

Estimation Biomass, Carbon, and Carbon dioxide Absorption a Forest Management Unit of Lawu Manunggal, Sukowidi and Summersawit Villages

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Abstract: *Today's increase in global warming is very influential on the activities of living things in the world. The imbalance in the concentration of greenhouse gas emissions is the cause of extreme weather events such as floods and droughts, and extreme weather. One effort that needs to be done with reforestation one of the alternatives is planting activities in the community forest area. The aim of the study is to calculate the estimated biomass, carbon content and the ability of community forests to absorb carbon dioxide in Sukowidi and Summersawit Village which are included in the Forest Management Unit of Lawu Manunggal in Magetan Regency. The method used is an inventory of community forest stands with a sampling intensity of 10%, the amount of biomass is done by felling on the types of stands that exist, in various kinds of plant organs, the calculation of carbon content is carried out by Walkley and Black methods. The results of the research on the average potential of community forests covering an area of 330.95 Ha are for Sengon (M³/Ha) 32.154, Mahogany, 112.878, mindi 21.272 and teak 24.544 or a total of 191.279 m³ / ha. Biomass potential is 315,755 tons /Ha or a total of 110,475,394 tons. The average carbon content is 155,257 tons C/ha or the total available is 54,132,943 tons of carbon. The ability of community forest carbon dioxide (CO₂) absorption by 567,793 tons of CO₂/Ha, with the area of management of community forests capable of absorbing CO₂ content of 198.667,9 tons of CO₂*

Keywords: Stand density, Biomass, Carbon, carbon dioxide absorption

1. Introduction

Climate change is the focus of attention throughout the world including Indonesia. The environmental issue was on the agenda of the 21st COP (Conferences of the Parties) international conference in the City of Paris, France in late 2015 was organized by the UNFCCC (United Nation Framework Convention on Climate Change).. The aim is to produce a new international agreement related to climate change, is binding and applies to all countries, to maintain global warming below 2 ° C [1]

Global warming results in climate change caused by an increase in the content of greenhouse gases (GHG) in the atmosphere. The high content of charcoal (CO₂) by human activities. The six main types of GHGs based on the Kyoto Protocol that are concentrated in controlling GHG emissions are carbon dioxide (CO₂), methane (CH₄), dinitro oxide (N₂O), hydroflourocarbons (HFCs), perfluorocarbons (PFCs), and sulfurhexafluoride (SF₆) [2]. GHG in the atmosphere works to keep the surface temperature of the earth warm, but when the composition is not balanced. The high content of CO₂, sunlight radiation which is partially reflected back into space tends to be trapped under the atmosphere by GHGs and reflected back to the earth, thus causing an increase in the earth's surface temperature, this is known as the greenhouse effect. If GHG emissions are not reduced among other things, it can increase the risk of extreme weather events such as major storms, floods and droughts, followed by sea level rise, water and food

shortages, irreversible impacts on vulnerable communities and ecosystems [3].

The forest besides being an economic supporter is also very ecologically beneficial, including carbon dioxide absorbent. Today the function starts to become important when the earth is confronted with the problem of the greenhouse effect, there is a tendency for an increase in air temperature or commonly referred to as global warming. The cause of this global warming is an increase in the concentration of Greenhouse Gases (GHG) in the atmosphere where this increase results in increased radiation balance. Greenhouse Gases are gases in the atmosphere that have the ability to absorb long-wave radiation emitted back into the atmosphere by the earth's surface. This thermal nature of radiation causes global warming of the atmosphere. Increasing GHG concentrations when they become an alarming factor so that GHGs must be immediately controlled. On the surface of the earth, carbon is stored in every organism, such as trees. The amount of carbon dioxide in plants collected as carbon in the body tissues of the plant will disappear if it no longer conducts a physiological process.

Forests have the highest biomass and carbon content compared to other vegetation in the world, Carbon sequestration by forests is determined through photosynthesis and carbon release through respiration, where trees use CO₂ in photosynthesis and produce O₂ and energy, and some energy is stored in the form of biomass [4]. Forest biomass can provide estimates of carbon sources in forest vegetation, because it is suspected that 50% of total tree biomass is carbon.

