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Saharjo BH, Nurhayati AD. 2006. Domination and composition structure change at hemic peat natural regeneration following burning; a case study in Pelalawan, Riau Province. Biodiversitas 7: 154-158. DOI: 10.13057/biodiv/d070213

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds) Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of Rhazya stricta. 50th annual symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.) Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from internet: Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic Escherichia coli predator-prey ecosystem. Mol Syst Biol 4:187. www.molecularsystembiology.com

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Variabilities of the carbon storage of mangroves in Gili Meno Lake, North Lombok District, Indonesia

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Abstract. *Hilyana S, Rahman FA. 2022. Variabilities of the carbon storage of mangroves in Gili Meno Lake, North Lombok District, Indonesia. Biodiversitas 23: 5862-5868.* Mangrove is one of the coastal vegetation that can act as carbon mitigation (carbon sink and carbon storage). This study aims to determine the potential for carbon sinks and storage in the leaves and roots of each type of mangrove found in Gili Meno lake, North Lombok, Indonesia. The research includes the identification of species and sampling (leaves and roots) of mangroves in the research quadrant. The organic carbon content of mangrove leaves and roots was tested using the Wakley and Black method. The results showed that there were 5 (five) types of mangroves in Gili Meno lake, namely: *Avicennia marina, Lumnitzera racemosa, Bruguiera cylindrica, Rhizophora apiculata*, and *Excoecaria agallocha*. The highest leaf tissue carbon content value was *R. apiculata* at 45.85%C or equivalent to 3.19 g.C, while in roots, *A. marina* was 50.06%C, equivalent to 4.49 g.C. In addition, the potential carbon stock in the leaves of the entire mangrove ecosystem in an area of 3 ha is 762.81 tons.C±199.257 and at the roots is 659.76 tons.C±394.848, while the largest potential carbon stock in leaf organs is the type of mangrove *R. apiculata*, which is 318.91 tons.C.ha^{-1}. and at the root is the type of mangrove *A. marina*, amounting to 448.54 tons.C.ha^{-1}. The estimated carbon dioxide uptake by the Gili Meno mangrove leaves is in the range of 130.36 g.CO_2-168.27 g.CO_2 or with an average of 154.34 g.CO_2±14.376, while the species with the highest carbon dioxide absorption capacity is *R. apiculata* (268.27 g.CO_2) and the lowest in the species of *L. racemosa* (130.36 g.CO_2).

Keywords: Carbon dioxide, carbon stores, mangroves

INTRODUCTION

Gili Meno is a small island in North Lombok District, West Nusa Tenggara (NTB) Province. Geographically, Gili Meno is located between Gili Trawangan and Gili Air. One of the characteristics of Gili Meno among small islands in general in NTB or Indonesia is the presence of a saltwater lake located in the middle of the island. Gili Meno saltwater lake has an area of 6.6 ha with a diversity of biota (flora and fauna) and unique physical and chemical characteristics of the lake waters. One of them is extreme salinity conditions with an average of 54.00±0.82 ppt (Rahman and Hadi 2021), this condition is different in general in Indonesian marine waters, namely in the range of 33-43 ppt by the salinity quality standard based on the Indonesian Minister of Environment Decree No. 51 of 2004.

The uniqueness of extreme environmental parameters in the Gili Meno saltwater lake requires the biota that makes up the lake ecosystem to survive, one of which is the vegetation of various types of mangroves that grow around the lake with an area of ±3 ha. Mangrove vegetation that grows around the Gili Meno lake has various environmental services, namely as a buffer for the island ecosystem in its benefits environmental services such as carbon dioxide (CO_2) absorption, disaster mitigation (abrasion, coastal waves, sea breeze barriers, and tsunamis), availability of clean air (O_2), stability of coastal waters, habitat for biota, mangrove ecotourism and germplasm (Aksornkoae and Kato 2011; Mcleod et al. 2011; Pendleton et al. 2012; Giri et al. 2015; Nordhaus et al. 2019; Rahman et al. 2020; Sadono et al. 2020; Alimbon and Manseguiao 2021a).

