Measurement of Carbon and Carbondioxide Fmu Argomulyo using Biomass Approach in Community Forests, Sundul Village and Banjar Panjang, Magetan Regency

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Received: 02 Sept 2021,
Received in revised form: 23 Sept 2021,
Accepted: 06 Nov 2021,
Available online: 09 Nov 2021
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Keywords — Biomass, Carbon Content, C02 Absorption, Inventory,

Abstract— The existence of community forests today has provided real benefits, especially the economic value of communities around the forest and a real contribution to environmental services with the ability to reduce greenhouse gas emissions in the context of mitigation and adaptation to climate change. Sustainable Forest Management facilitates efforts to reduce emissions in the forestry sector more economically than other sectors, which later became the forerunner to the birth of the concept of REDD+. This study aims to calculate the potential for standing stands in the villages of Sundul and Bandarpanjang Forest Management Unit. (FMU) Argomulyo, Magetan regency, looking at the ability of the forest to produce biomass, carbon content and the ability to absorb C02 content, including an allometric estimation model, by means of an inventory, for the potential destructive sampling method on samples of tree species to be measured Biomass, stored carbon and carbon dioxide uptake. The results showed that the average standing potential was 54.25 m3/ha, or a total volume of 26.732.831 m3, the average forest biomass content per ha was 955.32 tons or total of 1.944.178 tons. The average carbon content is 467.80 tons C/ha or the total available is 913.763 tons Carbon The ability to absorb carbon dioxide (C02) is 1,716.82 tons C/Ha, with an area of community forest management capable of absorbing C02 content of 3,353.512 tons C02.

I. INTRODUCTION

Forest is an ecosystem unit in the form of a stretch of land containing biological natural resources which are dominated by trees in their natural environment which cannot be separated from one another. Based on the land status, it is divided into two types, namely state forest and private forest. One example of a private forest is a private forest where the forest is located on land that is encumbered with common property rights Annonymous (1999).

The function of community forests is one of the alternative solutions to the problem of pressure on forest resources/forest areas. In its development, it has provided many positive benefits, both directly and indirectly, among them for the owner, namely being able to provide forest products obtained directly, either in the form of a source of wood tools, firewood, food, animal feed.
The positive benefits of community forests indirectly are the maintenance of hydrological, climatological, aesthetic and other functions which are the basic needs of the community (Dako, 2019)

The role of forests is very important in human life, in terms of products, forests produce three groups of products: wood, non-timber forest products and environmental services. The environmental benefits of forests are indirect and difficult to measure in value but are easy to feel in their absence due to damage. Another environmental benefit is that forests protect and at the same time serve as a source of biodiversity, both flora and fauna. Puspitojati Triono M. et al, (2014)

Forest is an ecosystem unit in the form of a stretch of land containing biological natural resources which are dominated by trees in their natural environment which cannot be separated from one another. An example of a private forest is a private forest where the forest is located on land that is encumbered with common property rights Anonymous (1999). One of the roles of community forests in environmental services is the ecological pressure of forest resources. Natural disasters and global warming occur partly because of the destruction of forests. The pressure on high carbon dioxide gas emissions has made the forest sector play a strategic role, including community forests.

Reducing emissions in the forestry sector has a high selling price compared to other sectors, which became the forerunner to the birth of the concept of REDD+ (Reducing Emissions from Deforestation and Forest Degradation plus). Forests are the main determinant of global climate change mitigation. Making forestry a part of world politics, from the perspective of global climate change Stern (2007).

The agenda for sustainable forest management has become a major global issue in the context of climate change. The role of forests in mitigating and adapting to climate change, priority on mitigation in developing countries. Sustainable Forest Management is evolving to facilitate the concept and implementation of REDD+, play a role in mitigating climate change and increasing adaptation to climate change. as well as, function for carbon conservation, sequestration and substitution. REDD as carbon conservation has its main role in carbon sequestration. Sustainable forest management is intended to increase carpentry and construction wood products or tools as well as carbon storage outside the forest. Purbawiyatna, et al (2012) Adaptation of sustainable forest management is used to reduce the openness of forest communities to the effects of climate change, as well as reduce sensitivity and increase community adaptive capacity.

Increasing forest development as a material for increasing CO2 absorption can be carried out in state forest areas or private forests, including community forests. Darusman and Suhardito (1998), the high potential of community forests both in terms of tree population and species will result in a large accumulation of CO2 absorption. However, with the high rate of forest degradation and deforestation, CO2 absorption has decreased. Degraded forests will gradually lose their function as CO2 absorbers Junaedi, (2008).

