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Vegetation Structure, Diversity and Value of Carbon in the Tutuwoto Mangrove Area in Orchid District North Gorontalo Regency

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Abstract:- The method to be used is the stripped method and the combination method and exploration method. To measure the structure of mangrove vegetation by calculating the Relative Density (KR), Relative Frequency (FR), and Relative Dominance (DR), then the data obtained is tabulated to obtain INP. The diversity index (diversity) were analyzed using *the Shannon Wien* formula *n er* every strata of mangrove growth. The estimation of carbon stock on the surface (stem) uses a *non-destructive* sampling method. The results of this study found that for the vegetation structure 10 species of mangrove were obtained, namely *Rhizophora mucronata* Lamk., *Rhizophora apiculata* Bl., *Rhizophora stylosa* Griff., *Ceriops decandra* (Griff.) Ding Hou, *Ceriops tagal* (Perr.) CBRob, *Brugueira gymnorrhiza* (L.) Lamk, *Sonneratia alba* JE Smith, *Xylocarpus granatum* Koen, *Avi cennia alba* Bl. , *Avi cennia marina* (Forsk) Vierh. The diversity index value at the study site showed a high level of diversity. This is evidenced by the value obtained at 2,287 ie on the H ^{1} value criteria > 1,5 - 3.0 . The total biomass of all mangrove species was 297,765.93 Kg. The total value of carbon k in the Tutuwoto mangrove forest was 247,845.54 Kg, and carbon dioxide uptake reached 909,557. The findings of this study are used as data in the management of mangrove forests Anggrek District, North Gorontalo Regency and can be used as data in the development of REDD (*Reduced Emissions from Deforestation and Degradation*) programs so that efforts to conserve mangrove can be increased.

Keywords :- *INP, Mangrove, Diversity, Carbon.*

I. INTRODUCTION

Mangrove ecosystems are a system in nature where life takes place that reflects the reciprocal relationship between living things and their environment and among living things themselves found in coastal areas, are affected by tides, and are dominated by distinctive and capable species of trees or shrubs growing in salty / brackish waters (Sahoo *et al.*, 2008)."Mangrove forests are generally tropical coastal vegetation communities, which are dominated by several types of trees that are able to grow and develop in muddy coastal tidal areas. The difference with other forests is the existence of specific flora and fauna, with high species diversity "(Gi sen, *et al* 2007).

Mangrove ecosystems have the most important ecological and socio- economic values, especially humans, among them can be used as food ingredients and raw materials for medicines. Besides that, mangrove forests have a function that is very important for the survival of humans, as other forests are as carbon sinks and storers. Mangrove plants can absorb some carbon in the form of CO_2 which is used for photosynthesis, while others remain in the form of gases in the atmosphere. According to Ilmiliyana (2012) over the past decade CO_2 emissions doubled from 1400 million tons per year to 2900 million tons per year. With increasing CO_2which is one of the greenhouse gases in this atmosphere, it will trigger climate change globally. By being aware of these problems, the international world is rich in reducing greenhouse gas emissions in the atmosphere. According to Siregar *et al* (2010), one of the efforts made was through the Kyoto Protocol agreement in which it offered a joint effort to reduce greenhouse gas emissions between developed countries and developing countries through the *Clean Development Mechanism* (CDM) whose implementation in period I would be carried out for 4 year (2008-2012).The other agreement is the result of COP 13 (*Bali Action Plan*) in which it mandates the implementation of *REDD*$^{+}$(*Reducing Emission from Deforestation and Degradation*) in 2012. With this REED $^{+}$ mechanism, Indonesia has a great opportunity in the carbon trading mechanism because it has a vast tropical forest area.