Biomass is the total living organic matter above and below the soil surface which includes trees, palms, saplings and components of understorey and litter which are expressed as oven dry weight area [5]. Thus the measurement of tree biomass can be used to estimate carbon uptake absorbed by a forest area per unit area and taken as a result of forest management

The importance of forest functions in carbon storage and sequestration,[6] 32 billion tons of CO₂ produced by human activities per year is less than 5 billion tons absorbed by forests but the ability of forests to absorb and store carbon is not the same in natural forests, plantations, brackish forest, swamp forest and in community forest depending on tree species, soil type and topography [7]. Carbon absorbed by plants is stored in the form of woody biomass, making it the easiest way to increase carbon stocks

Community forest management is a form of community-based forest management practices. One form of community forest is agroforestry. agroforestri has the potential as one of the large carbon sinks. Report more than 345 million ha of planted and agroforestry areas have the potential to be developed for carbon conservation and absorption [8]. This practice will result in carbon uptake of around 6.3-16.4 GtC per year, as well as providing economic benefits for farmers in the framework of the Clean Development Mechanism (CDM). More than 50% of forest carbon can originate through community-based activities given the large size of community forests in Indonesia where the National Medium Term Development Plan 2015-2019, The Ministry of Environment and Forestry is tasked with allocating 12.7 million ha of forest area for Social Forestry activities by involving communities through Community Plantation Forests (HTR), Community Forests (HKm), Village Forests (HD), Customary Forests and Community Forests / Partnerships [9]

The research objective of Estimating Model of Biomass and Carbon Deposits of Community Forest Areas in the Area Managing Forest Management Unit (FMU) Lawu Manunggal Panekan and Sidorejo District Magetan District focused on plants in the Community Forest in Sukowidi and Summersawit villages was knowing the amount of biomass, carbon content and capacity absorbing carbondioxide

2. Data Methods and Analysis

Community Forest Inventory

The inventory activity was carried out in Sukowidi village, Panekan sub-district and Summersawit village, Sidorejo sub-district, Magetan district, in the management area of Lawu Manunggal Forest Management Unit (FMU) by making a circular plot with a radius of 12.61 meters or equivalent to 0.05 Ha. its location is adjusted based on field observations. Determination of the plot with a sampling system. Measurements are made for each tree that enters the PU, based on the measurement results of height and diameter, then the volume is determined. Determination of tree volume using formula (Lukito Martin, et al 2017)[10]
Volume Standing Stock

$$V = 1/4 . \pi . d^2 . t . f \dots\dots\dots (1)$$

V = Tree Volume (M³)
 Π = Constant 3,14
 d = diameter of breast high (cm)
 t = Total High m
 f = Form factors [0,6]

Actual stem volume measurement is carried out with the formula volume per segment using the Smallian formula [10].

$$V_s = \left[\frac{Lbds\ pangkal + Lbds\ ujung}{2} \right] \times L \dots\dots\dots (2)$$

Keterangan :
 Vs : log segment volume (M³)
 LBDS pangkal : broad base area = 1/4 π x d_{pkl}² (m²)
 LBDS ujung : Wide base end area = 1/4 π x d_{ujung}² (m²)
 L : segment length (m)

Standing Stock Volume (Vst) is known by summing the volume of each segment, using the formula

$$Vst = Vs1 + Vs2 + Vs3 + \dots + Vstn \dots\dots\dots (3)$$

Note :
 Vst : Total segmen Volume (m³)
 Vs1, Vs2, Vs3.....Vsn : Volume of each segment

Plant Biomass Measurement

Biomass measurements are carried out on aboveground biomass in Sukowidi and Summersawit villages. The selection of biomass sample trees is the object for research by destructive sampling Logging. measurements and weighing of the tree's wet weight for each component of stem, branch, leaf and root are carried out. Furthermore, measurements for each dry weight to determine the water content and biomass calculation were carried out by drying the samples taken from the field using an oven at a temperature of 103 ± 2 °C until a constant weight was obtained [10].

Biomassa Total Pohon (Total Weight)

$$(W_T) = W_S + W_B + W_L + W_R \dots\dots\dots (4)$$

Weight Stem (WS) = (100% - Moisture Content (%)) x Wet Total Stem Weight

Weight Branch (WB) = (100% - Moisture Content (%)) x Wet Branch Total Weight

Weight Leaf (WL) = (100% - Moisture Content (%)) x Total Wet Weight of Leaves

Weight Root (WR) = (100% - Moisture Content (%)) x Total Wet Weight of Root

Measurement of Carbon

The carbon content in plants is calculated using the titration method using the Walkley and Black methods with the steps to analyze the total carbon content (C-total) [10]

Measurement of carbon dioxide absorption

Measurement of carbon absorption is done by multiplying the carbon value stored by 3.67, the magnitude of the value of forest carbon uptake can be known. (2011) [11]

