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Research Report: Structure Of Vegetation, Biomass, And Carbon Stock Of Langge Mangrove Forest, Gorontalo Utara Regency, Gorontalo Province

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ABSTRACT

Background: Mangrove forest plays a vital role in mitigation of climate change as an impact of global warming since mangrove is able to reduce CO_2 by sequestration mechanism, in which the carbon is absorbed from theatmosphere and stored in bio compartments, e.g., plant, organic waste, and organic materials of soil. (Hairiah and Rahayu, 2007). There is plenty of mangrove area in Gorontalo; one of them is in Langge village in Anggrek District, Gorontalo Utara Regency. The mangrove forest area in Langge is considered significant in carbon absorption potential towards its surrounding ecosystem due to the mangrove area is still in good condition and has no significant damage. The high absorption of carbon contributes to decrease CO_2 contain in the air. Rooted from the previous background, in-depth information of the mangrove forest's structure of vegetation, biodiversity, and carbon valueis needed as areference and initial data in carbon trading, along with the improvement in thepreservation of mangrove forest within Anggrek District or in other sites. One needs to preserve mangrove forest to prevent carbon release to the air and further, helps to decrease the effect of climate change and global warming. **Objective:** To identify the structure of vegetation, biomass, and carbon stock in Langge mangrove forest, Atinggola District, Gorontalo Utara Regency. **Results:** There are 12 species of mangrove, including*Avicennia Alba, Avicennia marina, Sonneratia Alba, Sonneratia ovata, Ceriops decandra, Ceriops tagal, Rhizophora apiculata, Rhizophora mucronata, Rhizophora stylosa, Bruguiera gymnorrhiza, Bruguiera parviflora*and *Xylocarpus granatum.* The highest IVi value is found in *Rhizophora mucronata*, with *IVi* value of 57, 2 percent. Two other notable species are *Avicennia marinaSonneratia Alba*with *IVi* value of 44,935 percent and 40, 44 percent respectively. The total value of biomass is 1.085.676, and the carbon contained in Langge mangrove forest is 542.838,3138 kg with carbon dioxide absorption of 1.992.216, 611. **Conclusion:** There are 12 species of mangrove in Langge forest at thetree, stake, and seeding level, including*Avicennia Alba, Avicennia marina, Sonneratia Alba, Sonneratia ovata, Ceriops decandra, Ceriops tagal, Rhizophora apiculata, Rhizophora mucronata, Rhizophora stylosa, Bruguiera gymnorrhiza, Bruguiera parviflora*and *Xylocarpus granatum.* The total amount of carbon biomass in stem of all species of mangrove in Langgevillage is 1.085.676 kg.Meanwhile, the total carbon content of all species is 542.838,3138kg, and the total absorption ability of all species reaches 1.992.216,611kg/ha.

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INTRODUCTION

Mangrove forest plays a vital role in mitigation of climate change as an impact of global warming since mangrove is able to reduce CO_2 by sequestration mechanism, in which the carbon is absorbed from theatmosphere and stored in bio compartments, e.g., plant, organic waste, and organic materials of soil. (Hairiah and Rahayu, 2007). Moreover, mangrove forest is potential to absorb more CO_2 than other plants since it is a wetland forest, with less emission release than forests on drylands. The mechanism is due to the decomposition process of aquatic plants do not release carbon to the air. By that, the total carbon emission release can be suppressed (Purnobasuki, 2012).

There is plenty of mangrove area in Gorontalo; one of them is in Langge village in Anggrek District, Gorontalo Utara Regency. The mangrove forest area in Langge is considered significant in carbon absorption potential towards its surrounding ecosystem due to the mangrove area is still in good condition and has no significant damage. The high absorption of carbon contributes to decrease CO_2 contain in the air. Rooted from the previous background, in-depth information of the mangrove forest's structure of vegetation, biodiversity, and carbon value is needed as are ference and initial data in carbon trading, along with the improvement in the preservation of mangrove forest within Anggrek District or in other sites. One needs to preserve mangrove forest to prevent carbon release to the air and further, helps to decrease the effect of climate change and global warming.

Methodology:

Research Site:

The research was carried out in mangrove forest area of Langge village, Anggrek district, Gorontalo Utara regency. Geographically, the research site is located within 00^0. 48'. 28,809" N and 122^0. 50'. 24,836" E. The research site shares its border with Sulawesi Sea at north, Tutuwoto village in the east, Tolongio village in thesouth, and Ilodulunga village in the west. The detail of geographical location of research site is displayed as a map by fig.1.