One of the important issues related to mangrove ecosystems is the study of mangrove ecology related to environmental services, namely the ability to absorb and store carbon below and above the soil surface (Estrada and Soares 2017; Taillardat et al. 2018; Widyastuti et al. 2018; Kusumaningtyas et al. 2019; Matatula et al. 2021). Various previous studies have proven that mangrove ecosystems have a greater carbon storage capacity than terrestrial forest and seagrass ecosystems, even though the world's mangrove forests only cover 0.2% of land vegetation cover (Hamilton and Casey 2016). Mangrove forest carbon storage can reach 6-8 tons.C.ha^{-1}.yr^{-1} compared to land forest carbon storage capacity of 1.8-2.7 tons.C.ha^{-1}.yr^{-1} and seagrass ecosystem with a storage capacity of 2-4 ton.C.ha^{-1}.yr^{-1} (Murray et al. 2011). In addition, according to Murdiyarso et al. (2015) that the total carbon potential of Indonesian mangrove forests is around 3.14 Pg.C or globally of 69 million tonnes of carbon (Worthington and Spalding 2018).

Considering the importance of mangroves as a buffer ecosystem for the Gili Meno lake area, which has a role in ecological and ecotourism services, it needs attention. The purpose of this study was to determine specifically the carbon content stored in each species found on Gili Meno in the leaves and roots of the mangroves so that they can be used as a reference source for the conservation of certain mangrove species that can absorb and store scattered carbon.

MATERIALS AND METHODS

The research was carried out in the Gili Meno lake ecosystem, Gili Indah Village, Pemenang Sub-district, North Lombok District, West Nusa Tenggara Province, Indonesia in July-August 2021 with a research area of 6.6 ha (Figure 1).

Research procedure

The study began with determining the point of making the quadrant followed by the process of identifying all types of mangroves contained in the quadrant. Next is the process of taking root and leaf samples for each type of mangrove. Samples of mangrove leaves and roots were taken randomly for each different species so that they could represent the same species in the same quadrant. Root samples were taken to a depth of 30 cm and included roots above the soil surface, such as the breath roots of *Avicennia marina, Bruguiera cylindrica,* and *Rhizophora apiculata*. All samples of leaves and roots of each type of mangrove were prepared as testing materials for biomass (wet weight and dry weight) and tissue carbon at the Laboratory for the Study of Agricultural Technology in West Nusa Tenggara and the Soil Laboratory at the University of Mataram.

Identification of mangrove

Type Mangrove identification was carried out based on the morphological characteristics of mangrove species, such as leaf shape and color, fruit shape and color, flower shape and color, and root morphology with reference to reference to the Guide to Introduction to Mangroves in Indonesia.

Data analysis

Biomass of mangroves

The analysis of leaf and root biomass began with the addition of the wet weight of the sample and continued with the oven process at a temperature of 60°C until the dry weight of each sample became stable. Calculation of the analysis of the biomass of mangrove leaves and roots is carried out with the following formula:

$$\%\ \text{Water content} = \frac{GW - DW}{GW} \times 100\ \%$$

$$\text{Biomass} = \frac{GW}{1 + \frac{\%\ \text{Water content}}{100}}$$

Where:
GW: Gross weight (g)
DW: Dry weight (g)

