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Stored Carbon FMU Lawu Manunggal Using a Biomass Approach in the Community Forest in Sidomulyo Village, Magetan Regency, Indonesia

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ABSTRACT: Community forests provide real benefits, especially the economic value of communities around the forest, and a real contribution to environmental services. One of the benefits of forests is vital for the survival of living things because it has a role in regulating the micro and macro climate. On the other hand, forest destruction can cause climate instability. Sustainable management of community forests has become a necessity due to global economic and political changes. Sustainable Forest Management is a manifestation of the concept of sustainable forestry development. The research aims to calculate the standing potential of Sidomulyo Village FMU Lawu Manunggal, Magetan Regency, the ability of the forest to produce biomass, carbon content, and the ability to absorb $C0_2$ content including allometric estimation models through inventory activities for potential by using the method Destructive sampling of the sample of tree species to be measured biomass, stored carbon and carbon dioxide uptake. The results showed the average stand potential was 10,340 m3/ha, or a total volume of 1,046,402 m^3, the highest for the Melia azedarach species, at 4,468 m^3/Ha. The average forest biomass content per ha is 28,379 tons or a total of 1,773,259 tons. The average carbon content is 13,338 tons C/ha or the total available carbon is 199.85 tons. The ability to absorb carbon dioxide ($C0_2$) is 44,789 tons C/Ha, with a community forest management area capable of absorbing 3,058,695 tons of $C0_2$ content.

KEYWORDS: Absorption $C0_2$, Biomass, Carbon Content, Potential

INTRODUCTION

A community forest is one of the alternative solutions to the pressure on forest resources. The benefits obtained from community forest management include meeting timber needs, increasing community income, and increasing community land productivity. The benefits obtained by the community depend on the management carried out by community forest owners. As part of the action plan for reducing GHG emissions and climate change, community forests contribute significantly, even though it is not widely understood by various parties (Setiahadi et al., 2010).

Community forests are examples of valuable forests in forest rehabilitation in Indonesia. However, on the other hand, it also plays a role in meeting the needs of firewood, medicinal gardens, cooking spices, and economic income for the community managing the forest. Moreover, community forests multi-functional forests, so many community members voluntarily and independently use their land to plant various types of hardwood and herbal plants in the form of empon-empon.

One of the essential roles of community forests that are still rarely known by many people, especially for the managers themselves, is its ability to store carbon. The role of community forests in storing carbon will be very beneficial if it is integrated with the ability of managers to conserve their forests. Thus, community forests will create double benefits; namely, the land becomes more productive because it is rehabilitated, generates economic income and carbon sequestration that can help combat the impacts of climate change because the carbon dioxide that crosses the threshold in the atmosphere can cause a greenhouse effect that has an impact on climate change in the form of global warming.

Increasing forest development as a material for increasing $C0_2$ absorption can be carried out in state forest areas or private forests, including community forests. Lukito, Rohmatiah (2021), The potential of community forests in tree population and species will result in a significant accumulation of $C0_2$ absorption. However, with the high rate of forest degradation and deforestation, $C0_2$ absorption has decreased. Degraded forests will gradually lose their function as $C0_2$ absorbers (Junaedi, 2008)

The purpose of the study was to calculate the potential of community forests and above-ground biomass in Sidomulyo Village, Lawu Manunggal FMU, Magetan Regency, to estimate the potential for carbon content (C) and carbon dioxide uptake ($C0_2$). The benefits of this research can provide scientific information, become a reference for local government policies in regional development and conservation plans, and become data and

information that can be a reference for further research. The main cause is increased greenhouse gases such as $C0_2$, CH_4, N_2O, and CF_4. (IPPC 2001) which has an impact on increasing global temperatures and changes in rainfall (IPPC 2007). Carbon dioxide gas is the biggest problem and the leading cause of Greenhouse Gases on earth.

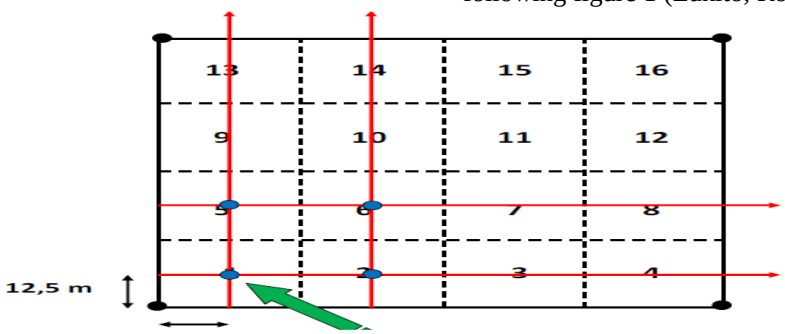
Forests with tree components can absorb atmospheric carbon, convert it into biomass, and be stored in the system as carbon stocks or carbon stocks (Hairiah & Rahayu, 2007). The more trees there are, the more carbon dioxide is absorbed. If Indonesia's forest development is increased, Indonesia has helped reduce $C0_2$ concentrations. The absorptive capacity of tree stands in the forest is influenced by tree physiology, such as the rate of photosynthesis which is influenced by atmospheric $C0_2$ concentration, air temperature, air humidity, chlorophyll content, and stomata. The content of chlorophyll and the number of stomata per leaf area can determine the rate of photosynthesis. The larger the leaf area per unit of land, the greater the $C0_2$ absorbed. However, leaf area will be directly proportional to the age of the stand. Therefore it can be assumed that the age of the stand will affect the absorption of $C0_2$ Forest plants absorb $C0_2$ through photosynthesis and store it in biomass, which affects preventing and handling of global warming on earth. Lukito, and Rohmatiah (2021) said that half of the biomass in the forest is composed of carbon. The primary function of forests is important, especially about global warming, especially because forests have a role as a source of emissions and absorption

Reducing emissions from forests is carried out through 2 main stages: increasing carbon sequestration and conserving forest carbon. Carbon calculations can also support forestry policies at the national and regional levels, especially in Community Forests where the amount of carbon from forest stands determines the right policy direction for sustainable forestry development. Carbon accounting is also an effort to find out the actual condition of forests in Indonesia, which is very wide and diverse. For this reason, it is recommended that carbon calculations be carried out with a combination of ground survey and remote sensing activities. In order to maintain the accuracy of the numbers and the efficiency of carbon calculations. one of which has been stated in the application to calculate emission reductions through the IPCC (GL) application, IPCC (2003)

METHODS AND DATA ANALYSIS

Inventory of Community Forest Stands

Inventory of the community forest stands of the Lawu Manunggal FMU group by determining the Measurement Plots in Sidomulyo Village, as many as 16 plots with a size of 25 x 25 m, so that the area of each Measurement Plot is 1 hectare. The steps for data collection for each Measurement Plot, Measurement Plot Plan, and unit can be seen in the following figure 1 (Lukito, Rohmatiah, 2021).