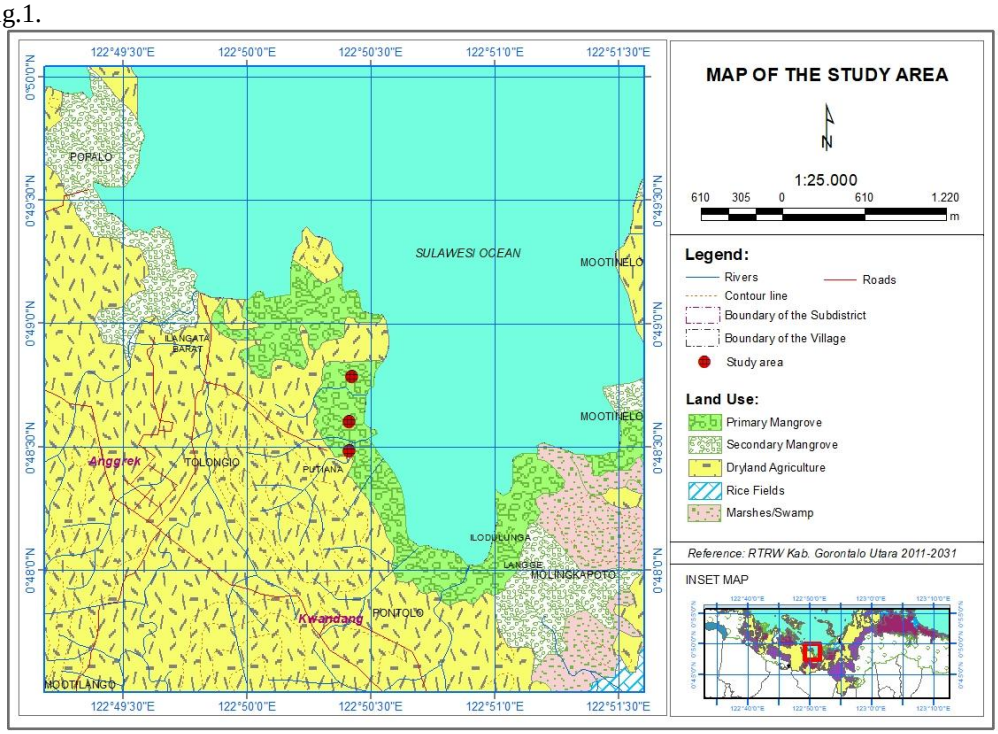


Fig. 1: Study Location

The research employed line plot method (combination of plot and transect) and exploration method to calculate vegetation structure, biomass content, and carbon stock at the site. The sampling process engaged vegetation structure sampling, by creating a square transect marked. Every line of the transect is perpendicular towards land from the beach, cutting from front line formation mangrove community at the shore to the rearmost formation (bordering with land). The transect line was placed purposively based on area utilization. Inventory of tree growth strata is recorded at every line, dividing into the plot of 20x20m. In the meantime, stake stratification was applied on the smallersubplot of 10x10m while seeding stratification was applied on subplot 5x5 m (Dombois and Ellenberg, 1974). Species sampling of mangrove was obtained and recorded by

direct species identification process at every transect. To calculation of biomass value on the surface (stem) was utilized by measuring the sample tree parallel to the diameter at breast height (DBH), i.e., 1,3 m on the soil surface from flood limit. The data obtained were further treated to compute biomass on the surface (stem) by allometric formula (Komiyana, 2008). Data analysis employed structure analysis of mangrove vegetation at tree, stake, and seeding. Afterwards, the data were analyzed to identify the dominance, relative dominance, density, relative density, frequency, relative frequency, and Important Value Index (IVi) by the formula of Dombois and Ellenberg (1974), as follows:

$$\text{Density (D)} = \frac{\text{Total individu of species}}{\text{Area of observation transect}}$$

$$\text{Relative Density (Rd)} = \frac{\text{Density of species}}{\text{Density of all species}}$$

$$\text{Dominance(D)} = \frac{\text{Total of basal area of species}}{\text{Area of observation transect}}$$

$$\text{Relative Dominance (Rd)} = \frac{\text{Dominance ofa species}}{\text{Dominance of all species}}$$

$$\text{Frequency(F)} = \frac{\text{Amount of Transect in which species are found}}{\text{Total amount of all transects}}$$

$$\text{Relative Frequency (Fr)} = \frac{\text{Total frequency of all species}}{\text{Frequency of aspecies}}$$

The allometric formula by Komiyama *et al*. (2008) was applied to calculate stem biomass, as follows:
$DW = 0{,}251 \times \rho \times D^{2,46}$
Details:
ρ = density of wood (g cm^{-3})
DW = dry weight
D = Tree diameter (1,3m from sea level or soil surface)

