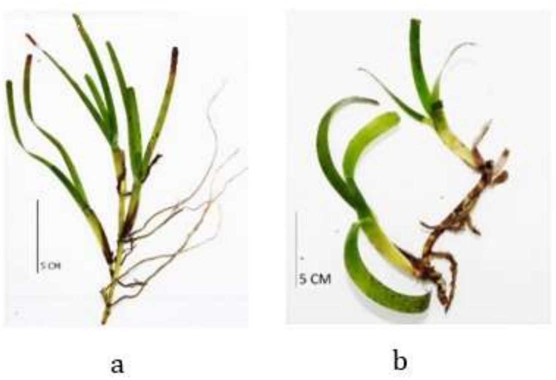

Figure 3. Types of seagrasses (a. Cymodocea rotundata, b. Thalassia hempricii)

Source. Personal documentation

There are two seagrass species found in the littoral zone of Sancang Beach, namely *Cymodocea rotundata* and *Thalassia hempricii*. *Cymodocea rotundata* has the general characteristics of straight, long leaves and has 1 leaf middle bone that does not stand out as well as a leaf blade is perfectly covered. The leaf tips of Cymodocea rotundata are letter m-shaped, and the special feature of the edges of the leaves is not jagged (Rawung, et al., 2018). As for Thalassia hempricii, it has special characteristics of brown spots on the leaves, rhizomes are thick and thick, and leaves similar to Cymodocea rotundata (Sjafrie, et al., 2018). Rhizoma is up to 5 mm thick, generally leaf length reached 40 cm and 0.4 – 1.0 cm wide, ribbon-shaped leaf blade (Syukur, 2015). The types of seagrass can be seen in Figure 2.

Seagrass Density

Seagrass density is the number of individuals/stands of seagrass plants in one particular area. The highest density is obtained at station one (Cibako) due to the condition of the station which is rarely passed by people both fishing, and visiting so that seagrasses are not stepped on, in contrast to station three (Ciporeang) which is often passed by people both fishing and visiting because it is close to the entrance to the beach, so seagrass plants are often stepped on.

Then when the conditions receded, station one area was still flooded with a little water so that the seagrass conditions were still wet and did not wither due to exposure to direct sunlight, while at station three at low tide the conditions were part of the area was almost dry so that many seagrasses withered due to exposure to direct sunlight. Judging from the substrate, stations one and two have sandy mud substrates, according to Supriharyono in (Sari, et al., 2021), in general, seagrass plant ecosystems with large expanses are found in thick sandy mud substrates. So seagrasses developed well at the station. The substrat type at station three in the form of sand and coral fragments is still suitable for the life of seagrass ecosystems.

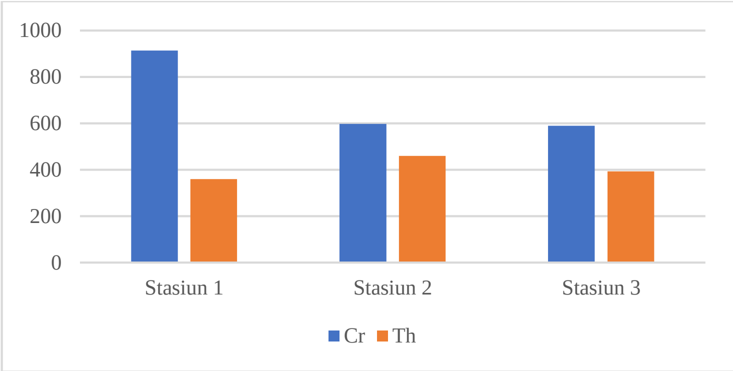

Figure 4. Seagrass density
Source. Personal documentation

Seagrass density types Cymodocea rotundata and Thalassia hempricii density three stations are presented in Figure 3.

Seagrass Biomass

Biomassis divided into two categories, namely biomass above the substrate (above ground biomass) and biomass under the substrate (below ground biomass). Biomass measurement above the surface consists of seagrass leaves, while for biomass below in subsurface (substrate) consists of rhizoma part and seagrass root.