Information :

= recording unit center point = the outer boundary of the sample plot

Figure 1. Measurement Plot, Measurement Plot Plan, and Unit

The determination of the volume of each tree included in the Measurement Plot is based on the results of height and diameter measurements, then the volume is determined. Determination of tree volume using the formula. Measurement of standing trees:

$V = ¼ \pi \times d^2 \times t \times f \times n$ ……..(1)

Information :

V = standing stock volume

π = phi (22/7)

d = diameter at chest height

t = tree height

n = number of trees per hectare (n/ha)

Actual Bar Volume

From the basic formula above, it is reduced to

V = π/8 (Dp2 + Du2). p …….. (2)

Where:

Dp = Average base diameter;

Du = Average tip diameter

p = Segment Length

The actual total volume is known by adding up the volume of each segment, using the formula:

Vst = Vs1 + Vs2 + Vs3 + ····· +Vstn……(3)

Information :
Vst : Segment total volume (m^3)
Vs1, Vs2, Vs3····Vsn : Volume of each segment

Plant Biomass Measurement

Biomass above ground in Sidomulyo Village is carried out by destructive sampling of all tree organs (roots, stems, branches, and leaves). The model is used to extrapolate data samples to a wider area—allometric model approach. Published standard allometric equations are often used, but because the coefficients of these allometric equations vary for each location and species, it is necessary to make significant equations in estimating vegetation biomass (Heiskanen, 2006).

Tree Organ Biomass (BOP)

Lukito Martin (2010) said the calculation of the biomass of plant tree organs above the ground (above ground) is known based on the formula:

$$\text{Tree Organ Biomass (BOP)} = \frac{BKS}{BBS} \text{ x BBT}\text{……..(4)}$$

Information :
BOP = Tree organ biomass (g, kg)
BKS = Dry weight of sampel (g,kg)
BBS = Wet weight of sample (g,kg)
BBT = Total wet weight of tree organs (g, kg

The measurement of each dry weight was carried out by drying the samples brought from the field using an oven at a temperature of 103±2 ^{0}C until a constant weight was obtained. The total tree biomass can be calculated by adding up all the tree component biomass in the formula used:

$W_t = W_s + W_L + W_B + W_t$.....(5)

Keterangan =
W_t = *above ground (total weight*)
W_s = *Stem weight*
W_L = *leaf weight*)
W_B = *branch weight*

Carbon Dioxide Measurement

Carbon dioxide is the primary source of greenhouse gases in the forestry and land use change sector. Forest Carbon Stock is stored in vegetation, namely, in stems, shoots and roots, other biomass, and in the soil Ariwibowo et al. (2013). The carbon content obtained from each tree organ multiplies the biomass of each plant organ by the weight percentage of the total carbon content.

C_t = Wt X % carbon content (KK).....(6)
Information =
Ct = Weight of tree organ carbon content (g,kg)
wt = weight of plant organ biomass (g,kg)
% KK = Total carbon content (C total %)

The carbon calculation guideline is used by the national carbon accounting standard (SNI 7724/7725 of 2011) to understand and implement carbon measurement and calculation, supporting climate change mitigation in the forestry sector. Carbon content was calculated by multiplying the biomass of trees, necromass, litter, and undergrowth by 47% (Annonymous, 2011).

Measurement of Carbon Dioxide Uptake

CO_2 absorption through conversion of C and O Atomic Mass. Comparison of $C0_2$ to C (Carbon) Atomic Mass = 3.67. The potential of forests to absorb $C0_2$ from the atmosphere varies according to species, age level and plant density (Heriansyah, 2005). The approach to calculating CO_2 absorption can be approximated by the formula:

$W_{CO2} = W_{tc}$ X 3,67.....(7)

Where
W_{CO2} = Amount of $C0_2$ absorbed (tonnes/ha)
w_{tc} = Total carbon weight of the stand of a certain species and age (ton/ha)
3,67 = The equivalent number/conversion of the element carbon (C) ke $C0_2$

Measurement of the ability to absorb carbon dioxide by multiplying the value of stored carbon by a constant with a large value of C and O atoms of 3.67, so that the value of forest carbon dioxide absorption can be known Manuri et al. (2011).

Allometric Equations

Logging data such as tree height, dbh, searched for correlation with wet weight of plant organs, biomass, carbon dioxide content, and $C0_2$ absorption were made in an allometric equation with a regression model. Regression models that have been developed in Indonesia are generally presented in rank (Krisnawati et al, 2012).

$Y = aX^b$ ----------(8)

Information
X = Independent variable (Diameter, Hight)
Y = Dependent variable (biomass)
a = Allometric model coefficient
b = Allometric model exponent

The regression model selection is based on the coefficient of determination (R2), the highest and smallest residual sum of squares. In addition, the significance test of the resulting equation was also carried out. The minimum number of residual error deviations shows that the regression error rate that occurs is also getting smaller (Lukito, 2010).