Carbon Value and CO^2 Absorption:

Carbon value calculation applies formula as follows:
Carbon content = Biomass x 50% (Brown, 1997)
The CO^2 absorption applies following equation

$$(CO_2) = \frac{\text{Rm. } CO_2}{Ra.C} \text{(or 3,67 x carbon content)}$$

CO_2 = carbondioxide absorption
Ra = Relative atom
Rm = Relative molecule

RESULTS AND DISCUSSION

Structure of Mangrove Vegetation:

The identification result shows that there are 12 species of mangrove found on atree, stake, and seeding, including *Avicennia Alba, Avicennia marina, Sonneratia Alba, Sonneratia ovata, Ceriops decandra, Ceriops tagal, Rhizophora apiculata, Rhizophora mucronata, Rhizophora stylosa, Bruguiera gymnorrhiza, Bruguiera parviflora* and *Xylocarpus granatum.* The species found are included into Division of magnoliophyta, Class of magnoliopsida, spread into four Ordos, i.e., Scrophulariales, Myrtales, Rhizophorales, and Sapindales. Moreover, the species are spread into four Families, i.e., Acanthaceae, Rhizophoraceae, Sonneratiaceae, Meliaceae, and six Genes, i.e., Avicennia, Sonneratia, Ceriops, Rhizophora, Bruguiera, and Xylocarpus. The mangrove classification is displayed in Table 1.

Table 1: Classification of Mangrove Species in Research Site

Regnum	Division	Class	Ordo	Family	Genus	Species
Plantae	Magnoliophyta	Magnoliopsida	Scrophulariales	Acanthaceae	Avicennia	*Avicennia alba*
						Avicennia marina
			Myrtales	Sonneratiaceae	Sonneratia	*Sonneratia alba*
						Sonneratia ovata
			Rhizophorales	Rhizophoraceae	Ceriops	*Ceriops decandra*
						Ceriops tagal
					Rhizophora	*Rhizophora apiculata*
						Rhizophora mucronata
						Rhizophora stylosa
					Bruguiera	*Bruguiera gymnorrhiza*
						Bruguiera parviflora
			Sapindales	Meliaceae	Xylocarpus	*Xylocarpus granatum*

Structure of Mangrove Vegetation and Important Value Index of Tree Level:

The computation result of Important Value Index is obtained by three criteria, i.e., relative density, relative dominance, and relative frequency. The *IVi* value can describe dominance, density, and frequency of each species. The detail of the structure of mangrove vegetation is displayed as follows:

Table 2: Structur eof Mangrove Vegetation and Important Value Index of three level at Station I

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	Dom (cm^2)	Rdom (%)	IVI (%)
1	*Sonneratia ovata*	0,055	15,45	1	8,333	0,37	16,66	40,44
2	*Rhizophora apiculata*	0,042	11,8	1	8,333	0,26	11,56	31,69
3	*Rhizophora stylosa*	0,041	11,52	1	8,333	0,25	11,11	30,96
4	*Rhizophora mucronata*	0,037	10,39	1	8,333	0,24	10,75	29,48
5	*Avicennia alba*	0,03	8,427	1	8,333	0,19	8,528	25,29
6	*Bruguiera gymnorrhiza*	0,029	8,146	1	8,333	0,17	7,836	24,32
7	*Bruguiera parviflora*	0,027	7,584	1	8,333	0,18	8,083	24
8	*Avicennia marina*	0,024	6,742	1	8,333	0,14	6,057	21,13
9	*Ceriops decandra*	0,022	6,18	1	8,333	0,13	5,971	20,48
10	*Ceriops tagal*	0,021	5,899	1	8,333	0,13	5,75	19,98
11	*Sonneratia alba*	0,015	4,213	1	8,333	0,09	4,247	16,79
12	*Xylocarpus granatum*	0,013	3,652	1	8,333	0,08	3,442	15,43

Table 2 displays particular species with high vegetation parameter value, in which it is used to specify the dominant species in a particular community. *Sonneratia ovata* is the most dominant species (13%) among all. It has 40, 44% Important Value Index, dominance of 0, 37 cm^2, frequency of 1%, and density of 0,055 m^2. Concurrentl, *Xylocarpus granatum* has uneven distribution, only on particular points, since the species has the lowest Important Value of 5%, dominance of 0, 06 cm^2, the frequency of 1%, and density of 0, 01cm^2. Furthermore, the detailed structure of mangrove vegetation and Important Value of tree level in Station II is shown in Table 3 below.