3. Results and Discussion

General condition of community forests in Sukowidi and Summersawit villages initially entered the Panekan and Sidorejo sub-districts Which was then separated based on Magetan Regency Local Regulation Number 2 of 2007 concerning the Establishment of Sidorejo Subdistrict which separated the sukowidi village into the administrative area of Panekan District while the Summersawit Village entered the administrative area of Sidorejo District Magetan Regency[12]

The management area of Forest Management Unit (FMU) Lawu Manunggal is included in a village like Sukowidi Village Tapak Village and Sumberdodol Village, Panekan Sub-district and Summersawit Village and Sidomulyo Village, Sidorejo Subdistrict, which all villages are located in one stretch and the level of development is relatively equivalent. The area of Lawu Manunggal FMU covers an area of tegal and moors with a total of 921.37 Ha, in which

the area of Sukowidi Village for the tegal area is 101.61 Ha and the yard is 14.59 Ha with the number of 435 families. For the vast Summersawit Village, tegal is 169.25 Ha, 45.42 Ha in the yard with the number of family members 979 households.

Inventory Standing Stock Result

The results of the inventory of community forests in Sukowidi and Summersawit villages are the types of trees cultivated in community forests such as Sengon (*Paraserianthes falcata* (L.) Nielsen), mahogany (*Switenia mahagoni* (L)), and Mindi (*Melia azedarach*) and Teak (*Tectona grandis*). The measurement results of the average volume obtained for sengon the number of trees per hectare is 129, with a potential of 32.154 M3, Mahoni 756 trees/ha with a volume of 112.878 m³, Mindi 119 trees/Ha or 21.722 m³/ ha and Teak 208 trees/ ha or 24.544 m³/Ha. Recapitulation of the volume and authority is presented in table 1:

Table 1: Potential (N/Ha) and Volume (M³/ Ha) of FMU Trees "Lawu Manunggal" Sukowidi and Summersawit Villages

No.	Village	Hamlet	Area (Ha)	Type of Plant							
				Sengon		mahogany		Mindi		Teak	
				N/ha	M3/ha	N/ha	M3/ha	N/ha	M3/ha	N/ha	M3/ha
1.	Sukowidi	Sukowidi	22.49	39	14.535	93	18.249	34	5.388	25	2.076
		Sempu	33.54	38	5.173	408	45.837	31	6.080	42	2.988
		Nerang	60.26	30	5.669	196	22.253	83	9.910	26	0.458
	Total (a)	116.29	107	25.378	697	86.340	148	21.379	94	5.522	
2	Summersawit	Godoh	43.25	39	10.229	221	36.605	19	4.261	84	9.139
		Baran	74.67	74	16.230	255	38.477	48	12.210	80	10.216
		Mitir	96.74	38	12.471	340	64.334	24	5.594	158	24.211
	Total (b)	214.66	151	38.930	816	139.416	91	22.065	321	43.565	
Total (a+b)			330.95	129	32.154	756	112.878	119	21.722	208	24.544

Based on the table above, the total volume of sukowidi village forest and Summersawit from the total area of 330.95 Ha is the total potential for sengon species is 3.02.806 m³,

Mahogany 2,429,775 M3, Mindi 1,538,219 M3 and teak 11,390,497 m³ or total stands of 11,390,497 m³. As presented in Table 2

Table 2: Total Tree Potential and Volume (M³) of FMU "Lawu Manunggal" in Sukowidi and Summersawit Villages

No.	Village	Hemlet	Area (Ha)	Total trees and Volume (m ³)							
				Sengon		mahogany		Mindi		teak	
				Total	Vol (M3)	Total	Vol (M3)	Total	Vol (M3)	Total	Vol (M3)
1.	Sukowidi	Sukowidi	22.49	874	326.894	1,349	265.257	618	98.334	561	46.693
		Sempu	33.54	1,273	173.504	2,109	237.118	1,416	278.707	1,425	100.219
		Nerang	60.26	1,834	341.640	1,112	126.163	1,843	220.535	1,587	27.591
	Sub Total (a)	116.29	3,981	842.038	4,570	628.538	3,876	597.576	3,572	174.503	
2	Summersawit	Godoh	43.25	1,672	442.416	2,261	374.440	684	155.968	3,648	395.244
		Baran	74.67	5,529	1,211.894	4,142	624.481	1,853	469.805	5,938	762.811
		Mitir	96.74	3,705	1,206.458	4,237	802.317	1,530	359.870	15,238	2,342.140
	Sub Total (b)	214.66	10,906	2,860.768	10,640	1,801.237	4,066	985.643	24,824	3,500.194	
Total (a+b)			330.95	14,887	3,702.806	15,210	2,429.775	7,942	1,583.219	28,396	3,674.697

Biomass of Community Forest Stand

Forest biomass measurement is carried out on all parts of the tree consisting of above-ground biomass including stems, branches and leaves, and subsurface biomass includes tree roots. Biomass is carried out on plants that make up community forest plantations in Sukowidi and Summersawit

villages. Measurements were carried out by 3 sample trees for each type of community forest tree.