RESULTS AND DISCUSSION

Geographical Location and Position

Sidomulyo Village, Sidorejo District, is included in the management group of FMU Lawu Manunggal while the Village Boundaries are as follows:

Regional boundaries

North	: Sumbersawit Village
East	: Widorokandang Village
South	: Getasanyar Village
West	: Mount Lawu

Geographical Position Coordinates

North	:7^0 63'38.58" S, 111^0 25'24.35" E
East	:7^0 64' 38.96" S, 111^0 26'53.10" E
South	:7^0 65' 25.73" S, 111^0 24'78.00" E
West	:7^0 64' 35.56" S, 111^0 23'32.09" E

The area of Sidomulyo Village is 475,885 Ha with a combination showing varying conditions, namely sloping conditions to mountainous conditions, in terms of soil depth, the effective dominance of the soil is less than 30 cm located in Parang, Lembeyan, Kawedanan, Soil types in Sidomulyo village consist of grumosol, latosol, Dusun Ngijo, and Andosol. Enter the western part of the Lawu mountain area. Sidorejo District has a C climate type, the altitude is between 300-1,176 above sea level, with an average rainfall of 1,453 mm/year with hilly topography. Administratively, the area of Sidomulyo Village consists of five hamlets: Gangging Hamlet, Klatak Hamlet, Gondang Hamlet, Ngrobyong Hamlet, and Ngrobong Hamlet. Based on the Community Forest Management Areas included in the Lawu Manunggal FMU, Sidomulyo Village is Gondang Hamlet, Ngrobyong Hamlet, and Ngijo Hamlet.

Community Forest Organizations in Panekan District (Annonymous, 2014)

1. Community Forest Management Organizations (OPHR) in the villages of Sumberdodol, Tapak and Sukowidi, Sumbersawit and Sidomulyo are part of the **Forest Management Unit (FMU) "Lawu Manunggal" Panekan and Sidorejo Subdistricts, Magetan Regency.**
2. FMU "Lawu Manunggal" is a Forest Management Unit (FMU) in Magetan Regency which has a community forest conservation management program, consists of OPHR in 5 villages in Panekan and Sidorejo sub-districts.
3. FMU "Lawu Manunggal" Panekan Subdistricts, Magetan Regency was established on June 14, 2014 in Sumberdodol Village, Panekan District, Magetan Regency.
4. Management is carried out by the combined community from each Village OPHR selected in a participatory manner by members in a member meeting/meeting.

FMU Lawu Manunggal Working Area

In accordance with the agreement of FMU Lawu Manunggal, FMU working area is 896,620 Ha consisting of 5 villages, including an area of 286.34 Ha in Sidomulyo Village area, Sidorejo District, Magetan Regency, as presented in Table 1 and Figure 1.

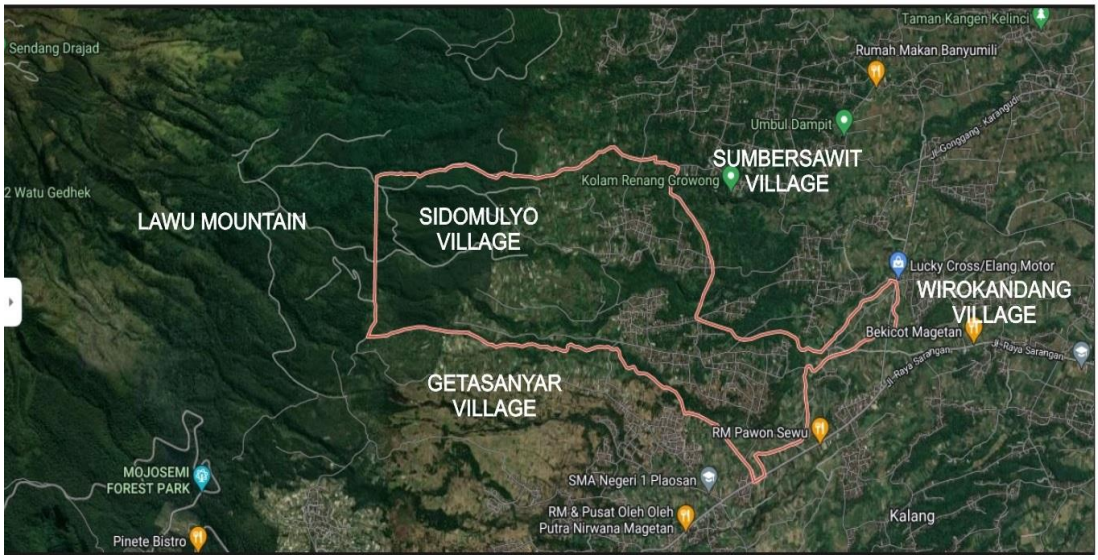


Figure 1. Sidomulyo Village, Magetan Regency, East Java

Table 1. Recaptulation of Community Forest Area of Lawu Manunggal FMU, Sidomulyo Village, Kecamatan Sidorejo Magetan Regency

No.	Village	Hamlet	Garden Area (Ha)	Farm Area (Ha)	Total (Ha)
1	Sidomulyo	Gondang	55,81	41,00	96,81
		Ngrobyong	17,92	48,52	66,44
		Ngijo	30,67	92,42	123,09
	Total (Ha)		**104,40**	**181,94**	**286,34**

Source: Annonymous 2014

Inventory of stands in the community forest of Sidomulyo village, Lawu Manunggal FMU area, obtained an average potential of community forest per ha of 642 trees or with a volume of 10,340 M3/ha, consisting of stands of Paraserianthes falcataria of 153 trees with a standing stock volume of 1,660 m3/ha, Swietenia mahagoni 115 trees with standing stock potential of 3,302 M3/Ha, Tectona grandis Lf of 204 trees with standing stock volume of 1,034 m3, and potential for Melia azedarach of 4,869 M3/Ha with an average of 171 trees per ha, shown in Table 2 and Table 3.