Table 3: Structure of Mangrove vegetation and Important Value at tree levelon Station II

No	Species	Dens (m^2)	R dens (%)	F (%)	Rf (%)	Dom (cm^2)	R dom (%)	IVI (%)
1	*Rhizophora apiculata*	0.08	23.67	1	9.09	0.52	24.42	57.2
9	*Rhizophora stylosa*	0.046	13.61	1	9.09	0.31	14.63	37.3
2	*Bruguiera parviflora*	0.045	13.31	1	9.09	0.28	12.93	35.3
3	*Bruguiera gymnorrhiza*	0.036	10.65	1	9.09	0.22	10.06	29.8
4	*Sonneratia ovata*	0.025	7.396	1	9.09	0.16	7.595	24.1
5	*Rhizophora mucronata*	0.025	7.396	1	9.09	0.16	7.431	23.9
6	*Ceriops decandra*	0.022	6.509	1	9.09	0.13	6.029	21.6
7	*Ceriops tagal*	0.018	5.325	1	9.09	0.12	5.456	19.9
8	*Avicennia alba*	0.019	5.621	1	9.09	0.11	4.999	19.7
11	*Sonneratia alba*	0.012	3.55	1	9.09	0.08	3.518	16.2

10	*Xylocarpus granatum*	0.01	2.959	1	9.09	0.06	2.92	15

Furthermore, the structure of vegetation and Important Value at tree level of Station III is elaborated in Table 4 as follows.

Table 4: Structure of Mangrove vegetation and Important Valueat tree level on Station III

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	Dom (cm^2)	Rdom (%)	IVI (%)
1	*Avicennia marina*	0.072	17.48	1	10	0.442	17.46	44.935
2	*Rhizophora stylosa*	0.068	16.5	1	10	0.437	17.27	43.772
3	*Rhizophora apiculata*	0.05	12.14	1	10	0.309	12.2	34.34
4	*Rhizophora mucronata*	0.045	10.92	1	10	0.265	10.48	31.403
5	*Xylocarpus granatum*	0.04	9.709	1	10	0.26	10.26	29.97
6	*Ceriops tagal*	0.039	9.466	1	10	0.227	8.978	28.444
7	*Sonneratia ovate*	0.035	8.495	1	10	0.208	8.23	26.725
8	*Bruguiera parviflora*	0.028	6.796	1	10	0.175	6.925	23.721
9	*Avicennia alba*	0.019	4.612	1	10	0.123	4.84	19.451
10	*Ceriops decandra*	0.016	3.883	1	10	0.085	3.355	17.239

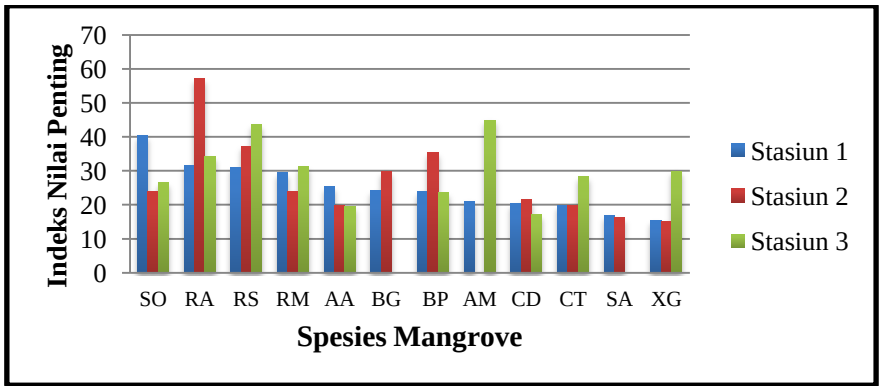


Fig. 2: The comparison of Important Value Index of tree level at Station I, II, and III.

Structure of Mangrove Vegetation and Important Value of Sapling Level:

The vegetation analysis shows that there are particular species containing ahigh value of vegetation parameter and thus considered as the most dominant. Being the most dominant species by 13 percent, *Rhizophora mucronata*possesses 47,58% of Important Value, dominance of 0,64 cm^2, frequency of 1%, and density of 0,167 m^2, on the other hand, *Bruguiera gymnorrhiza* possesses34,36% Important Value, dominance of 0,43 cm^2, frequency of 1 %, and 0,11m^2 density. The analysis suggests that the spread of *Rhizophora mucronata* is more even than other species, thus having wider canopy. Furthermore, the display of structure of mangrove vegetation and dominant species distribution of stake level in station I is shown in Table 5.