Pro v insi Gorontalo has extensive mangrove areas one mangrove areas are located in the District Orchid, Regency of North Gorontalo, Gorontalo province. The mangrove forest area in the Anggrek Subdistrict is a mangrove area with potential for carbon uptake which is important for the surrounding ecosystem. This is because the condition of mangroves in this region is still in good condition. Mangrove forests are the main ecosystems that support important life in the Anggrek District, because of the various functions and benefits they can produce, one of which is the ability of mangroves to absorb and store carbon. The ability of mangroves as carbon sinks and storing them in biomass can reduce the increase in carbon dioxide in the atmosphere. Based on the description of the background above, information about the structure of vegetation, diversity, and carbon values in mangrove forests in Anggrek District is very necessary, so that it can be used as preliminary data in carbon trading. Efforts to preserve

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mangrove forests both in Anggrek District and in other regions in Indonesia can be further improved. Because if the number of mangroves continues to decrease, it certainly has an impact on the ability of mangroves to absorb and store carbon. The decomposition of carbon stored in mangrove forests into the atmosphere will change the role of mangrove ecosystems that were initially absorbent and storage carbon is a contributor to carbon emissions that has an impact on climate change in the world.

II. MATERIALS AND METHODS

A. Study Area

Areas of study in the mangrove areas Tutuwoto Village, District Orchid, Regency of North Gorontalo, Gorontalo province. Geographically the research area is located between coordinates 0 0 ^{0} .4 8 $^{'}$ .03.0 " N and 122 ^{0} .50 $^{'}$ .35.9 "E. Administratively the research area is bordered by: The North is bordered by the Sulawesi Sea , the East is bordered by Tolongio Village , the South is bordered by Molinggapoto Village , the West is bordered by Pontolo Village .

B. Method

The method used in this research is to use m etode the terraced path method (combination of plots and transects) and methods of exploration. This method is used to calculate the vegetation structure, diversity index and carbon at the study site.

➢ *Vegetation Sampling Techniques*

The vegetation sampling technique includes the structure of vegetation by making rectangular transects marked with ropes. Each transect path is made perpendicular to the mainland from the coast, cutting the frontline mangrove community formation (the waterfront) to the backmost formation (bordering the mainland).Transect lines are placed *purposively* based on area utilization. Inventory of tree growth strata is recorded on each path divided into 20 mx 20 m plots. Meanwhile, the stratum is carried out in smaller sub-plots measuring 10 mx 10 m and seedling strata in the 5 mx 5 m sub-plot (Dombois and Ellenberg , 1974).The mangrove species at the study site were identified by identifying species directly in the field on each transect .Number of individuals s achthe mangrove species found on the transect were recorded.

➢ *Species diversity*

To find out the variety of species, the Shannon-Wienner variety index is calculated for each strata of mangrove growth.

➢ *Stem Carbon Biomass Value*

The aboveground biomass (stem) value is measured by diameter at breast height (DBH), which is 1 , 3 m above ground level from the buttress limit. Data from tree diameter measurements are used to calculate surface biomass (stem) using the allometric formula (Komiyama, 2008).

C. Data analysis

➢ *Mangrove Vegetation Structure*

The structure of the mangrove vegetation that was analyzed was the structure of tree level, mangrove vegetation, saplings and seedlings. The vegetation data collected at the study sites were analyzed to determine dominance, relative dominance, density (density), relative density, frequency, relative frequency and Important Value Index (INP) using the Dombois and Ellenberg (1974) formulas , as follows:

$$\text{Density (K)} = \frac{\text{Total individuals of a species}}{\text{Area of observation}}$$

$$\text{Relative density (Kr)} = \frac{\text{Density of a species}}{\text{Density of all species}} \times 100\ \%$$

$$\text{Dominance (D)} = \frac{\text{The total area of the basal area}}{\text{Area of observation transect}}$$

$$\text{Relative Dominance (Dr)} = \frac{\text{Dominance of a species}}{\text{Dominance of all species}} \times 100\ \%$$

$$\text{Frequency (F)} = \frac{\text{The number of transects found in a species}}{\text{Total number of all transects}}$$

$$\text{Relative frequency (Fr)} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100\ \%$$

➢ *Diversity*

Diversity index is calculated using the *Shannon and Wienner* formulas (Fachrul 2007) as follows:

$$H' = -\sum_{i=1}^{S} pi\, ln\, pi$$

where: $pi = \frac{ni}{N}$

K attack

H' = Diversity index Shannon-Wien ner
S = Number of species
Pi = proportion of species i
Ln = Natural logarithms
Pi = ni / N (comparison of the number of individuals of a type with the whole type)