Table 2. Inventory of Stands Tree Level per Ha Community Forest Sidomulyo Village FMU Lawu Manunggal Magetan Regency

No	Village	Hamlet	Number of Trees (btg) And Volume (m^3) per Ha									
			Paraserianthes falcataria		*Swietenia mahagoni*		*Melia azedarach*		*Tectona grandis*, L		Jumlah	
			N	Vol	N	Vol	N	Vol	N	Vol	N	Vol
1	Sidomulyo	Gondang	75,0	1,058	111,0	1,034	163,5	3,438	200	0,653	549,8	6,183
		Ngrobyong	7,5	0,072	1,5	0,422	1,9	0,634	-	-	10,9	1,128
		Ngijo	70,0	0,530	2,4	1,845	5,3	0,617	4	0,037	81,2	3,029
Total per Ha			153	1,660	115	3,302	171	4,689	204	0,690	642	10,340

Description: N = Number of Trees, V = Volume
Source: Primary data (2022)

Table 3. Standing potential of Community Forest Stands in Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

No	Village	Hamlet	Luas (Ha)	Jumlah Pohon (btg) Dan Volume (m^3)									
				Paraserianthes falcataria		*Swietenia mahagoni*		*Melia azedarach*		*Tectona grandis*, L		Jumlah	
				N	Vol	N	Vol	N	Vol	N	Vol	N	Vol
1	Sidomulyo	Gondang	96,81	7.261	102,406	10.746	100,137	15.828	332,82	19.386	63,206	53.221	598,567
		Ngrobyong	66,44	498	4,775	98	28,029	125	42,139	-	-	721	74,943
		Ngijo	123,19	8.616	65,292	300	227,150	652	75,933	431	4,516	9.999	372,891
	Total (Ha)		286,34	16.375	172,473	11.144	355,316	16.605	450,89	19.817	67,722	63.942	1.046,402

Description: N = Number of Trees, V = Volume
Source: Primary data (2022)

Table 3 shows that the area of community forest in Sidomulyo Village is in the management area of the Lawu Manunggal FMU area of 286.34 ha. The distribution of species and potential based on the Mindi species (Melia

azedarach) seems to dominate the area of the community forest. It is almost evenly distributed in every hamlet village of Sidomulyo village, namely of 16,605 trees with a total standing stock volume of 450,890 m^3, Swietenia mahagoni species of 11,144 trees (355,316 m^3) also almost evenly distributed, species of Tectona grandis, LF of 19,817 trees with a total volume of standing stock of 67,722 m^3, Paraserianthes falcataria species of 16,375 trees (172.473 m^3) when compared with the villages of Sundul and Banjar Panjang at FMU Argomulyo, there was no significant difference. Lukito, Rohmatiah 2021, said the average potential of community forest per hectare for Acacia auricuriformis stands with a standing stock volume of 5.706 m^3, Swietenia mahagoni of 8.825 m^3, Tectona grandis Lf standing stock volume of 153.98 m^3, and the potential for Dalbergia latifolia roxb of 1.229 m^3.

Biomass Potential of Community Forest Stands

The amount of forest biomass is carried out on all parts of the tree consisting of above-ground biomass, including stem organs, branches, and leaves, and belowground biomass, including tree roots. The amount of the results of the inventory per segment is presented in Figure 2 and Table 4.

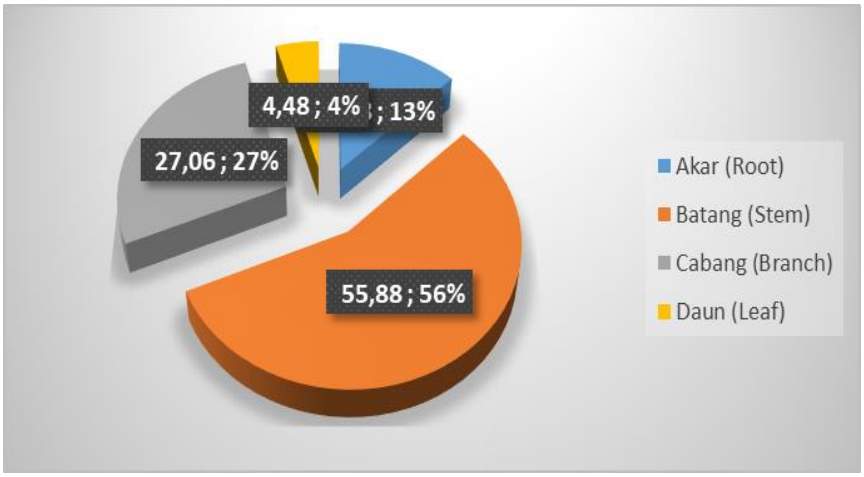


Figure 2. Prosentase Biomassa Organ Tanaman Desa Sidomulyo Kecamatan Sidorejo

Table 4. Biomass kg Per Ha Community Forest Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

Organ	Biomass (Kg)/Ha				
Type	Root	Stem	Branch	Leaf	Total
Paraserianthes falcataria	4.020,573	12.105,865	9.100,613	738,990	25.966,041
Melia azedarach	3.928,833	18.123,657	4.035,665	2.034,869	28.123,024
Tectona grandis, LF	3.259,261	11.086,572	8.787,839	890,907	24.024,580
Swietenia mahagoni	3.067,587	22.122,125	8.787,839	1.425,175	35.402,726
Average	3.569,063	15.859,555	7.677,989	1.272,486	28.379,093

Source: Primary data (2022)

The average weight per tree per Ha is 28,379.093 tons/Ha, Sengon (Paraserianthes falcataria) is 25,966 tons/Ha Mindi (Melia azedarach) 28,123 tons/Ha, Mahogany (Swietenia mohagoni) 35,379 tons/ha and the type of Teak (Tectona grandis LF) of 24,024 Ton/Ha. The average wet weight of Sidomulyo Village is 123,042 kg/tree. Therefore, the average biomass per Ha is 28,379 Tons/ha, the Total Biomass Potential of Community Forests in Sidomulyo Village, Lawu Manunggal FMU Managed Area, is presented in Table 5.