Table 5: Structure of Mangrove vegetation and Important Value of sapling level at Station I

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	Dom (cm^2)	Rdom (%)	IVI (%)
1	*Rhizophora mucronata*	0.167	19.49	1	8.333	0.64	19.76	47.58
2	*Bruguiera gymnorrhiza*	0.11	12.84	1	8.333	0.43	13.19	34.36
3	*Rhizophora apiculata*	0.11	12.84	1	8.333	0.43	13.18	34.35
4	*Sonneratia ovata*	0.077	8.985	1	8.333	0.3	9.247	26.57
5	*Ceriops tagal*	0.068	7.935	1	8.333	0.26	7.974	24.24
6	*Rhizophora stylosa*	0.085	9.918	1	8.333	0.19	5.933	24.18
7	*Ceriops decandra*	0.066	7.701	1	8.333	0.26	7.937	23.97
8	*Avicennia marina*	0.05	5.834	1	8.333	0.26	8.083	22.25
9	*Bruguiera parviflora*	0.047	5.484	1	8.333	0.18	5.622	19.44
10	*Avicennia alba*	0.031	3.617	1	8.333	0.11	3.507	15.46
11	*Xylocarpus granatum*	0.024	2.8	1	8.333	0.09	2.88	14.01
12	*Sonneratia alba*	0.022	2.567	1	8.333	0.09	2.677	13.58

Structure of vegetation and Important Value at mangrove stake level is elaborated in detail in Table 6.

Table 6: Structure of Mangrove vegetation and Important Value of Sapling level at Station II

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	Dom (cm^2)	Rdom (%)	IVI (%)
1	*Rhizophora apiculata*	0.105	16.01	1	9.09	0.41	16.3	41.4
2	*Bruguiera gymnorrhiza*	0.096	14.63	1	9.09	0.37	14.8	38.5

3	*Rhizophora mucronata*	0.078	11.89	1	9.09	0.3	12.02	33
4	*Bruguiera parviflora*	0.066	10.06	1	9.09	0.25	9.928	29.1
5	*Rhizophora stylosa*	0.067	10.21	1	9.09	0.25	9.783	29.1
6	*Ceriops decandra*	0.064	9.756	1	9.09	0.25	9.95	28.8
7	*Sonneratia ovata*	0.056	8.537	1	9.09	0.22	8.829	26.5
8	*Ceriops tagal*	0.055	8.384	1	9.09	0.21	8.244	25.7
9	*Xylocarpus granatum*	0.031	4.726	1	9.09	0.11	4.312	18.1
10	*Avicennia alba*	0.023	3.506	1	9.09	0.09	3.538	16.1
11	*Sonneratia alba*	0.015	2.287	1	9.09	0.06	2.305	13.7

Table 6 illustrates that each species contains different Important Value, either from density, and dominance. *Rhizophora apiculata* is the most dominant species of all, by IV index of 41,4%, relative density of 16,01%, relative frequency of 9,09%, and relative dominance of 16,03%. Conversely, *Sonneratia alba* is the least dominant, with only 13,7% IV index, 2,28% relative density, 9,09% relative frequency, and 2,3% relative dominance. From the data, it suggests that *Rhizophora apiculata*has the highest adaptability towards the environment. Furthermore, the structure of mangrove vegetation and IV of stake level in Station III is detailed in Table 7.

Table 7: Structure of Mangrove vegetation and Important Value of sapling level at Station III

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	Dom (cm^2)	Rdom (%)	IVI (%)
1	*Sonneratia ovata*	0.181	14.73	1	10	0.708	14.78	39.51
2	*Ceriops tagal*	0.175	14.24	1	10	0.682	14.23	38.47
3	*Rhizophora apiculata*	0.164	13.34	1	10	0.64	13.35	36.698
4	*Rhizophora mucronata*	0.159	12.94	1	10	0.622	12.98	35.913
5	*Ceriops decandra*	0.132	10.74	1	10	0.517	10.8	31.538
6	*Avicennia marina*	0.124	10.09	1	10	0.479	9.998	30.087
7	*Rhizophora stylosa*	0.115	9.357	1	10	0.443	9.246	28.604
8	*Avicennia alba*	0.102	8.299	1	10	0.402	8.382	26.681
9	*Bruguiera parviflora*	0.055	4.475	1	10	0.216	4.511	18.986
10	*Xylocarpus granatum*	0.022	1.79	1	10	0.083	1.723	13.513

Furthermore, the comparison of mangrove vegetation structure and IV at stake level in the three stations is illustrated in the graph as follows:

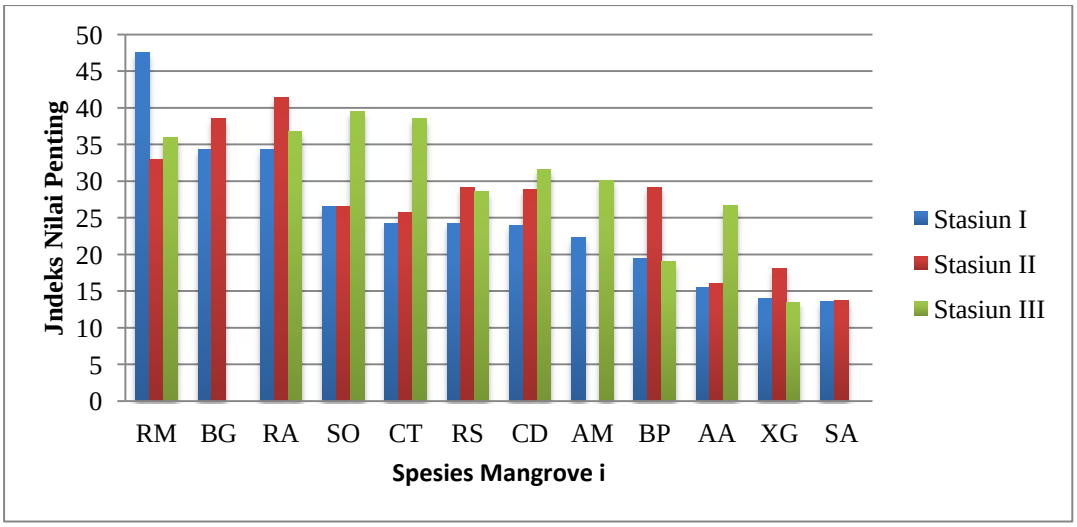


Fig. 3: Graph of comparison of *IVi* at sapling level in three stations

Structure of Mangrove Vegetation and Important Value of Seedling Level:

The calculation result of IV of mangrove at seeding level elaborates that there are two dominant species with 16% dominance, i.e.,*Rhizophora mucronata* and *Rhizophora apiculata*, by IV of 25,2% and 12%, density of 0,09 m^2 and 0,07 m^2, and frequency of 1% respectively. Taxonomically, the two dominant species are in genus Rhizophora, thus, from thee co-physiological aspect, both species shares similar traits in adaptation towards the environment. This is to say thatboth species have optimal grow and even distribution over the research site, making them the primary vegetation of mangrove forest structure. In detail, the structure of mangrove vegetation and dominant species distribution at seeding level in Station I is presented in Table 8.

Table 8: Structure of Mangrove vegetation and Important Value of seedling level at Station I

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	IVI (%)
1	*Rhizophora apiculata*	0.19	16.75	1	8.333	25.1
2	*Rhizophora mucronata*	0.171	15.08	1	8.333	23.4
3	*Sonneratia ovata*	0.123	10.85	1	8.333	19.2
4	*Ceriops tagal*	0.1	8.818	1	8.333	17.2
5	*Rhizophora stylosa*	0.101	8.907	1	8.333	17.2
6	*Bruguiera parviflora*	0.099	8.73	1	8.333	17.1
7	*Bruguiera gymnorrhiza*	0.091	8.025	1	8.333	16.4
8	*Ceriops decandra*	0.086	7.584	1	8.333	15.9
9	*Avicennia marina*	0.067	5.908	1	8.333	14.2
10	*Avicennia alba*	0.065	5.732	1	8.333	14.1
11	*Xylocarpus granatum*	0.036	3.175	1	8.333	11.5
12	*Sonneratia alba*	0.005	0.441	1	8.333	8.77

Each species possesses different adaptability to maintain its existence and thus be the most dominant species, shall it succeeds. Table 8 displays that the most dominant species is *Rhizophora apiculata*with IVI of 25,1%, relative density of 16,75%, and relative frequency of 8,33%. Concurrently, *Sonneratia Alba* is the least dominant of all, by only having IV of 8,77%, relative density of 0,44%, and relative frequency of 8,33%. Furthermore, the following table 9 illustrates the structure of mangrove vegetation and Important Value at seeding level in Station II.