Measurement of sample water content Per tree organ segmentation obtained average water content types as presented in Table 3

Table 3: Water Content of each segment of the Community Forest Plant Organs FMU Lawu Manunggal Sukowidi and Summersawit Villages

Type	Trees Code	Dbh (cm)	H (m)	Vol (M3)	Average Moisture			
					Root	Stem	Branch	Leaves
Sengon	<i>Paraserianthes-1</i>	13.80	15	0.011	0.51	0.46	0.47	0.50
	<i>Paraserianthes-2</i>	13.32	17	0.012	0.50	0.48	0.47	0.50
	<i>Paraserianthes-3</i>	15.48	14	0.012	0.48	0.52	0.46	0.50
	Average	14.20	15	0.012	0.50	0.48	0.47	0.50
Mindi	<i>Melia azedarach-1</i>	16.08	22	0.019	0.52	0.48	0.49	0.47
	<i>Melia azedarach-2</i>	18.36	19	0.020	0.51	0.49	0.46	0.51
	<i>Melia azedarach-3</i>	18.12	19	0.019	0.50	0.51	0.49	0.50
	Average	17.52	20	0.019	0.51	0.49	0.48	0.49
Teak	<i>Tectona grandis-1</i>	19.23	19	0.020	0.36	0.55	0.47	0.49
	<i>Tectona grandis-2</i>	21.24	24	0.028	0.49	0.49	0.51	0.50
	<i>Tectona grandis-3</i>	24.21	26	0.034	0.50	0.51	0.48	0.51
	Average	21.56	23	0.028	0.45	0.52	0.49	0.50
Mahogany	<i>Switenia-1</i>	21.29	23	0.027	0.51	0.52	0.47	0.50
	<i>Switenia-2</i>	23.63	23	0.030	0.49	0.46	0.50	0.50
	<i>Switenia-3</i>	26.56	24	0.035	0.48	0.50	0.50	0.50
	Average	23.82	24	0.031	0.49	0.49	0.49	0.50

The average water content for the types of community forest plants from various plants is 49 %. For the range between 48 - 51%. So that the measurement of average biomass of community forest constituent trees found that for Sengon of

140.22 kg, Mahogany of 277.06 kg/tree, Mindi of 265.10 kg/tree and teak of 272.56 kg/tree. Average biomass per tree is 238.73 kg/tree. As presented in Table 4

Table 4: Biomass of Community Forest Plant Organ FMU Lawu Manunggal Sukowidi and Summersawit Villages

Type	Trees Code	Dbh (cm)	H (m)	Vol (M3)	Average Moisture				
					Root	Stem	Branch	Leaves	Total
Sengon	<i>Paraserianthes-1</i>	13.8	15	0.011	28.89	91.24	16.33	12.51	148.97
	<i>Paraserianthes-2</i>	13.32	17	0.012	25.97	72.49	18.08	18.07	134.6
	<i>Paraserianthes-3</i>	15.48	14	0.012	36.64	73.17	14.82	12.48	137.11
	Average	14.2	15	0.012	30.5	78.97	16.41	14.35	140.22
Mindi	<i>Melia azedarach-1</i>	16.08	22	0.019	34.69	181.88	45.43	32.53	294.54
	<i>Melia azedarach-2</i>	18.36	19	0.02	29.39	106.6	39.87	22.81	198.67
	<i>Melia azedarach-3</i>	18.12	19	0.019	52.79	155.73	50.58	42.97	302.08
	Average	17.52	20	0.019	38.96	148.07	45.29	32.77	265.1
Teak	<i>Tectona grandis-1</i>	19.23	19	0.02	59.08	149.23	43.88	22.78	274.96
	<i>Tectona grandis-2</i>	21.24	24	0.028	60	154.5	18.97	20.43	253.89
	<i>Tectona grandis-3</i>	24.21	26	0.034	63.53	162.24	34.3	28.76	288.83
	Average	21.56	23	0.028	60.87	155.32	32.38	23.99	272.56
Mahogany	<i>Switenia-1</i>	21.29	23	0.027	43.73	127.66	22.59	23.2	217.18
	<i>Switenia-2</i>	23.63	23	0.03	63.56	197.06	19.56	13.43	293.61
	<i>Switenia-3</i>	26.56	24	0.035	78.95	200.07	24.21	17.16	320.4
	Average	23.82	24	0.031	62.08	174.93	22.12	17.93	277.06