Table 5. Total Biomass of Community Forests in Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

Village/Type	Amount of Biomass per species (Ton)						
	N	V (M3)	Root	Stem	Branch	Leaf	Total (Ton)
Melia azedarach	16.605	450,89	300.95	65.24	67.01	33.79	467.00
Swietenia mahagoni	11.144	355,32	246.53	34.19	108.37	15.88	404.97

Tectona grandis, LF	19.817	67,72	219.70	64.59	174.15	17.66	476.10
Paraserianthes falcataria	16.375	172,47	198.24	65.84	149.03	12.10	425.20
Total	3.942	1.046,4	965.42	229.85	498.56	79.43	1.773.26

Source: Primary data (2022)

Based on the table above, it can be seen that the total biomass of Sidomulyo village is 1,773,259 tons, with the largest distribution of species composition for Tectona grandis, LF for 476,966 tons, Melia azedarach for 466,995 tons, Swietenia mahagoni for 404,966 tons, and Paraserianthes falcataria for 425,203 tons. An overview of Total Biomass per Ha is presented in Figure 3.

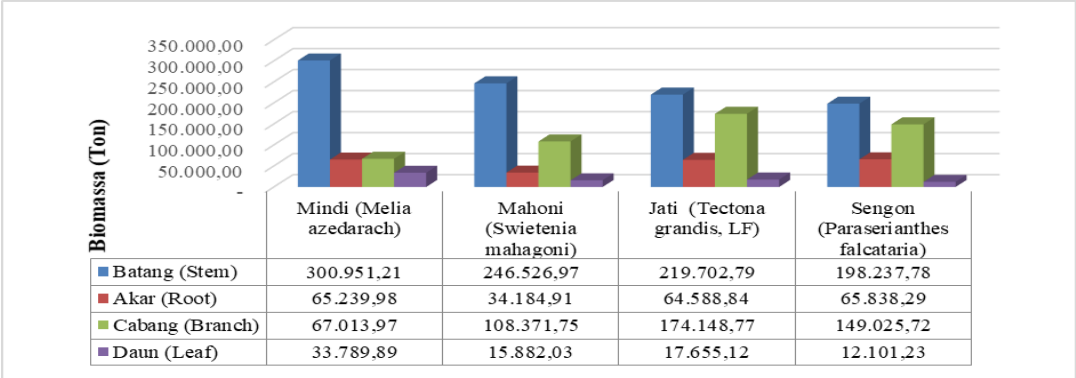


Figure 3. Biomass Potential of Sidomulyo Village, Sidorejo District (Ton)

The total biomass potential of Sidomulyo Village is 1,773,259 tons. In community forest covering an area of 286.34. Lukito Martin, Rohmatiah, 2013 Plant Biomass JUN (Jati Unggul Nusantara) Krowe Village Kabupaten Magetan The total potential biomass content of the JUN stands is 27.30 tons per hectare. The potential biomass of the JUN stands in Trosono Village. Regency. Magetan of 56.2 tons. Or 17,295 tons per hectare (Lukito, Ahadiati 2014). Lukito, Rohmatiah, 2015 Measurement of Biomass in Madiun Regency, the potential for biomass of JUN stands, Dungus Village, Kabupaten Madiun averages 27.30 tons per hectare or a total of 121.1 tons in an area of 131.4 ha. Rohmatiah, Lukito Martin, 2015 Estimated volume, biomass, and carbon of community forest in Kare Village, Madiun Regency, obtained the biomass content of 168.35 tons per ha. Total of 6,462.67 Tons. Lukito, Rohmatiah (2021) said that the biomass content of the villages of Sundul and Banjar Panjang FMU Argomulyo, with an area of 199.144 hectares of community forest, obtained an average biomass per hectare of 955.32 tons/ha, consisting of Acacia auricuriformis of 148.41 tons/ha, Swietenia mahagoni of 213.87 tons/ha, Tectona grandis Lf of 611.56 tons/ha, and Dalbergia latifolia roxb of 21.48 tons/ha.

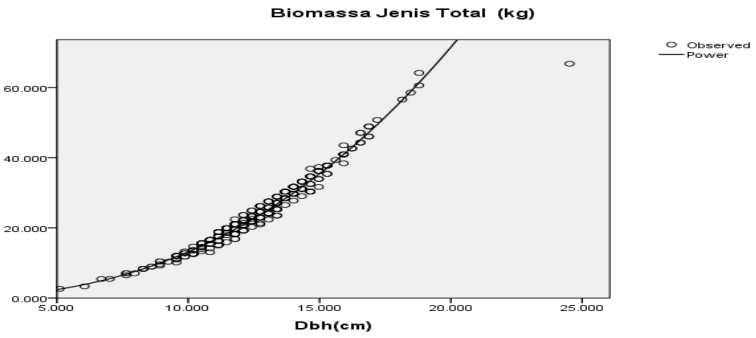
Biomass Estimation Model

The model for estimating the biomass of Community Forest species against the diameter at chest height (Dbh) Sidomulyo Village FMU Lawu Manunggal Kabupaten Magnets is depicted as a scatter plot in Table 6 and Figure 4.

Table 6. Biomass Allometry Model Community Forest Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

No.	Type	Model	Equality	R^2	RSS	Std Error
1.	*Melia azedarach*	Power	$Y = 0{,}71\ dbh^{2{,}451}$	0,937	1.108	0,070
2	*Swietenia mahagoni*	Power	$Y = 0{,}071\ dbh^{2{,}527}$	0,985	0.007	0,016
3	*Tectona grandis lf*	Power	$Y = 0{,}086\ dbh^{2{,}141}$	0,972	0.007	0,016
4	*Paraserianthes falcataria*	Power	$Y = 0{,}135\ dbh^{2{,}324}$	0,912	1.456	0,204
5	Biomassa	Power	$Y = 0{,}061\ dbh^{2{,}636}$	0,919	1.111	0,034

Source: data analysis (2022)



Biomassa Total . Power Y = 0,061 dbh^{2636} R^2 = 0,919, RSS = 1.111, Std Error 0,034

Source: Primary data (2022)

Figure 4. Biomass Estimation Model of Community Forests in Sidomulyo Village FMU Lawu Manunggal Magetan Regency

Carbon Potential

Research on the carbon content of community forest stands is limited to living plants. Therefore, the measurement method used, the carbon value, is calculated by multiplying the tree biomass by 47% (Annonymous, 2011). The results of the calculation of the carbon content are presented in Table 7 and Figure 5.