Table 9: Structure of Mangrove vegetation and Important Value of seedling level at Station II

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	IVI (%)
1	*Bruguiera parviflora*	0.196	14.07	1	9.09	23.2
2	*Rhizophora apiculata*	0.183	13.14	1	9.09	22.2
3	*Rhizophora stylosa*	0.177	12.71	1	9.09	21.8
4	*Bruguiera gymnorrhiza*	0.175	12.56	1	9.09	21.7
5	*Sonneratia ovata*	0.155	11.13	1	9.09	20.2
6	*Ceriops tagal*	0.137	9.835	1	9.09	18.9
7	*Ceriops decandra*	0.122	8.758	1	9.09	17.8
8	*Rhizophora mucronata*	0.12	8.615	1	9.09	17.7
9	*Avicennia alba*	0.072	5.169	1	9.09	14.3
10	*Xylocarpus granatum*	0.049	3.518	1	9.09	12.6
11	*Sonneratia alba*	0.007	0.503	1	9.09	9.59

Furthermore, Table 10 displays the structure of mangrove vegetation and IV index at seeding level in Station III.

Table 10: Structure of Mangrove vegetation and Important Value of seedling level at Station III

No	Species	Dens (m^2)	Rdens (%)	F (%)	Rf (%)	IVI (%)
1	*Sonneratia ovata*	0.243	15.2	1	10	25.2
2	*Rhizophora apiculata*	0.231	14.5	1	10	24.5
3	*Ceriops tagal*	0.195	12.2	1	10	22.2
4	*Rhizophora stylosa*	0.188	11.8	1	10	21.8
5	*Avicennia alba*	0.148	9.26	1	10	19.3
6	*Rhizophora mucronata*	0.142	8.89	1	10	18.9
7	*Avicennia marina*	0.135	8.45	1	10	18.4
8	*Bruguiera parviflora*	0.12	7.51	1	10	17.5
9	*Ceriops decandra*	0.113	7.07	1	10	17.1
10	*Xylocarpus granatum*	0.083	5.19	1	10	15.2

The comparison of IV index of mangrove at seeding level in three stations is illustrated in the graph as follows:

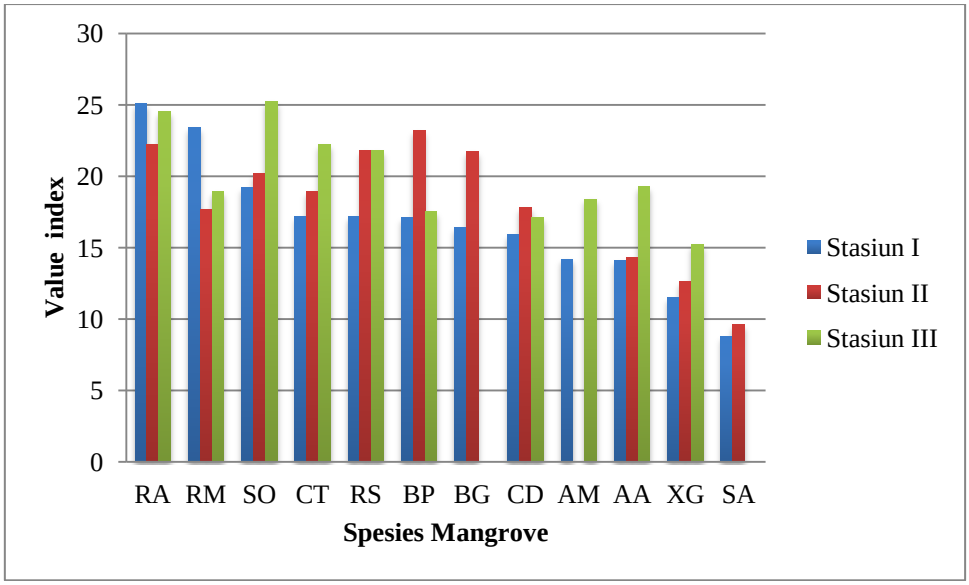


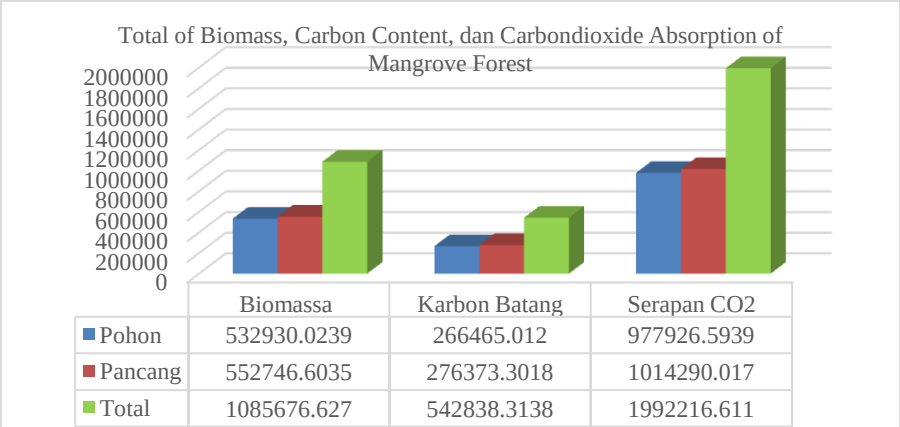
Fig. 4: Graph of comparison of *IVi* at stake level in three stations