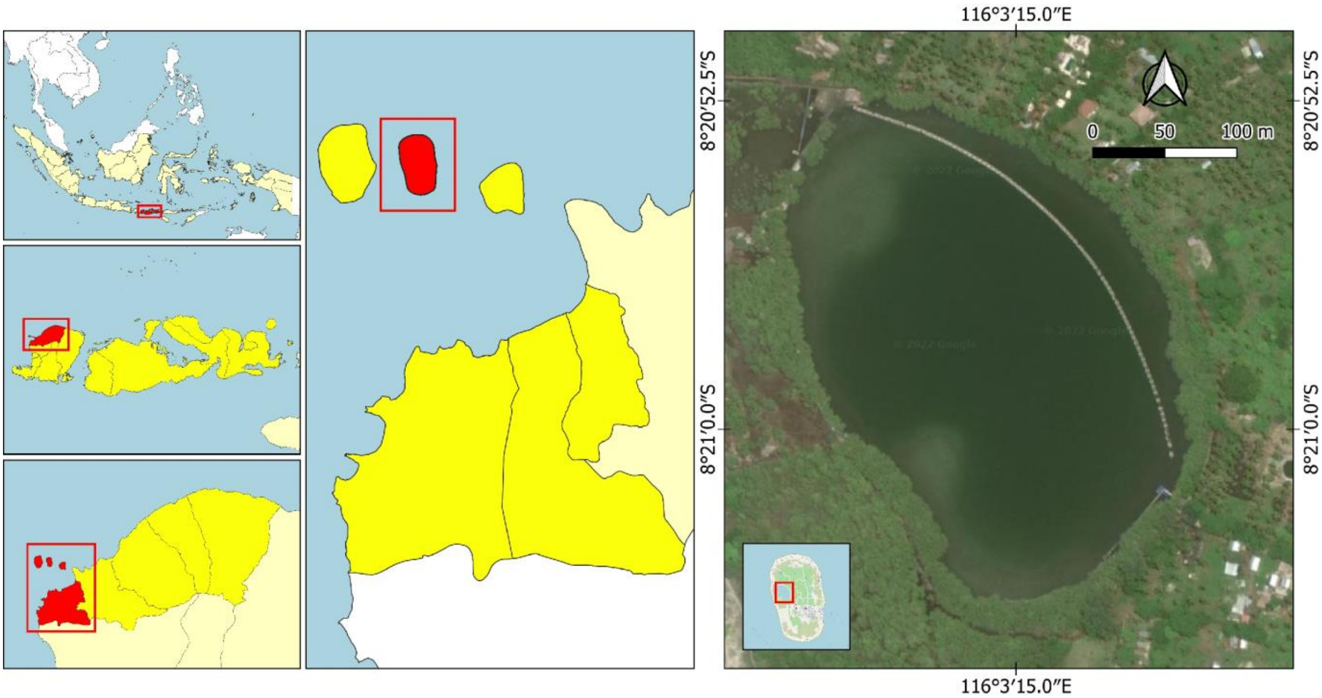

Figure 1. Research site in Gili Meno Lake of Gili Indah Village, Pemenang Sub-district, North Lombok District, West Nusa Tenggara Province, Indonesia

The organic carbon content (%) of mangroves

The organic carbon content of mangrove leaves and roots was carried out using the Wakley and Black method, i.e., weigh a minimum of 5 g of sample and put it in a 100 mL volumetric flask. Added 5 mL $K_2Cr_2O_7$ 1 N and then shaken. Added 7.5 mL of concentrated H_2SO_4, shake, and let stand for 30 minutes. Diluted with ionized water, allow to cool and squeeze. The absorbance of the clear solution was measured by a spectrophotometer at a wavelength of 561 nm. The measurement results are then calculated by the formula:

The organic carbon content (%) = Curva ppm x mL extract 1.000 mL^{-1} x 100 mg $sample^{-1}$ x CF

= Curva ppm x 100 1.000^{-1} x 100 500^{-1} x CF

= Curva ppm x 10 500^{-1} x CF

Where:

Curva ppm	:	The sample rate obtained from the curve of the relationship between the standard series content and its reading after correcting for blanks
100	:	Convert to %
CF/Corr. Factor	:	100/(100 - % moisture content)

The carbon stock of mangroves

The carbon stock estimation of mangroves is calculated based on the biomass content and tissue carbon content of each mangrove species with the formula:

The carbon stock of mangroves (ton/ha) = Biomass x The organic carbon content (%)

Mangrove leaf CO_2

Absorption Estimation Carbon dioxide absorption in mangrove leaves is an estimate of the ability of mangroves in the photosynthesis process. This analysis was calculated based on Howard et al. (2014) as follows:

$$CO_2 \text{ absorption} = \frac{Mr\ CO_2}{Ar\ C} \text{ x Cb}$$

Where:

CO_2 absorption: Total carbon dioxide absorption (g/g-dry)

Mr CO_2: Relative molecule

CO_2: 44 (atomic mass C: 12, O: 16)

Ar C: Relative atoms (C: 12)

Cb: Mangrove carbon content (%)

RESULTS AND DISCUSSION

Results

Based on the identification results, there are 5 (five) mangrove species found on Gili Meno, namely: *Avicennia marina*, *Lumnitzera racemosa, Bruguiera cylindrica, Rhizophora apiculata*, and *Excoecaria agallocha*. Biomass is the result of the photosynthesis process, which is stored in every plant organ, such as leaves, stems, roots, fruits, and flowers. Based on the calculation results, the total leaf biomass content in 5 mangrove species is between 3.66 g-7.08 g with an average of 6.05 g±1.448. The highest biomass content in leaves was found in mangrove *E. agallocha* (7.08 g) and the lowest in *B. cylindrica* (3.66 g) (Table 1). In addition, the root biomass content of 5 (five) mangrove species was in the range of 2.82 g-8.96 g with an average of 4.88±2.321, i.e., the highest root biomass content was found in *A. marina* (8.96 g) and the lowest was at species of *R. apiculata* (2.82 g).

Percentage of carbon content of mangrove leaves and roots

Based on the results of laboratory analysis, it was found that the highest percentage of carbon content in the leaf tissue was *R. apiculata* (45.85% C) and the lowest was *L. racemosa* (35.53% C) (Table 2). Meanwhile, the highest percentage of carbon content in the root tissue was *A. marina* (50.06% C) and the lowest was *L. racemosa* (32.19% C) (Table 3).

Carbon content of mangrove leaves and roots

Carbon content in grams of carbon (g.C) is calculated based on biomass value and the content of % carbon contained in each organ under study. The results showed that the carbon content of mangrove leaves was in the range of 1.55 g C - 3.19 g.C or with an average of 2.54 g C ± 66.419 (Table 4). The highest leaf carbon content was found in the type of mangrove *R. apiculata* (3.19 g.C) and the lowest was in the type of *B. cylindrica* (1.55 g.C). Meanwhile, the carbon content of the roots was in the range of 1.26 g.C-4.49 g.C with an average of 2.20 g.C±1.316. The highest root carbon content was *A. marina* (4.49 g.C) and the lowest was *R. apiculata* (1.26 g.C).

CO2 absorption of mangrove leaves and roots

The estimated carbon dioxide uptake in the leaf organs of the Gili Meno mangrove ecosystem is in the range of 130.36 g.CO_2-168.27 g.CO_2 or with an average of 154.34 g.CO_2±14.376 (Table 6). The species with the highest adsorption capacity was found in the mangrove species *R. apiculata* (268.27 g.CO_2) and the lowest in the *L. racemosa* species (130.36 g.CO_2).

Table 1. The biomass of mangroves tissue

Sample	Mangrove tissue of leaft biomass				Mangrove tissue of root biomass			
	GW (g)	DW (g)	Water content (%)	Biomass (g)	GW (g)	DW (g)	Water content (%)	Biomass (g)
Avicennia marina	6.45	5.58	13.49	5.68	10.14	8.80	13.21	8.96
Rhizophora apiculata	7.95	6.80	14.42	6.95	3.14	2.79	11.30	2.82
Excoecaria agallocha	8.08	6.95	13.98	7.08	5.03	4.37	13.29	4.44
Bruguiera cylindrica	3.95	3.64	7.99	3.66	5.09	4.39	13.92	4.47
Lumnitzera racemosa	8.26	6.58	20.26	6.87	4.83	4.19	13.17	4.27
Average	6.94	5.91	14.029	6.05	5.65	4.91	12.98	4.99
Standard deviation	1.817	1.378	4.352	1.448	2.639	2.278	0.985	2.321