Table 7. Carbon Content (kg) Per Community Forest Segment in Sidomulyo Village FMU Lawu Manunggal, Sidorejo District, Magetan Regency

Type /Organ	Carbon (Kg)				
	Root	Stem	Branch	Leaf	Total
Paraserianthes falcataria	1.889,669	5.689,757	4.277,288	347,326	12.204,039
Melia azedarach	1.846,551	8.518,119	1.896,763	956,389	13.217,821
Tectona grandis, LF	1.531,853	5.210,689	4.130,285	418,726	11.291,553
Swietenia mahagoni	1.441,766	10.397,399	4.130,285	669,832	16.639,281
Rata rata	1.677,460	7.453,991	3.608,655	598,068	13.338,174

Source: data analysis (2022)

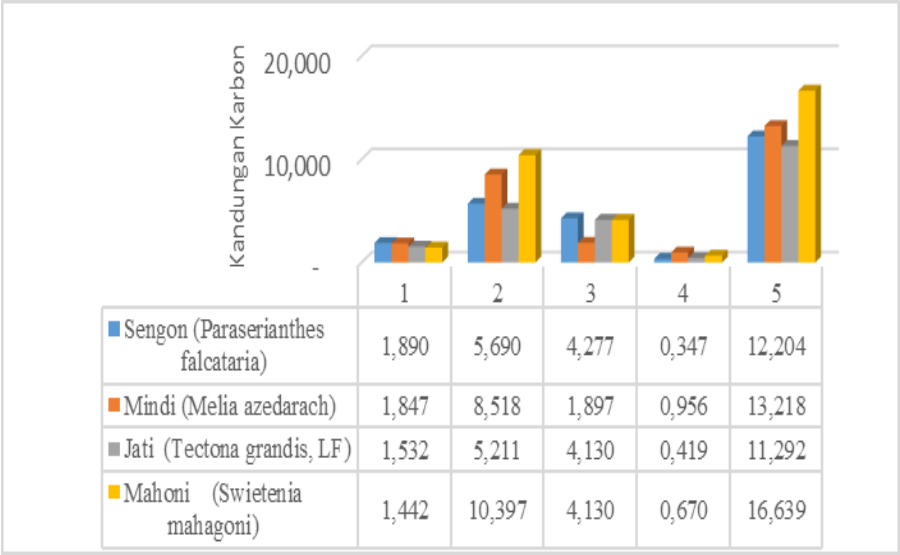


Figure 5. Carbon Content (kg) Per Community Forest Segment in Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

In Table 7 and Figure 5 the average weight of carbon content per tree per Ha is 13,338,174 tons/Ha, for Paraserianthes falcataria for 12,204,039 tons/Ha for Melia azedarach for 13,217,821 tons/Ha, Swietenia mohagoni for 16,639 ,281 tons/ha and the type of Tectona grandis LF of 11,291,553 tons/ha. The average wet weight of Sidomulyo Village is 123,042 kg/tree. The average carbon content is 8,379 tons/ha. The total potential carbon content of the Sidomulyo Village Community Forest Management Area of Lawu Manunggal FMU is presented in Table 8

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Table 8. Carbon Content of Community Forests in Sidomulyo Village FMU Lawu Manunggal, Sidorejo District, Magetan Regency

Jenis/Organ	**Karbondioxsida per jenis (Ton)**						
	N	**V (M3)**	**Stem**	**Root**	**Branch**	**Leaf**	**Total**
Melia azedarach	16.605	450,89	141.45	30.66	31.50	15.88	219,49
Swietenia mahagoni	11.144	355,32	115.87	16.07	50.94	7.47	190,33
Tectona grandis, LF	19.817	67,72	103.26	30.36	81.85	8.30	223,76
Paraserianthes falcataria	16.375	172,47	93.17	30.94	70.04	5.69	199,85

Source: data analysis (2022)

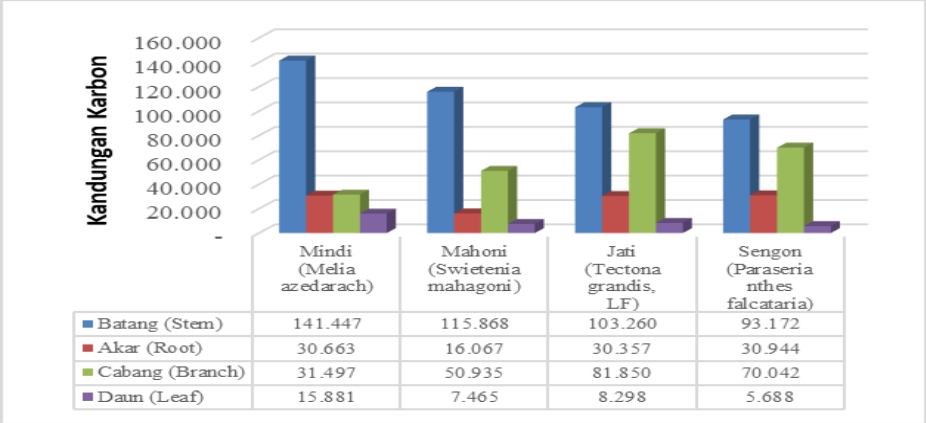


Figure 6. Total Carbon Content of Community Forests in Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

The average carbon content of community forest plant organs in Sidomulyo Village FMU Lawu Manunggal is 47.12%. Calculating total community forest carbon depends on the need and ease of data collection. The average carbon content (organic C) percentage is 47% (Ravindranath et al., 2008). The average carbon content of community forest stands in Sidomulyo Village FMU Lawu Manunggal, Magetan Regency, is 833.432 tons/ha. Paraserianthes falcataria species are 199.85 tons, Melia azedarach species are 219.49 tons, Swietenia mohagoni is 190.33 tons Ha, and Teak (Tectona grandis LF) is 223.76 tons. The average wet weight of Sidomulyo Village is 123,042 kg/tree. The area of community forest management of FMU Lawu Manunggal, Sidorejo District, Magetan Regency is 286.34 Ha. By looking at the types of stands in the management area, the amount of carbon content is 102.33 Tons.