➢ *Stem Biomass Measurement*

To calculate the stem biomass using the equation compiled by Komiyama *et al.*, (2008).The geometric all equation used is as follows:

$BK = 0.251 \times \rho \times D^{2,46}$

Information :

ρ = Wood Specific Gravity (g cm $^{-3}$)
BK = Dry Weight
D = Tree Diameter (1 , 3 m above ground level or above buttress)

➢ *Carbon Value and Absorption of Carbon dioxide (CO_2)*

Carbon values use the formula:
Content of Carbon Trees = Biomass x 50% (Brown, 1997).
Measurement of carbon dioxide absorption uses the following equation (Heriyanto *et al.*, 2012):

$$(CO_2) = \frac{Mr.\ CO_2}{Ar.C}$$ (or 3, 67 xcarbon content)

Information :

- CO_2= carbon dioxide uptake
- Mr = relative molecule
- Ar = Atom relative.

III. RESULTS

➢ *Mangrove Vegetation Structure*

Based on the results of the identification of mangrove plants in the study location found 10 mangrove species at the level of trees, saplings and seedlings namely *Rhizophora mucronata* Lamk. , *Rhizophora apiculata* Bl. , *Rhizophora stylosa* Griff. , *Ceriops decandra* (Griff.) Ding Hou, *Ceriops tagal* (Perr.) CBRob, *Brugueira gymnorrhiza* (L.) Lamk, *Sonneratia alba* JE Smith , *Xylocarpus granatum* Koen , *Avicennia alba* Bl. , *Avicennia marina* (Forsk) Vierh . Emukan dit 10 species are included in D ivisi m agnoliophyta, one K elas namely Magnoliopsida, four O rdo namely Scrophulariales, Myrtales, Rhizophorales , and Sapindales . Included in the four families namely Acanthaceae , Rhizophoraceae, Sonneratiaceae, Meliaceae and six genera namely Avicennia, Sonneratia, Ceriops, Rhizophora, Bruguiera and Xylocarpus. The detailed classification of mangrove found on penelit ian locations are presented in Table 1.

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

Table 1:- Classification of Mangrove Species Found in Research Sites

➢ *Mangrove Vegetation Structure and Tree Level Important Values*

Index This calculation results I enting P values obtained with the number three criteria namely the relative density, relative dominance and relative frequency. The existence of this important value can describe the dominance, density and frequency of each species. The structure of mangrove vegetation and the distribution of dominant species are presented in Table 2.

Species Name	K	Kr	D	Dr.	F	Fr	INP
Rhizophora mucronata	0.02	19.4	0.162	18.5	1	10	47.96
Rhizophora apiculata	0.02	12.4	0.099	11.3	1	10	33.68
Ceriops decandra	0.01	12	0.099	11.3	1	10	33.31
Bruguiera gymnorrhiza	0.01	10.3	0.083	9.45	1	10	29.78
Sonneratia alba	0.01	9.5	0.079	9.06	1	10	28,56
Avicennia alba	0.01	9.5	0.079	9.06	1	10	28,56
Rhizophora stylosa	0.01	8.68	0.076	8.66	1	10	27,34
Avicennia marina	0.01	8.68	0.075	8.57	1	10	27.25
Ceriops tagal	0.01	7.85	0.068	7.75	1	10	25.6
Xylocarpus granatum	0.01	4.96	0.077	8.78	1	10	23.74

Table 2:- Mangrove Vegetation Structure and Tree Level Important Values

- *Mangrove Vegetation Structure and Important Stake Rate*

Based on the analysis of vegetation for saplings, there are certain species that have high vegetation parameter values and this can characterize the dominant species in a community. The mangrove species, namely *Rhizophora mucronata* were the most dominating species in the study location at 13 % with an important value of 35.27 % , dominance of 0.163cm², frequency of 1 %, and density of 0 , 07m², whereas *Rhizophoraapiculata* Memi Liki critical value of 11%, the dominance of 146cm², frequency of 1 %, and density of 0.06m² .This can mean that the spread of Rhizophora mangrove can be said to be evenly distributed in the study location and because it has a large dominance compared to other species in the same location it can mean that the shape of the *Rhizophora mucronata* tree is larger and has a wider canopy closure than other species.