Table 2. The carbon content of leafs tissue

Sample	GW (g)	DW (g)	KL	FK	Abs	ppm Kurva	% C
Avicennia marina	6.45	5.58	15.60	116	0.30	184.39	42.63
Rhizophora apiculata	7.95	6.80	16.86	1.17	0.32	196.17	45.85
Excoecaria agallocha	8.08	6.95	16.26	1.16	0.31	189.35	44.03
Bruguiera cylindrica	3.95	3.64	8.69	1.09	0.32	194.31	42.24
Lumnitzera racemosa	8.26	6.58	25.40	1.25	0.23	141.61	35.52

Note: GW: Gross weight; DW: Dry weight; KL: Soil moisture content; FK: Correction factor; Abs: absorbance; %C: The percentage of carbon content

Table 3. The carbon content of roots tissue

Sample	GW (g)	DR (g)	KL	FK	Abs	ppm Kurva	% C
Avicennia marina	10.14	8.80	15.22	1.15	0.35	217.25	50.06
Rhizophora apiculata	3.14	2.79	12.75	1.13	0.32	198.03	44.66
Excoecaria agallocha	5.03	4.37	15.32	1.15	0.30	185.01	42.67
Bruguiera cylindrica	5.09	4.39	16.19	1.16	0.31	190.59	44.29
Lumnitzera racemosa	4.83	4.19	15.15	1.15	0.23	139.75	32.19

Note: GW: Gross weight; DW: Dry weight; KL: Soil moisture content; FK: Correction factor; Abs: absorbance; %C: The percentage of carbon content

Table. 4. Carbon content in leaf and roots of mangrove

Sample	Leaves carbon stored			Roots carbon stored		
	Biomass (g)	% C	Carbon stored (g.C)	Biomass (g)	% C	Carbon stored (g.C)
Avicennia marina	5.68	42.63	2.42	8.96	50.06	4.49
Rhizophora apiculata	6.95	45.85	3.19	2.82	44.66	1.26
Excoecaria agallocha	7.08	44.03	3.12	4.44	42.67	1.90
Bruguiera cylindrica	3.66	42.24	1.55	4.47	44.29	1.98
Lumnitzera racemosa	6.87	35.52	2.44	4.27	32.19	1.37
Average	6.05	42.05	2.54	2.54	42.77	2.20
Standard deviation	1.448	3.917	0.664	0.664	6.538	1.316

Table 5. The carbon stock area

Sample	Leafs carbon stored		Roots carbon stored	
	Carbon stored (g.C)	Carbon stored ($ton.C.ha^{-1}$)	Carbon stored (g.C)	Carbon stored ($ton.C.ha^{-1}$)
Avicennia marina	2.42	242.27	4.49	448.54
Rhizophora apiculata	3.19	318.66	1.26	126.03
Excoecaria agallocha	3.12	311.91	1.90	189.58
Bruguiera cylindrica	1.55	154.64	1.98	198.06
Lumnitzera racemosa	2.44	243.88	1.37	137.39
Average	2.54	254.27	2.20	219.92
Standard deviation	0.664	66.419	1.316	131.616

Table 6. CO_2 Absorption of mangrove leaves and roots

Sample	Leafs carbon absorption		
	% C	Mr CO_2/ Ar C	Carbon absorption (g.CO_2)
Avicennia marina	42.63	3.67	156.45
Rhizophora apiculata	45.85	3.67	168.27
Excoecaria agallocha	44.03	3.67	161.59
Bruguiera cylindrica	42.24	3.67	155.02
Lumnitzera racemosa	35.52	3.67	130.36
Average	42.05	3.67	154.34
Standard deviation	3.917	0.000	14.376