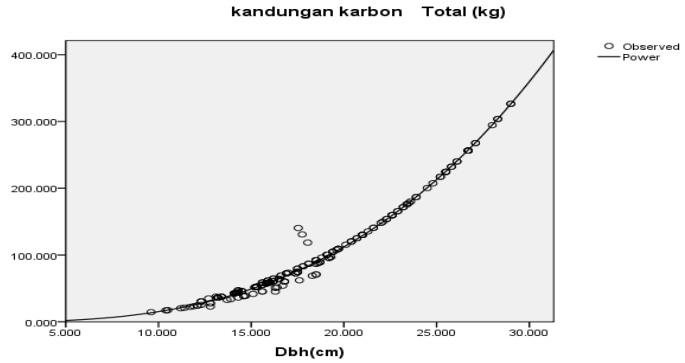
Lukito, Rohmatiah (2021) in the villages of Sundul and Banjar Panjang, FMU Argomulyo, obtained an average carbon content of 467.80 tons C/ha with an area of 199.44 ha, so the potential for carbon dioxide available is 913,763 tons of carbon. In the JUN stand, Krowe Village, Lembeyan Subdistrict, Magetan Regency, the average was 13.65 tons Ca/Ha, Lukito Martin, Rohmatiah, 2013. The carbon potential of Jati Unggul Nusantara, Trosono Village, Parang District, Magetan Regency was 8.73 tons of carbon/Ha. The total is 26.1 tons. Rohmatiah and Lukito Martin, 2015 said that the total potential carbon content of the JUN (Jati Unggul Nusantara) stands of Dungus Village, Dagangan District, Madiun Regency is 46.61 tons of carbon or volume per hectare of 12.45 – 13.65 tons of carbon per hectare, furthermore, Rohmatiah Lukito Martin, 2015 said that the total potential carbon content of JUN stands for community forest in Kare Village, Kare District, Madiun Regency is 3,180.71 tons of carbon. Per hectare ranges from 84.175 tons. The carbon content of the Kare Lestari UPHR community forest covering an area of 625.82 hectares is 48,709.92 tons, or an average of 77.833 tons carbon/ha Setiahadi, et al (2014)

Carbon Estimation Model

The carbon estimation model for Sidomulyo Village in the Lawu Manunggal FMU area, Magetan Regency, for the total carbon of Community Forest species to the diameter at chest height (Dbh) is presented in Table 9, and the diagram (scatter plot) in Figure 7.

Table 9. Carbon Allometry Model for Community Forests in Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

No.	Type	Model	Equality	R^2	RSS	Std Error
1.	*Melia azedarach*	Power	Y = 0,0313 $dbh^{2,823}$	0,930	0,067	0,041
2	*Swietenia mahagoni*	Power	Y = 0,132 $dbh^{2,345}$	0,947	0.032	0,021
3	*Tectona grandis lf*	Power	Y = 0,135 $dbh^{2,410}$	0,957	0.162	0,038
4	*Paraserianthes falcataria*	Power	Y = 0,197 $dbh^{2,341}$	0,921	1.286	0,216
5	Kandungan Karbon	Power	Y = 0,121 dbh^{2562}	0,921	1.476	0,083



Total Carbon. Power Y = 0,921 dbh^{2562} R^2 = 0,921, RSS 1.476, Std Error 0,083

Figure 7. Estimation Model of Content (kg) of Community Forest Segments in Sidomulyo Village and Bandar Panjang FMU Lawu Manunggal, Magetan Regency

Carbon Dioxide Absorption

The measurement of potential $C0_2$ absorption was carried out by using the ratio of the mass of $C0_2$ gas to the atomic mass of C. The average $C0_2$ absorption potential from the Community Forest of Sidomulyo Village FMU Lawu Manunggal was 49,355 tons $C0_2$/ha, as presented in Table 10. The highest carbon dioxide absorption was for the Swietenia species. mahagony of 62,682 Ton/Ha. Melia azedarach of 448.59 Tons/Ha. Paraserianthes falcataria of 44,789 tons/ha and Tectona grandis Lf of 41,440 tons/ha.

Table 10. Potential for Carbon Dioxide Uptake Tons Per Ha Community forest Sidomulyo Village, Lawu Manunggal FMU, Magetan Regency

	Carbon dioxide uptake per species			
Average Per Ha	N	V (M3)	Total Carbon	CO2 Absorption
Melia azedarach	171	4,689	13,218	48,509
Swietenia mahagoni	115	3,302	17,080	62,682
Tectona grandis, LF	204	0,690	11,292	41,440
Paraserianthes falcataria	153	1,660	12,204	44,789

Description: N = Number of Trees, V = Volume

Total $C0_2$ absorption in Sidomulyo village is 3,058,695 tons per year, or an average of 764,674 tons. Paraserianthes falcataria is 733,433 tons, and Swietenia mahagoni is 698,525 tons, as presented in Table 11.