The structure of mangrove vegetation and the distribution of dominant species for the sapling level are presented in Table 3.

Species name	K	Kr	D	Dr.	F	Fr	INP
Rhizophora mucronata	0.07	12.6	0.163	12.7	1	10	35.27
Rhizophora apiculata	0.06	10.77	0.146	11.4	1	10	32,18
Rhizophora stylosa	0.05	10.48	0.13	10.1	1	10	30,61
Avicennia alba	0.05	10	0.128	10	1	10	30
Ceriops decandra	0.05	9,808	0.13	10.2	1	10	29.98
Sonneratia alba	0.05	9,327	0.134	10.5	1	10	29.78
Ceriops tagal	0.05	9,712	0.121	9.43	1	10	29.14
Bruguiera gymnorrhiza	0.05	8.75	0.117	9.13	1	10	27,88
Avicennia marina	0.05	9,327	0.106	8.3	1	10	27,63
Xylocarpus granatum	0.04	8,365	0.107	8.3	1	10	26.67

Table 3:- Mangrove Vegetation Structure and Important Value of Stake Levels

- *Mangrove Vegetation Structure and Important Value of Seedling Levels*

The results of the calculation of important values for seedling mangroves at the location of the study showed that there were two seeded mangrove species which had a large dominant value of 16 % for *Rhizophoramucronata* species with an important value of 25.2 %, a density of 0.09m², a frequency of 1 % and the species *Rhizophoraapiculata* with an important value of 12 %, a large density of 0.07 m², frequency of 1 %.

Both of these species appear dominant compared to other species for seedlings and are widely distributed in the study sites. Taxonomically these two species belong to the genus Rhizophora so that it has an ecophysiological similarity in adapting to the environment, thus it can be indicated that at the location of the study of the Rhizophora seedling genus mangrove spread widely and grow well. This also proves that these two species are the main vegetation compilers of mangrove forests in the study area. The structure of mangrove vegetation and the distribution of dominant species for seedling levels are presented in Table 4.

Species name	K	KR	F	FR	INP
Rhizophora mucronata	0.09	15,19	1	10	25.2
Rhizophora apiculata	0.07	12.52	1	10	22.5
Rhizophora stylosa	0.06	10.04	1	10	20
Ceriops decandra	0.05	9,591	1	10	19.6
Ceriops tagal	0.05	9,503	1	10	19,5
Bruguiera gymnorrhiza	0.05	9,147	1	10	19,1
Avicennia marina	0.05	9,147	1	10	19,1
Avicennia alba	0.05	8,703	1	10	18.7
Sonneratia alba	0.05	8.526	1	10	18.5
Xylocarpus granatum	0.04	7,638	1	10	17.6

Table 4:- Mangrove Vegetation Structure and Important Value of Seedling Levels

- *Diversity*

Diversity index based on research results obtained by using the formula *Shannon - Wiennerpresented* in Table 5.

NO	SPECIES	Pi	ln Pi	Pi ln Pi	H '
1	Rhizophora mucronata	0.14	-1.93	-0.28	
2	Rhizophora apiculata	0.12	-2.14	-0.25	
3	Rhizophora stylosa	0.1	-2.29	-0.23	
4	Bruguiera gymnorrhiza	0.09	-2.4	-0.22	
5	Ceriops decandra	0.1	-2.31	-0.23	2,287
6	Sonneratia alba	0.09	-2.37	-0.22	
7	Avicennia marina	0.09	-2.39	-0.22	
8	Avicennia alba	0.09	-2.41	-0.22	
9	Ceriops tagal	0.09	-2.36	-0.22	
10	Xylocarpus granatum	0.08	-2.57	-0.2	
	TOTAL	∑ =		-2.29	

Table 5:- Tutuwoto Mangrove Forest Diversity Index

Based on the results of research conducted in the mangrove areas Tutuwoto village Orchid District presented in Table 5, shows the mangrove forest diversity index of 2.287.If the results are based on the diversity index criteria, then the Tutuwoto village mangrove forest has a high diversity index that is on the criteria of H^1> 1, 5- 3.0.