Discussion

Based on the identification results, there are 5 (five) mangrove species found on Gili Meno, namely: *Avicennia marina, Lumnitzera racemosa, Bruguiera cylindrica, Rhizophora apiculata,* and *Excoecaria agallocha*. The results of this study were less than the 12 species of mangrove vegetation in Gerupuk Bay (*Rhizophora apiculata, Rhizophora stylosa, Rhizophora mucronata, Bruguiera gymnorrhiza, Ceriops decandra, Sonneratia alba, Avicennia marina, Avicennia lanata, Aegiceras corniculatum, Osbornia octodonta, Lumnitzera racemosa* and *Xylocarpus moluccensis*), while in Sereweh Bay there were 13 species *Avicennia lanata, Lumnitzera racemosa, Excoecaria agallocha, Pemphis acidula, Bruguiera gymnorrhiza, Ceriops decandra, Ceriops tagal, Rhizophora apiculata, Rhizophora mucronata, Rhizophora stylosa, Scyphiphora hydrophyllacea, Sonneratia alba,* and *Sonneratia caseolaris*) (Rahman et al. 2020). The small number of mangrove species found on Gili Meno can be caused by environmental factors that are quite extreme, namely high levels of salinity in the waters with an average of 54±0.82 ppt (Rahman and Hadi 2021).

Several things that can affect the mangrove biomass content of Gili Meno Lake are the condition of the chemical parameters of the waters, especially in conditions of quite extreme salinity (Rahman and Hadi 2021), so that it can affect the physiology and morphology of mangroves, especially the photosynthesis mechanism as part of the CO_2 binding process and plant biomass production. This is reinforced by the report of Shannon (1999) that extreme salinity conditions can affect the decrease in leaf area, leaf number, root thinning, and affect root growth. In addition, the osmotic effect of salinity can cause a decrease in plant growth rate, changes in leaf color, and a decrease in the development of the root/shoot ratio. This is by the report of Zhang et al. (2007); Tam et al. (2009); Abdelhakeem et al. (2016); Barreto et al. (2016); Hilmi et al. (2017); Shiau et al. (2017); Hilmi et al. (2019) that salinity, phosphate, soil nitrate, fertility, pH, and temperature can affect the growth rate.

In addition, the total biomass of an area can be influenced by vegetation characteristics, including vegetation strata (trees, poles, saplings, and seedlings), species density, species dominance, and leaf cover (Rahman et al. 2018), such as the high leaf biomass content of mangrove *E. agallocha* could be caused by leaf samples taken from the tree strata, while the type of *B. cylindrica* (3.66 g) was still in the sapling strata. In addition, Sheil et al. (2017) and Scales and Friess (2019) have that the biomass content of a mangrove species is influenced by the diameter of the trunk. The total biomass of the Gili Meno lake mangrove ecosystem is 110.42 tons.ha^{-1} or the equivalent of 331.26 tons.C in an area of 3 ha of the Gili Meno mangrove ecosystem. The total biomass of the Gili Meno lake ecosystem is still lower than the mangrove forest biomass of Alas Purwo National Park at 438.79 tons.ha^{-1} (equivalent to 219.53 tons.C.ha^{-1} or 805.68 tons.CO_2.ha^{-1}); and the mangrove biomass of Dukuh Tapak, Semarang city of 1507.91 tons.ha^{-1} (Irsadi et al. 2017). However, it is greater than the biomass of mangrove forests on Kemujan Island, Karimunjawa National Park, which is 91.31 tons.C and mangrove forest biomass in Bandar Bakau Dumai area of 78.6 tons.ha^{-1} or equivalent to 39.3 tons.C.ha^{-1} (Mandari et al. 2016).

The high percentage of carbon content stored in the mangrove of *R. apiculata* mangrove could be caused by the thick leaf morphology and wider leaf cross-section compared to the other 4 species in Gili Meno lake. This refers to the report by Hairiah and Rahayu (2007) that the carbon content of mangroves contained in the biomass is 46-50%. Meanwhile, the leaf carbon content of *L. racemosa* (35.53% C) has a low value due to the smaller leaf cross-sectional area with the largest percentage of water content compared to 4 other types of mangrove, namely 20.262% C.

The percentage of carbon content on the roots and leaves of *L. racemosa* both had the lowest values, this could be due to the relatively thin morphology of the roots of *L. racemosa* with a root diameter of ±0.2-0.5 cm. It was different with the root morphology of *A. marina* (50.06% C) and *R. apiculata* (44.66% C), and *B. cylindrica* (44.29% C) with larger diameters and root volumes.