The average biomass content of Mindi Type plant organs per hectare was 31.53 tons / ha consisting of stem organs of 17.63 tons, leaves weighing 3.902 ton, branches 5.371 tons and root organs of 4.638 tons. As presented in Table 5

Table 5: Biomass of Community Forest Plants Type Mindi Areas Manage FMU Lawu Manunggal Sukowidi and Summersawit Villages

Village	Hemlet	Total Biomass per Type				
		Mindi (Kg)				
		Stem	Root	Branch	Leaves	Total (Ton)
Sukowidi	Sukowidi	5,010	1,318	1,533	1,109	8.970
	Sempu	4,573	1,203	1,355	1,012	8.143
	Nerang	12,263	3,227	3,751	2,714	21.955
Total-1		21,845	5,747	6,638	4,835	39.068
Sumber-sawit	Godoh	2,767	728	846	612	4.954
	Baran	7,129	1,876	2,181	1,578	12.763
	Mitir	3,520	926	1,077	779	6.302
Total-2		13,416	3,529	4,103	2,969	24.019
Total (1+2)		35.261	9.277	10.742	7.804	63.087
Average per Ha		17.630	4.638	5.371	3.902	31.543

The average biomass content of mahogany stands per hectare in Sukowidi and Summersawit villages was 209,534 tons / ha. With the composition for stem organs of 132,295 tons, Branch Organ 16,729 tons, roots 46,947 tons and leaves of 13,56 tons as presented in Table 6

Table 6: Biomass Community Forest Type Mahogany Region Manage FMU Lawu Manunggal Sukowidi and Summersawit Villages

Village	Hemlet	Total Biomass per Type				
		Mohagony (Kg)				
		Stem	Root	Branch	Leaves	Total (Ton)
Sukowidi	Sukowidi	16,235	5,761	2,053	1,664	25.714
	Sempu	71,318	25,309	9,019	7,310	112.956
	Nerang	34,296	12,171	4,337	3,515	54.319
Total-1		121,849	43,240	15,408	12,489	192.989
Sumbersawit	Godoh	38,666	13,721	4,890	3,963	61.240
	Baran	44,644	15,843	5,646	4,576	70.708
	Mitir	59,432	21,091	7,516	6,092	94.131
Total -2		142,741	50,654	18,050	14,631	226.079
Total (1+2)		264,591	93,895	33,459	27,120	419.067
Average per Ha		132,295	46,947	16,729	13,560	209.534

Biomass types of teak plants in the study area on average have a weight of 56,572 tons /ha with a composition for stem organ of 32,237 tons, branch organs 2,199 tons, roots of 12,634 ton and leaves of 4,978 tons as presented in Table 7

Table 7: Biomass of Community Forests of FMU Lawu Manunggal Teak Type Sukowidi and Summersawit Villages

Village	Hemlet	Total Biomass per Type				
		Teak (Kg)				
		Stem	Root	Branch	Leaves	Total (Ton)
Sukowidi	Sukowidi	3,871	1,517	807	598	6.793
	Sempu	6,599	2,586	1,376	1,019	11.580
	Nerang	4,089	1,603	852	632	7.176
Total-1		14,559	5,705	3,035	2,248	25.549
Sumbersawit	Godoh	13,101	5,134	2,731	2,023	22.990
	Baran	12,351	4,840	2,575	1,907	21.673
	Mitir	24,465	9,588	5,100	3,779	42.932
Total-2		49,916	19,562	10,406	7,709	87.595
Total (1+2)		64,475	25,268	13,441	9,957	113.144
Average Ha		32,237	12,634	6,720	4,978	56.572

The type of sengon community forest form stands has an average biomass weight of 18,106 tons/ha consisting of stem organs amounting to 10.196 tons, roots 3,938 tons, branches 2,119 tons and leaf organs 1,853 tons as presented in table 8

Table 8: The Forest Forest Biomass of Sengon Type in the Area Manage FMU Lawu Manunggal, Sukowidi and Summersawit Villages

Village	Hemlet	Amount of Biomass per type				
		Sengon (Kg)				
		Stem	Root	Branch	Leaves	Total (Ton)
Sukowidi	Sukowidi	3,069	1,185	638	558	5.449
	Sempu	2,997	1,158	623	545	5.322
	Nerang	2,403	928	499	437	4.267
Total-1		8,468	3,270	1,759	1,538	15.038
Sumbersawit	Godoh	3,053	1,179	634	555	5.421
	Baran	5,847	2,258	1,215	1,063	10.383
	Mitir	3,024	1,168	628	550	5.370
Total-2		11,924	4,605	2,477	2,166	21.174
Total (1+2)		20,393	7,875	4,237	3,706	36.212
Average per Ha		10,196	3,938	2,119	1,853	18.106