Table 2. The value of seagrass biomass

Station	Total seagrass biomass (grams BK/m²)		
	Top Substrate	Bottom Substrate	Total
1	132,15	297,065	429,215
2	97,115	226,49	323,605
3	85,645	260,74	346,385

Source. Personal documentation

The results of biomass measurements show that station two, station three and station four have a greater value of biomass under the substrate than biomass above the substrate. This is because the biomass material formed below ground is generally in the form of denser biomass (wood). compared to biomass (above ground) (Agustin Rustam, et al., 2019). Several studies that have been carried out on different seagrass species have found that biomass under substrat has a greater value than biomass above the substrate. This is in accordance with the research (Indriani, et al., 2017), (Sophianto, et al., 2020), (Budiarto, et al., 2021) which states that the average biomass is higher at the bottom of the substrate (BS) compared to the upper biomass of the substrate (AS). Seagrass biomass as a potential blue carbon is more stored at the bottom of the substrate. The biomass material formed in the BS section is generally a denser biomass compared to biomass in the US part such as leaves. In addition, high biomass in the BS section is related to the size or morphology of rhizoma and roots.

Carbon Storage

Carbon content is defined as the amount of carbon contained in each type of seagrass (Rahmawati, 2011). The result of carbon content % with the drying method is continued by analyzing the carbon content in biomass using a conversion factor of Karbon for seagrass biomass of 0.34 (Agustin Rustam et al., 2019).

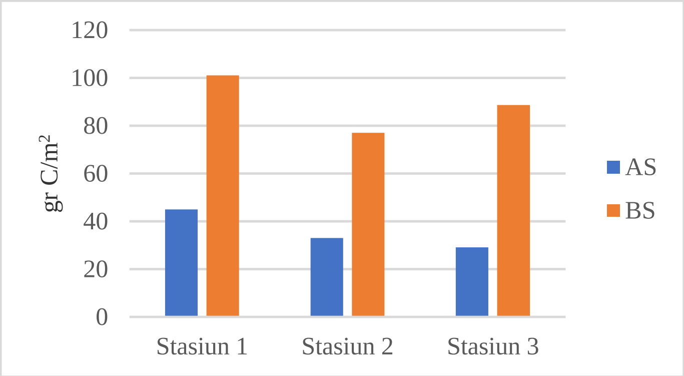

Figure 5. Value of carbon storage over substrate (AS) and bottom substrate (BS)
Source. Personal documentation

Carbon stored on top of the substrate ranges from 29,119 – 44,931 gr C/m2. The greatest carbon value obtained at station 1 is 44.931 gr C/m2. The smallest carbon value obtained at station 3 is 29.119 gr C/m2 while station 2 has a carbon value of 33.019 gr C/m2. The value of carbon stored under the substrate ranges from 77,007 – 101,002 gr C/m2. The greatest carbon value obtained at station 1 is 101.002 gr C/m2. The smallest carbon value obtained at station 2 is 77,007 gr C/m2 while station 3 has a carbon value of 88.625 gr C/m2. The overall carbon deposit at each station is 124,577 gr C/m2 or 1,246 C/ha. The Indonesian seagrass community with all its natural diversity has carbon stocks ranging from 0.34 to 1.53 tons C/ha. In general, the seagrass community is dominated by Enhalus acoroides and Thalassia hemprichii which are considered the largest contributors to total carbon stocks (Wahyudi et al., 2018).

The results of the stored carbon analysis showed that the carbon value under the substrate dominated at the three stations, namely Cibako, Cikujangjambe and Ciporeang. The high carbon stored in seagrass tissues, especially at the bottom of the substrate (below ground), namely rhizoma and roots, is influenced by its role as a nutrient absorber from the water and sedimentary column. This role causes organic matter that is deposited in rhizoma and roots to have a greater value than leaves. Substrate conditions related to the content of nutrients contained are also the cause of the large amount of biomass in seagrass tissues. (Christon, et al., 2012), explained that substrate types in an ecosystem can have a positive effect because sediment particles are so small that the nutrient content is high compared to coarser substrates that have a tendency to decrease nutrients and organic materials. Hamza in (Christon et al., 2012) adds that seagrass roots are quite strongly sharpened to the bottom of the waters. Seagrass roots do not function as important in water intake as terrestrial plants, since seagrass roots can absorb nutrients and carry out nitrogen fixation. The nutrient content in the waters decomposition by bacteria in the sediment is then absorbed by seagrass roots, because the storage of organic matter from photosynthesis and the largest absorption of nutrients is in rhizomes which are 60-80% of seagrass biomass.

CONCLUSION

Based on the results obtained from this study, the value of carbon stored above the substrate ranges from 29.119- 44.931 gr C/m2, while the value of carbon stored under the substrate ranges from 77.007-101.002 gr C/m2. The results of the carbon analysis explained that in general, the carbon deposits under the substrate (below ground) in seagrasses in the Sancang Beach Littoral Zone have a greater value than the value of carbon deposits above the substrate (above ground). All three stations have higher stored carbon under the substrate than carbon above the substrate. The overall carbon storage potential is 124,577 gr C/m2.

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