➢ *Carbon Level Tree Mangrove Vegetation*
The results of calculation of stem biomass, carbon content and carbon dioxide uptake at the tree level are presented in Table 6.

Species Name	Value BB (Kg)	KK (Kg)	Uptake CO_2
Rhizophora mucronata	40966.95	20483.48	75174.36
Rhizophora apiculata	22449,18	11224,59	41194,24
Rhizophora stylosa	19595.43	9797.71	35957,61
Bruguiera gymnorrhiza	18757.84	9378,92	34420,64
Ceriops decandra	25775.21	12887,6	47297,5
Sonneratia alba	15166,3	7583.15	27830,15
Avicennia marina	16311,59	8155.79	29931,8
Avicennia alba	13649.23	6824,62	25046.3
Ceriops tagal	18711.73	9355.87	34336
Xylocarpus granatum	21989.41	10,9947.2	403506,3
total	213372.87	205638,9	754694,9

Table 6:- Stem biomass, carbon content, and carbon dioxide uptake at the tree level

➢ *StakeLevel Mangrove Carbon Vegetation*
The results of calculation of stem biomass, carbon content and carbon dioxide uptake at the stake level are presented in Table 7.

Species Name	Value BB (Kg)	KK (Kg)	Uptake CO2
Rhizophora mucronata	11271.31	5635,7	20682.86
Rhizophora apiculata	11020,7	5510.35	20223
Rhizophora stylosa	8673.15	4336,58	15915.23
Bruguiera gymnorrhiza	8619,52	4309.8	15817
Ceriops decandra	9940.68	4970.34	18241
Sonneratia alba	7465.18	3732,6	13699
Avicennia marina	5112.66	2556.33	9382
Avicennia alba	6914.4	3457,19	12688
Ceriops tagal	8234.06	4117.03	15109
Xylocarpus granatum	7141.4	3570,72	13105
total	84393.06	42196.64	154862,1

Table 7:- Stem biomass, carbon content and carbon dioxide uptake at the tree level

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➢ *Total Biomass, Carbon Content and Absorption of Carbondiosides at the Research Site*
The total biomass, carbon content, and carbon dioxide uptake in the Tutuwoto village mangrove area are presented in Figure 1.