The recapitulation of biomass calculation per hectare found that the total biomass per hectare for the types of stands forming community forests in Sukowidi and Summersawit villages was 315,755 tons/ha divided into biomass organ 192,361 tons, branches 30,940 tons, roots 68,159 tons and leaves 24,295 tons. Or the average stem organ has the largest biomass of 61%, 21% root, 10% branch and leaf organ 8% as presented in Figure 1 and table 9

Table 9: Recapitulation of the average Biomass content per hectare of Sukowidi Village and Summersawit Village

Organ	Biomass (Ton/Ha)				
	Root	Stem	Branch	Leaf	Total
Mindi	4.639	17.631	5.371	3.902	31.543
Mohagony	46.948	132.296	16.730	13.560	209.534
Teak	12.634	32.238	6.721	4.979	56.572
Sengon	3.938	10.196	2.119	1.853	18.106
Total	68.159	192.361	30.940	24.295	315.755

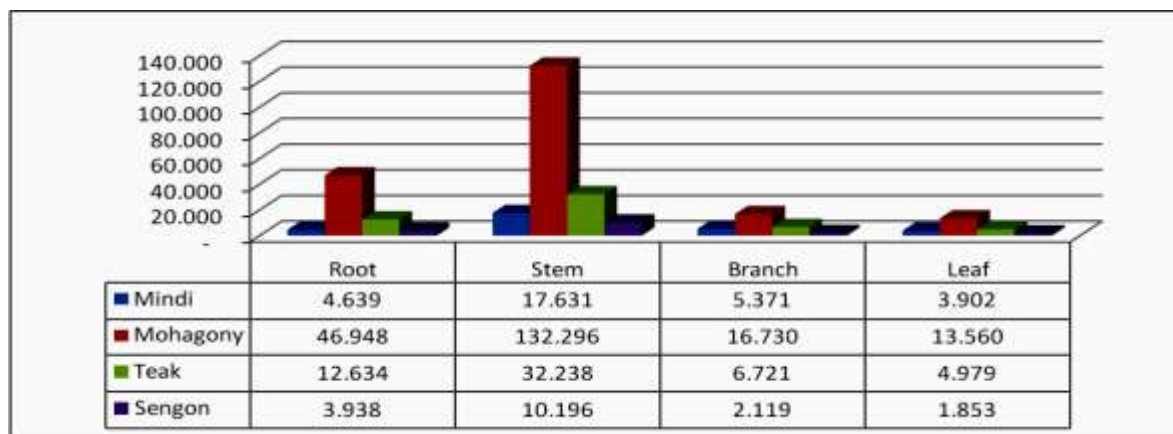


Figure 1: Percentage of Biomass of FMU Lawu Manunggal Plant Organ in Sukowidi and Summersawit Villages

Based on the calculation of inventory of stands in Sukowidi and Sumbersawit villages from the total volume of standing stock of community forest stands of 11,390,497 M3, the potential of biomass produced was 110,475,394 tons

consisting of mindi types of 9,699,155 tons, Mohagony types of 70,972,701 tons, teak of 21,691,643 tons and sengon of 8,111,895 tons as presented in Table 9

Table 9: Biomass Potential of FMU Lawu Manunggal Sukowidi and Sumbersawit Village

Village	Type	Content Biomass (Ton)				
		Stem	Root	Branch	Leaves	Total
Sukowidi	Mindi	2,540.444	668.429	772.008	562.295	4,543.177
	Mohagony	14,169.850	5,028.465	1,791.899	1,452.419	22,442.634
	Teak	1,693.090	663.525	352.965	178.957	2,888.537
	Sengon	984.815	380.379	204.614	178.957	1,748.766
Total-1		19,388.199	6,740.799	3,121.487	2,372.629	31,623.114
Sumbersawit	Mindi	2,879.881	757.740	880.932	637.425	5,155.978
	Mohagony	30,640.958	10,873.580	3,874.812	3,140.718	48,530.067
	Teak	10,715.126	4,199.276	2,233.825	1,654.878	18,803.106
	Sengon	4,377.526	988.652	531.818	465.132	6,363.129
Total-2		48,613.492	16,819.248	7,521.387	5,898.154	78,852.280
Total (1+2)		68,001.691	23,560.047	10,642.873	8,270.783	110,475.394