The aim of the study was to calculate the above-ground biomass in community forests, Sudul and Bandar Panjang villages, FMU Argomulyo, Magetan Regency, to estimate the potential for carbon content (C) and carbon dioxide Absorption (CO2). The benefits of this research can provide scientific information, and become a reference for local government policies in regional development and conservation plans, and can become data and information that can be a reference for further research. The issue of global warming has become the hottest discussion from the 20th decade until now, the main cause is the increase in greenhouse gases such as CO2, CH4, N2O, and CF4. (IPPC 2001) which has an impact on increasing global temperatures and changes in rainfall IPPC. (2007). Carbon dioxide gas is the biggest problem where the main cause of Greenhouse Gases.

Forests with tree components can absorb atmospheric carbon (carbon sequestration), converted into biomass (carbon sinks) as well as stored in the system as carbon stocks or carbon stocks Hairiah and Rahayu, (2007). The more trees there are, the more carbon dioxide is absorbed. If Indonesia's forest development is increased, Indonesia has helped reduce CO2 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 CO2 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. Thus, the larger the leaf area per unit of land, the greater the CO2 absorbed. However, leaf area will increase in line with the age of the stand, therefore it can be assumed that the age of the stand will affect CO2 absorption. However, leaf area will increase in line with the age of the stand, therefore it can be assumed that the age of the stand will affect CO2 absorption.

Half of the biomass in forests is made up of carbon. So that currently the main function of forests is important, especially related to global warming, especially forests
have a role as a source of emissions and absorption Brown (1997). Emission reduction from forests is carried out through 2 main stages, namely increasing carbon sequestration and forest carbon conservation. Carbon calculations can also be used to support forestry policies both at the national and regional levels, especially Community Forests. Where the amount of carbon from forest stands is determined by the right policy direction for sustainable forestry development.

Carbon accounting is also an effort to find out the real 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).

The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. MATERIALS AND METHODS

A. Inventory of Community Forest Stands

Inventory of community forest stands of the Argomulyo FMU group was carried out by determining Measurement Plots in 2 village locations, namely Sundul Village and Banjarpanjang Village. Each village was determined to measure 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 on each Measurement Plot, Measurement Plot Plan and Unit can be seen in the following figure-1. and figure-2.

\[ V = \frac{\pi}{4} \times d^2 \times t \times f \times n \]

Where:

- \( V \) = volume standing stock
- \( \pi \) = phi (22/7)
- \( d \) = diameter breast high (dbh)
- \( t \) = tree height
- \( n \) = number of trees per hectare (n/ha)

Actual Trunk Volume

From the basic formula above, it is reduced to:

\[ V = \pi/8 \times (Dp^2 + Du^2) \times p \]

Where:

- \( Dp \) = Average base diameter
- \( Du \) = Average end diameter
- \( p \) = Segment length

B. Measurement of the Biomass

Calculation of biomass Biomass above ground (above ground) Sacht Village Sundul and Banjar Long done by destructive sampling of the entire organ tree (roots, trunk, branches and leaves) the model used to extrapolate a
snapshot of data to wider area. Mathematically, it is done allometrically. Standard allometric equations that have been published are often used, but because the coefficients of this allometric equation vary for each location and species, it is necessary to make a special equation that is significant in estimating the biomass of a vegetation (Heiskanen, 2006).

C. Tree Organ Biomass (BOP)

Lukito Martin (2020) said the calculation of plant tree organ biomass above ground is known based on formula:

\[ \text{Tree Organ} = \frac{\text{BOP}}{\text{BKS} \times \text{BBT}} \] ...........................(4)

Biomass BOP= Tree organ biomass (g, kg)
BKS = Dry weight of sample (g, kg)
BBS = Wet weight of sample (g, kg)
BBT = wet weight total organ trees (g, kg)

Measurement every dry weight carried by drying the samples taken from the field using an oven at 103 ± 2 0C to obtain a constant weight (Nelson etal,1999, in Losi, 2003). Biomass total trees can be calculated by adding up all the tree component biomass. The formula used

\[ \text{Wt} = \text{Ws} + \text{WL} + \text{WB} + \text{Wt} \] .............................(5)

Wt = above ground (total weight)
Ws = Stem weight
WL = leaf weight
WB = branch weight

D. Carbon Measurement

Source of greenhouse gases in the forestry sector and land change is carbon dioxide. Forest Carbon Stocks are stored in vegetation, namely in stems, shoots and roots, other biomass and in the soil Dharmawan, 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

\[ \text{Ct} = \text{Wt} \times \% \text{carbon content (CC)} \] ...........................(6)

Ct = Weight of carbon content of tree organs (g, kg)
w = weight biomass of plant organs (g, kg)
% CC = Total carbon content (C total %)

Guidelines for calculating carbon are available including the national standard for calculating carbon (SNI 7724/7725 of 2011), used as an understanding and implementation of carbon measurement and calculation, supporting climate change mitigation in the forestry sector. Carbon content was calculated by multiplying the biomass of trees, necromas, litter and undergrowth by 47% (Anonymous, 2011).