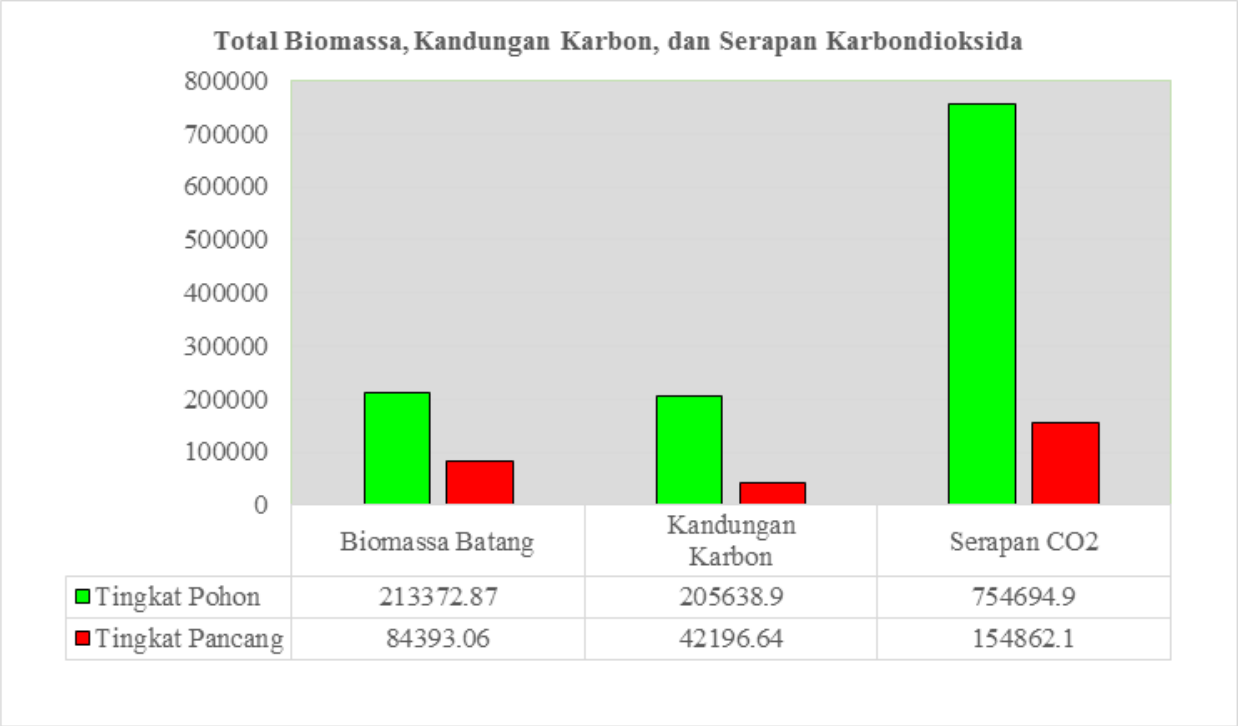

Fig 1:- The total biomass, carbon content, and carbon dioxide uptake in the Tutuwoto village mangrove area

IV. DISCUSSION

Based on research findings in the Tutuwoto mangrove ecosystem, 10 mangrove species were found at the observation site. The mangrove species found was *Rhizophora mucronata* Lamk. , *Rhizophora apiculata* Bl. , *Rhizophora stylosa* Griff. , *Ceriops decandra* (Griff.) Ding Hou, *Ceriops tagal* (Perr.) CBRob, *Brugueira gymnorrhiza* (L.) Lamk, *Sonneratia alba* JE Smith, *Xylocarpus granatum* Koen, *Avicennia alba* Bl., *Avicennia marina* (Forsk) Vierh . The results of data analysis of the structure of mangrove vegetation in Tutuwoto village showed that the mangrove genus Rhizophora was the most dominant mangrove in the region. G Enus Rhizophora dominate Tutuwoto village and the substrate due to environmental conditions at the study site to the supported n g the growth of this species, but it is largely made up of muddy so easy to mangrove *Rhizophora* spp can adapt well and support the growth of mangrove *Rhizophora* spp. This choco a i with advanced by Noor *et al* (2012) that in Indonesia muddy substrate is very good for *Rhizophora mucronata* and *Rhizophora apiculata* stands , this condition is in accordance with the environmental conditions that exist in the location of the research, namely sand-mixed mud.

The second, third and fourth paragraphs presented above, there are certain species that have a high index of vegetation value and indicate that the species is dominant in a community. At the tree, sapling and seedling levels, *Rhizophora mucronata* has a high density and dominance, meaning that this species has the highest number of individuals and has a larger diameter than the other species. Based on the sum of the value of ape ents/dominance and species *Rhizophora mucronata* mem IVI IVI iliki highest rank of the tree at 47.86, the dominance of 0.162 cm ^{2,} a frequency of 1%, and a density of 0.02 m ^{2,} for saplings and seedlings of species *Rhizophora mucronata* is also a species that has the highest INP value of 35.27%, dominance of 0.163 cm ^{2} , frequency of 1% and density of 0.07%, and seedling level of INP value of 25.5%, frequency of 15%, and density 0.09%.

Rhizophora mucronata has a high dominance compared to other species because this species has a large physical shape, extensive canopy closure area and wider distribution than other species. Furthermore *Rhizophora apiculata classically* belongs to the family Rhizophoraceae, and its habitat on muddy soil. P enyebaran *Rhizophora apiculata* tends to have the ability to adapt well in the mangrove community in Tutuwoto village. Furthermore, Irwanto (2007) states that a community is said to have high species diversity if the community is composed by many species with an abundance of the same or almost the same species. Conversely, if the community is composed of very few species and if only a few species are dominant, the species diversity is low.