The carbon content contained in the leaves of *R. apiculata* (3.19 g.C) with the largest content was not correlated with the low carbon content of the roots (1.26 g.C), this was inversely proportional to the carbon content of the mangrove *A. marina* which was greater in the roots (4.49 g.C) compared to leaves (2.42 g.C). The high and low carbon content in the Gili Meno mangrove organs is influenced by the percentage of water content, one of which is the low carbon content of the roots of *R. apiculata* (2.82 g) caused by the samples taken in the form of breath roots that are still relatively young and are always flooded by water, so that when After oven drying the sample, the lowest dry weight result (2.79 g) with the difference between wet rice and dry weight was 0.355 g, this will affect the carbon content results even though R. apiculata mangrove has the second highest % carbon content of root tissue among the mangrove root samples, Gili Meno lake. Overall, the average carbon content of the roots (2.20 g.C±1.316) was lower than that of the leaves (2.54 g.C±0.664) with a ratio of 1:1.156.

Mangroves are one of the vegetation with the largest potential carbon stock, this is supported by the report of Prasad et al. (2010); Lunstrum and Chen (2014); Matsui et al. (2015); Dahl et al. (2016); Wang et al. (2016); and Nyanga (2020) that mangrove forests can store carbon three to four times greater than forests on land because the organic matter contained in mangrove ecosystems sinks and is stored in the substrate, in contrast to terrestrial forest ecosystems which can easily release carbon through mechanisms. Weathering, combustion, and source of food for decomposer organisms. Several studies have observed the factors that influence carbon conservation in mangrove ecosystems, namely Matsui et al. (2015); Weiss et al. (2016); Martuti et al. (2017); Asadi et al. (2018); Perez et al. (2018); Gao et al. (2019); and Kida and Fujitake (2020).

Alongi et al. (2016) reported that the average carbon stock of mangroves in Indonesia is around 950.5 Mg.C.ha^{-1} with details of the soil carbon stock at 774.7 Mg.C.ha^{-1}, above ground at 159.1 Mg.C.ha^{-1} and below ground at 16.7 Mg.C.ha^{-1}. Meanwhile, the average mangrove forest carbon in the Kelantan Delta of Peninsular Malaysia is 156.35 Mg.C.ha^{-1} (Rozainah et al. 2018); and mangrove carbon stock in Honda Bay, the Philippines at 47.9 Mg.C.ha^{-1} (Castillo et al. 2018). While overall, the average carbon stock in the 3 ha area of the Gili Meno mangrove ecosystem was 762.81 tons.C±199.257 on the leaves and 659.76 tons.C±394.848 on the roots. The largest potential carbon stock in leaf organs is *R. apiculata* mangrove, which is 318.91 tons.C.ha^{-1} and at the roots is *A. marina* mangrove at 448.54 tons.C.ha^{-1} (Table 5), this is by field conditions that one of the dominant species in Gili Meno is *A. marina*.

The ability of carbon storage in mangrove type *A. marina* in Gili Meno lake has the same ability as the results of research by Kathiresan et al. (2013) in the mangrove ecosystem of the South Coast of India, which was 75% higher than *R. mucronata*, and while Alimbon and Manseguiao (2021b) also found that aboveground carbon stocks of *A. marina* were higher than *R. mucronata* and *S. alba*. Likewise, the research results of Purwanto et al. (2021) showed that *A. marina* trees in the Pangarengan mangrove forest store the highest amount of carbon than *A. alba*, *R. mucronata*, and *S. caseolaris* species.

Amount estimates of carbon stored in living plants (biomass) can reflect the CO_2 absorbed by plants from the atmosphere (Saderne et al. 2019). The ability of carbon absorption in each type of mangrove can be influenced by the age of the mangrove species, leaf cross-sectional area, water physicochemical factors, and the morphology of the mangrove strata.

Based on the research, it can be concluded that the high and low carbon content in the mangrove species of Gili Meno lake can be influenced by the biomass content, species strata, and water chemistry factors.

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