Carbon Potential

Carbon content of community forest constituents. The management areas of FMU Lawu Manunggal, Sukowidi Village and Sumbersawit Village are restricted to living plants. Measurements were made, with the method of converting biomass to carbon using the Walky and Black Titration Method presented in Table 16 and Table 10

Table 10: Analysis of Total Carbon Content Using Titration Methods Types of Community Forest Plants FMU Lawu Manunggal, Sukowidi and Sumbersawit Villages

No	Organ	Weight	Titration	Titration	C Content
		Sample	Sample	Control	Total
		G	ml	ml	%
1	Stem	0,0252	4,4733	7,6723	50,3267
2	Root	0,0253	4,4039	7,5778	48,0266
Average		0,0252	4,4386	7,6250	49,1767

Based on Table 10 the results of measurements of carbon content obtained an average carbon Stem of 50.32%, and the average root content of 48.03% so that the carbon content approach of various types of community forestry plants in Sukowidi and Sumbersawit villages was 49.18%. Carbon mass is considered to be equal to 50% biomass or

the conversion factor is equal to 0.5 in estimating the carbon mass potential of a stand without regard to the type of biomass and stand age [13]. Meanwhile, according the need to calculate the total forest carbon stock in community forests depends on the needs and ease of data collection. Measurement results using the titration method of the potential carbon content of stands per plant organ per hectare of community forest in Sukowidi and Sumbersawit villages obtained an average amount of carbon content of 155.257 tons/ha consisting of mindi stands of 15.456 tons/ha, mohagony stands 102.671 tons / ha, stands teak 27,720 tons/ha and for sengon stands the carbon content averaged 8,872 tons/ha, as presented in Table 11 and Figure 2 as follows:

Table 11: Carbon Content (Tons) Per Type of Community Forest Plants FMU Lawu Manunggal, Sukowidi and Sumbersawit Village

Organ	Carbondioksida Content (Ton/Ha)				
	Root	Stem	Branch	Leaves	Total
Mindi	2.281	8.669	2.641	1.919	15.510
Mohagony	23.084	65.050	8.226	6.668	103.028
Teak	6.212	15.851	3.305	2.448	27.816
Sengon	1.936	5.014	1.042	0.911	8.903

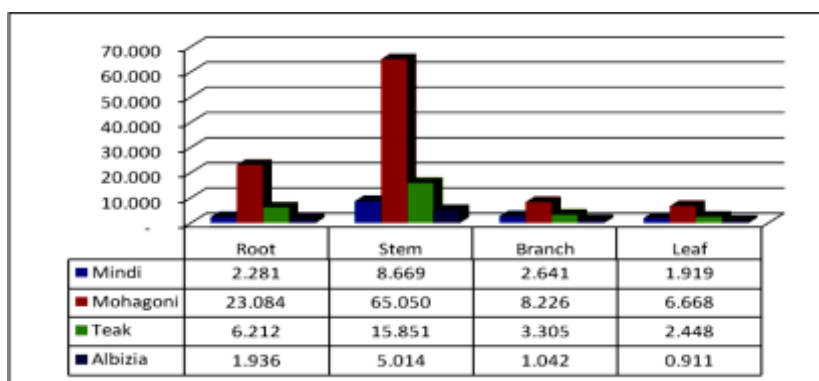


Figure 2: Carbondioxide content of FMU Lawu Manunggal, Sukowidi and Sumbersawit Village (Ton/Ha)

The content potential of carbon in the community forest stands of FMU Lawu manunggal, Sukowidi and Sumbersawit villages is 54,132,943 tons. divided into Sukowidi

Village with 15,495,326 tons and Summersawit village with 38,637,617 tons as seen in Table 12:

Table 12: Carbon content of FMU Lawu Manunggal, Sukowidi and Summersawit Villages

Village	Type	Carbon content (ton)				
		Stem	Root	Branch	Leaves	Total
Sukowidi	Mindi	1,244.82	327.53	378.284	275.525	2,226.16
	Mohagony	6,943.23	2,463.95	878.03	711.685	10,996.89
	Teak	829.614	325.127	172.953	87.689	1,415.38
	Sengon	482.559	186.386	100.261	87.689	856.895
Total-1		9,500.22	3,302.99	1,529.53	1,162.59	15,495.33
Sumbersawit	Mindi	1,411.14	371.293	431.656	312.338	2,526.43
	Mohagony	15,014.07	5,328.05	1,898.66	1,538.95	23,779.73
	Teak	5,250.41	2,057.65	1,094.57	810.89	9,213.52
	Sengon	2,144.99	484.439	260.591	227.915	3,117.93
Total-2		23,820.61	8,241.43	3,685.48	2,890.10	38,637.62
Total (1+2)		33,320.83	11,544.42	5,215.01	4,052.68	54,132.94