Mangrove vegetation in the village of Tutuwoto, has a diversity index of vegetation types that are included in the high criteria are found in trees, saplings, and seedlings. The high species diversity index at this location is because the mangrove area in this location is still in good condition. Diversity index (H ')Tutuwoto mangrove forest is 2, 287. This shows that the mangrove vegeta community is in high

condition. The greater the H 'of a community, the more stable the community will be. According to Irwanto (2007), the greater the H 'of a community, the more stable the community will be. The value of H ' = 0 can occur if only one species in one sample and H' is maximal if all species have the same number of individuals and this shows abundance is perfectly distributed. Furthermore Asmaruf (2013), argues that the species diversity index value describes the level of species diversity in a stand. A community is said to have a high species diversity if there are many species with individual numbers relatively evenly. A large diversity index value implies the presence of a large carrying capacity of the environment for life.

The density of mangroves is closely related to stand biomass, where the amount of biomass in an area is obtained from the production and density of biomass through measurements of diameter, height, specific gravity and density of each type of tree. Biomass is a form of organic material produced by plants through photosynthesis. In the process of photosynthesis CO_2 and water are converted into simple carbohydrates produced through plant metabolic processes to be subsequently converted into lipids, nucleic acids, proteins, and organic molecules for example CO_2.Organic molecules are then stored in the biomass of leaves, stems, roots, tubers, seeds, tissues, and other organ systems.CO_2absorbed by plants with the help of sunlight then stored in the body's biomass, namely the leaves, stems, roots, branches, fruits, and flowers of the substrate and roots. This process is called the *sequestration* process. The amount of carbon stored in biomass on a land can describe the amount of CO_2in the atmosphere absorbed by plants (Hairiah and Rahayu, 2007).

Ilmiliyana (2012) states that the greater the potential of stand biomass is caused by the older age of the stand. This is because the diameter of the tree experiences growth through cell division which continues so that new cells are formed which will increase the stem diameter. This growth is called secondary growth which causes greater stem diameter in plants due to cambium division activity. So that the larger the stem diameter, the value of stem biomass increases. *Rhizophoramucronata* mangrove stems have a hard and rough texture.The stem has a composition of cellulose, hemicellulose, and lingnin. The larger the diameter of the tree the greater the potential for cellulose. Stems are part of plants that can store more carbon than other plants. This is because wood constituents are better than other parts of the tree. The constituent of wood causes many cell cavities in the stem to be composed of wood constituent components rather than water, so the weight of the stem biomass will be greater (Purnobasuki, 2012).

The results showed that the carbon content of the mangrove stem *Rhizophora mucronata* which is a mangrove species that promotes the Tutuwoto mangrove area capable of absorbing the largest carbon in biomass compared to other species, with a value of 40.966.95 Kg for tree level and 11.271.31 Kg for the stake level. This fact proves that there is a correlation with stem diameter, where the greater the stem diameter of *Rhizophoramucronata*, the higher the value of biomass. Furthermore, the total value of carbon biomass in the stem of all mangrove species in Tutuwoto village is 297,765.93 Kg, the total value of carbon content is 247,845.54 Kg, and the total ability of carbon dioxide absorption of all species reaches 909,557 Kg / ha. With the ability of mangroves to store carbon, the increase in carbon emissions in nature can be reduced.

V. CONCLUSION

Based on the results and discussion in the study it can be concluded:

- 10 species of mangrove trees in Tutuwoto village at tree, sapling and seedling level were found, namely *Rhizophora mucronata* Lamk. , *Rhizophora apiculata* Bl., *Rhizophora stylosa* Griff. , *Ceriops decandra* (Griff.) Ding Hou, *Ceriops tagal* (Perr.) CBRob, *Brugueira gymnorrhiza* (L.) Lamk, *Sonneratia alba* JE Smith, *Xylocarpus granatum* Koen, *Avicennia alba* Bl., *Avicennia marina* (Forsk) Vierh . At the tree, sapling and seedling levels that dominate are *Rhizophora mucronata* Lamk.
- The index of mangrove forest diversity is 2,287.If the results are based on the diversity index criteria, the Tutuwo to village mangrove forest has a diversity index.
- The total value of carbon biomass in the stems of all mangrove species in Tutuwoto village is 297,765.93 Kg, the total value of carbon content is 247,845.54 Kg, and the total ability of carbon dioxide absorption of all species reaches 909,557 Kg / ha. With the ability of mangroves to store carbon, the increase in carbon emissions in nature can be reduced.

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