The analysis result of mangrove vegetation structure in Langge village suggests that mangrove categorized in Rhizophora genus is the most dominant at the site. As observable in Figure 2 and 3, the comparison of IV index in the tree stations shows that *Rhizophora apiculata*and *Rhizophora mucronata* are the most dominant species. The situation is down to the supportive environmental condition and substrates at the site, as well as muddy soil; thus aiding Rhizopora genus mangrove in growing and adapting optimally. The notion is in line with Noor *et al*. (2012), arguing that Indonesian muddy substrate is highly compatible to *Rhizophora apiculata*and *Rhizophora mucronata* stands. This is in accordance with the soil surface at the side, i.e., sandy mud.

Being the most dominant species, *Rhizophora mucronata*has physical features, i.e.,significantsize, broad canopy, and widespread. Moreover, *Rhizophora apiculata*is categorized in Rhizophoraceae family and inhabits on muddy soil. The species tends to spread evenly and adapt well to mangrove community in Tutuwoto village. Furthermore, Irwanto (2007) states that a mangrove community is said to be diverse in species if it consists of different and almost alike species, and vice versa.

Biomass, Carbon Content, and CO_2 Absorption:

The quantification result of stem biomass, carbon content, and CO_2 absorption is shownin Figure 5.



	Biomassa	Karbon Batang	Serapan CO2
Pohon	532930.0239	266465.012	977926.5939
Pancang	552746.6035	276373.3018	1014290.017
Total	1085676.627	542838.3138	1992216.611

Fig. 5: Graph of total biomass, carbon content, and CO_2 absorption

The density of a mangrove is highly related to the biomass of its standing, in which the total amount of biomass in an area is obtained from the biomass production and density by measuring the diameter, height, weight, and density of a tree. Biomass is a certain amount of organic materials produced by plants during photosynthesis process, in which CO_2 and water is converted into simple carbohydrate molecule during

metabolism. The molecules are further converted into lipid, nucleic acid, protein, and organic molecules, such as CO_2. These molecules undergo sequestration process, in which they are stored in biomass of leaves, stem, roots, tuber, fruit, and substrate. CO_2 content absorbed by plants from the air is described from theamount of carbon stored in biomass of a land (Hairiah and Rahayu, 2007).

Moreover, Ilmiliyana (2012) mentions that the higher the biomass potential in a tree is determined by how old the standing is. This is due to the growth in a tree diameter by continuous cambium cell division and regeneration, or simply said as secondary growth. Henceforth, the diameter of a tree can determine the amount of the biomass inside. The texture of stem of *Rhizophora mucronata* is hard and rough and contains cellulose, hemi cellulose, and lignin. The tree diameter determines the amount of cellulose in a stem. Moreover, tree stem contains the most amount of carbon among others, in theaccount of its forming substances which are stronger than the other parts. The cell cavity inside a stem is formed mostly of component substances than of water, making the biomass amount bigger than other tree parts. (Purnobasuki, 2012).

The result indicates that the stem of dominant species, *Rhizophora apiculata* and *Rhizophora mucronata*, can absorb carbon in the largest biomass of other species, having 47.422,5051 kg and 76.616,8952 kg respectively.This signifies the correlation that the bigger the diameter, the higher the biomass amount is. Moreover, the total of biomass amount in the stem of all mangrove species in Langge village reaches 1.085.676 kg, absorbing total carbon of 542.838,3138kg. By that, the research concludes that the CO_2 absorption ability of all species reaches 1.992.216,611kg/ha in total. This shows that mangrove is essential to decrease carbon emission in the air.

Conclusion:

There are two conclusions in this study:

1. There are 12 species of mangrove in Langge forest at thetree, stake, and seeding level, including*Avicennia Alba, Avicennia marina, Sonneratia Alba, Sonneratia ovata, Ceriops decandra, Ceriops tagal, Rhizophora apiculata, Rhizophora mucronata, Rhizophora stylosa, Bruguiera gymnorrhiza, Bruguiera parviflora*and *Xylocarpus granatum*.
2. The total amount of carbon biomass in stem of all species of mangrove in Langgevillage is 1.085.676 kg.Meanwhile, the total carbon content of all species is 542.838,3138kg, and the total absorption ability of all species reaches 1.992.216,611kg/ha

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