Carbondioxide Absorption

Calculation of the potential approach of CO₂ gas uptake is carried out using a weight ratio of CO₂ gas mass with the atomic mass of C. That is by converting the yield of carbon dioxide with a mass of CO₂ at 3.67. The average CO₂ absorption potential of the FMU Lawu Manunggal Community Forests in Sukowidi and Summersawit villages for (Ton CO₂/Ha) is 569,792 divided into mindi 56,921, Mohagony 378,112, Teak 102,086 and sengon 32,673 are presented in Table 13.

Table 13: Carbon dioxide uptake FMU Lawu Manunggal Sukowidi and Summersawit Villages

Organ	Carbondioxida Absorption (Ton CO ₂ /Ha)				
	Root	Stem	Branch	Leaf	Total
Mindi	8.371	31.816	9.693	7.042	56.921
Mohagony	84.719	238.732	30.190	24.470	378.112
Teak	22.799	58.175	12.128	8.985	102.086
Sengon	7.107	18.400	3.823	3.344	32.673
Total	122.996	347.123	55.833	43.840	569.792

The calculation results of carbon dioxide uptake of the total area of community forests in Sukowidi Village and Summersawit covering an area of 330.95 Ha is 198,667.90 tons of CO₂ consisting of Sukowidi village 56,867.85 tons and Summersawit Village 141,800.06 tons CO₂ as presented in Table 14.

Table 14: Absorption of Carbondioxide (Tons) Per Type of Community Forest Plants FMU Lawu Manunggal, Sukowidi and Summersawit Villages

Village	Area Community Forest (Ha)	Types of Forest Plants				
		Mindi	Mohagony	Teak	Sengon	Total (ton)
Sukowidi	116,29	8.169,99	40.358,588	5.194,456	3.144,808	56,867.85
Sumbersawit	214,66	9.272	87.271,620	33.813,625	11.442,814	141,800.06
Total	330,95	17.441,99	127.630.21	39.008,08	14.587,62	198,667.90

4. Conclusion

- 1) Inventory of stands in the community forest of Lawu Manunggal FMU was obtained for the villages of Sukowidi, sengon type (M³/Ha) 25.78, Mohagony 86.34, Mindi 21,379 and Teak 5,522. The villages of Summersawit sengon type 38,930, Mohagony 139,416, Mindi 22,065 and teak 43,565. The average of Sengon type is 32.154, Mohagony 112.878, mindi type 21.722 and Teak type 24.544.
- 2) The total volume of the area of Lawu Manunggal FMU Sukowidi Village and Summersawit from a total area of 330.95 Ha of 11,390,497 M³ spread over Sengon type 3,702,806 M³, Mohagony Type 2,429,775 M³, Mindi Type 3,674,697 M³ and Teak type 3,674,697 M³
- 3) Biomass per hectare from FMU Lawu Manunggal, Sukowidi and Summersawit villages is 315,755 tons/hectare, consisting of an average Mindi stand of

- 31,543 Ton/ha, Mohagony of 209,534 tons/ha, Teak of 56,572 tons /ha and Sengon of 18,106 tons/ ha
- 4) The total overall biomass content of the total area of 330.95 ha was 110,475,394 tons consisting of Sukowidi village of 31,623,114 tons and Summersawit village 78,852,280 tons
- 5) Carbon content is 155,257 tons/hectare which is divided into Mindi stands of 15.51 Ton/ha, Mohagony of 103.028 ton/ha, Teak of 27.816 ton /Ha and Sengon of 8.903 ton /ha
- 6) The total carbon content of the total area of 330.95 ha is 54,132,943 tons which consists of Sukowidi village of 15,495,326 tons and Summersawit village 38,637,617 tons
- 7) Carbondioxide uptake amounted to 569,793 tons of CO₂/ha which was divided into Mindi stands of 56.92 tons of CO₂/ha, Mohagony of 378.113 tons of CO₂/ha, Teak of 102,085 tons of CO₂/ha and Sengon of 32,674 tons of CO₂/ha.
- 8) The ability of carbondioxide absorption of FMU Lawu manunggal community forest is 198,667.9 tons of CO₂

consisting of Mindi types 17,441.99 tons CO₂, Mohogany 127,630.21 tons CO₂, Teak 39,008.08 tons CO₂ and Sengon types 14,587.62 tons CO₂

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