Table 11. Total Potential for Carbon Dioxide Uptake (tonnes) Community Forest Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

Village/Type	Carbon Dioxide Absorption Potential per species (Tons)			
	N	V (M3)	Total Carbon	$C0_2$ Absorption
Melia azedarach	16.605	450,89	219,49	805,52
Swietenia mahagoni	11.144	355,32	190,33	698,53
Tectona grandis, LF	19.817	67,72	223,77	821,22
Paraserianthes falcataria	16.375	172,47	199,85	733,43
Jumlah (Ton)	63.942	1.046,40	833,43	3.058,70

Description: N = Number of Trees, V = Volume

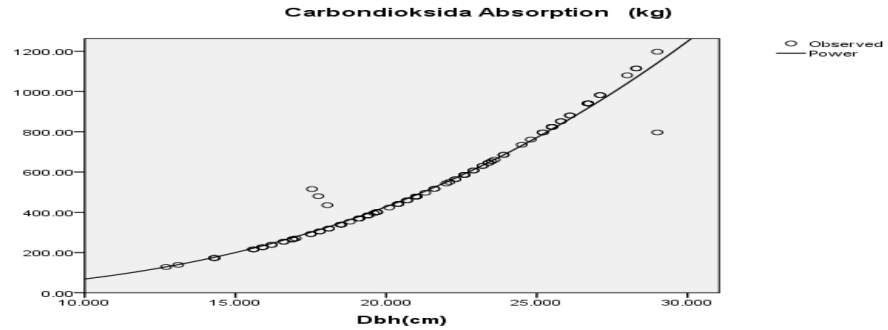
The potential for $C0_2$ absorption from Community Forest Plants in Sidomulyo Village FMU Lawu Manunggal, Magetan Regency, is influenced by the ability of leaves to absorb $C0_2$ in the photosynthesis process when viewed from the number of plants in community forests equivalent to 1,716.82 tons/ha with a total of 3,353,512 tons of $C0_2$. Lukito, Rohmatiah (2021) The carbon uptake capacity of the community forests of Sundul Village and Bandar Panjang FMU Argomulyo, with an area of 199.44 ha, absorbs the carbon dioxide of 1,716.82 tons C/ha, or is able to absorb $C0_2$ content of 3,353.512 tons C Lukito Martin, Rohmatiah, 2013 said the potential for $C0_2$ absorption, per hectare, the average JUN Plant in Krowe Village, Magetan Regency, was 50,113 tons $C0_2$/ha. The total potential carbon dioxide content of Jati Unggul Nusantara (JUN) stands at an average of 13.65 tons of Carbon/Ha, equivalent to 240.55 tons of carbon dioxide (Rohmatiah & Lukito, 2014). The potential for $C0_2$ absorption of JUN Plants in Trosono Village, Magetan Regency, is equivalent to 367.17 tons of carbon dioxide from JUN plants. The potential for $C0_2$ absorption from JUN plants in Dungus Village, Dagangan District, is 11,656 tons of $C0_2$ (Rohmatiah & Lukito, 2015).

Carbon dioxide Uptake Estimation Model

The model for estimating the carbon dioxide uptake in Sidomulyo Village in the Lawu Manunggal FMU area, Magetan Regency, for the total carbon dioxide of community forest species to the diameter at chest height (Dbh) is presented in Table 12, and the diagram (scatter plot) Figure 8.

Tabel 12. Allometric Model of Carbon Dioxide Absorption Community forest Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

No.	Type	Model	Equality	R^2	RSS	Std Error
1.	*Acacia auriculiformis*	Power	$Y = 0{,}134\ dbh^{2{,}652}$	0,914	0,092	0,056
2	*Swietenia mahagoni*	Power	$Y = 0{,}183\ dbh^{2{,}465}$	0,981	.0312	0,024
3	*Tectona grandis lf*	Power	$Y = 0{,}145\ dbh^{2{,}342}$	0,963	1.412	0,021
4	*Dalbergia latifolia roxb*	Power	$Y = 0{,}171\ dbh^{2{,}634}$	0,915	0,514	0,141
5	Karbondioksida Absoption	Power	$Y = 0{,}131\ dbh^{2564}$	0,973	1.276	0,036



Carbon Dioxide Absorption. Power $Y = 0{,}131\ dbh^{2564}$ $R^2 = 0{,}973$, RSS = 1.276, Std Error 0,036

Figure 8. Model for Estimating Carbon Dioxide Uptake (kg) Community Forest of Sidomulyo Village FMU Lawu Manunggal, Magetan Regency

CONCLUSION

1. The average standing stock of 10,340 m^3/ha with a total volume of 1/046,402 m^3 consisting of a standing potential of Paraserianthes falcataria of 1,660 m^3/ha, a total volume of 172,473 m^3, Swietenia mahagoni of 3,302 m^3/ha, a total volume of 355,316 m^3, 4,689 azedarach m^3/ha total volume 450,890 m3 Tectona grandis Lf, amounting to 0.690 m^3/ha total volume 67,722 m^3
2. The average biomass content per hectare of biomass is 28,379 tons/ha, Paraserianthes falcataria is 25,966 tons/ha, total biomass is 425,203 tons, Swietenia mahagoni is 35.02 tons/ha or a total area of 404,966 tons of biomass, Melia azedarach is 428,123 Tons/Ha or total biomass of 466,995 m3 Tectona grandis Lf, of 24,024 Tons/Ha or total volume of 476,906 Tons.
3. The average carbon content is 13,338 tons C/ha with an area of 286.34 ha, so the amount of carbon dioxide potential available is 833,432 tons of carbon.
4. The ability to absorb carbon from community forests in Sidomulyo Village FMU Lawu Manunggal absorb carbon dioxide is 197.420 tons C/ha, or able to absorb CO2 content of 3,058,695 tons C.
5. Relationship of Biomass, Carbon, and Carbon Uptake with Variable Diameter at chest height (Dbh) Allometric power model with model

Model	**Allometrik**	**R^2**	**RSS**
Allometri Biomassa	WT = 0,061 $dbh^{2,636}$	0,919	0,034
Allometri Karbon	WT = 0,121 dbh^{2562}	0,921	0,083
Allometri serapan CO2	WT = 0,131 dbh^{2564}	0,973	0,036

Information: WT = Total Wight, Dbh = Diameter Brigt High, R = Coefficient of Determination, RSS = Residual Some Of Square

Suggestion

Measurement of carbon potential in the People's Forest of Argomulyo FMU, Kawedanan District, Magetan Regency, when this research was carried out only used the above and bellows ground methods. For the future, it is necessary to measure all aspects (trees, soil, necro-mass, litter) and analyze the carbon using all the organs/variables that affect it using the titration/carbonation method.

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