Absorption COabsorption2 through conversion of C and O Atomic Masses. Comparison of CO2 Atomic Mass to C (Carbon)= 3.67. The potential of forests to absorb CO2 from the atmosphere varies according to the type, age and level of plant density (Heriansyah, 2005). Approach to the calculation of absorption of CO2 can be approached by the formula:

\[ \text{WCO2} = \text{Wtc} \times 3.67 \] .................................(7)

WCO2 = amount of CO2 absorbed (tons / ha)
Wtc = the total weight of carbon stand a certain type and age (t / ha)
3.67 = Score equivalence / conversion element carbon (C) to CO2

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).

E. Allometric Equations

Data from such felling, tree height, dbh, sought correlation with fresh weight of plant organs, biomass, carbon dioxide, as well as CO2 sequestration order was made in an allometric equation regression model. From the regression models that have been developed in Indonesia, tree biomass estimation models are generally presented in rank (Krisnawati Haruni, et al, 2012)

\[ \text{Y} = a \times \text{X}^b \] .................................(8)

X = Independent Variable (Diameter, Height)
Y = Independent Variable (biomass)
a = Coefficient of allometric model
b = exponent of allometric model

Selection of the regression model based on the value of the coefficient of determination (R2), the highest as well as the sum of squared errors (residual sum of square) is the smallest. In addition, the significance test of the resulting equation was also carried out. Thenumber of deviations residual error minimum indicates the level of regression error that occurs is also getting smaller (Walpole, 1995).
III. RESULTS AND DISCUSSION

A. Community Forest Stands

Inventory of community forest stands of the Argomulyo FMU group was carried out by determining Measurement Plots in 2 village locations, namely Sundul Village and Banjarpanjang Village. One Plot Measurement is 1 hectare. The steps for data collection on each Measurement Plot, Measurement Plot Plan and Unit can be seen in the following figure-3.

Borders

| Village            | Sundul Village | Banjarpanjang Village |
|--------------------|----------------|-----------------------|
| North              | Bandarr Panjang Village | Banjarejo Village     |
| East               | Giripurno Village | Giripurno Village     |
| South              | Krowe Village | Sundul Village         |
| West               | Krajan Village | Banyudono Village      |
| Geographical Position | Sundul Village | Banjarpanjang Village |

North

| Location       | 70 42’12.46” S, 1110 22’24.42” E | 70 41’11.15” S, 1110 21’36.4” E |
|----------------|----------------------------------|----------------------------------|
| East           | 70 42’38.84” S, 1110 22’59.95” E | 70 41’42.25” S, 1110 22’34.46” E |
| South          | 70 45’7.78” S, 1110 21’59.83” E | 70 42’13.79” S, 1110 22’26.4” E |
| West           | 70 42’4.59” S, 1110 21’51.12” E | 70 46’8.92” S, 1110 21’19.4” E |

Table 1: Recapitulation of Community Forest Area of Sundul Village and Bandar Panjang FMU Argomulyo, Magetan Regency

| NO  | Village/District | Area of community forest (HA) | Number of Members |
|-----|-----------------|-------------------------------|-------------------|
|     |                 | Yard | Moor | Total |                             |
| 1   | BanJar Panjang  |        | 7,800 | 35,734 | 43,533 | 202 |
|     | Ngariroyo district |    | 50,166 | 50,166 |                             | 131 |
|     | Total           | 7,800 | 85,900 | 93,699 |                             | 333 |
| 2   | Sundul          | 0,07 | 0,515 | 0,585 |                             | 12  |
Inventory stands in the community forest of the villages of Sundul and Banjar Panjang in the Argomulyo FMU area, the average potential of community forest per ha for stands is Acacia auricuriformis 16 trees with a standing stock volume of 5.706 m³, Swietenia mahagoni is 8.825 m³ with an average of 46 trees per ha, Tectona grandis Lf is 186 trees with a standing stock volume of 153.98 m³, and the potential for Dalbergia latifolia roxb is 1.229 M³ with an average of 10 trees per Ha. As seen in Table 2, Table 3, and Table 4:

Table 2: Inventory of Stands at Pole Level per Ha Community Forest of Sundul and Banjar Panjang Villages FMU Argomulyo Magetan Regency

| Village    | Acacia auricuriformis | Swietenia mahagoni | Tectona grandis Lf | Dalbergia latifolia roxb | Total |
|------------|-----------------------|--------------------|--------------------|--------------------------|-------|
| Sundul     | 22                    | 2,774              | 101                | 12,635                   | 306   |
| Bandar panjang | 20              | 3,280              | 43                 | 5,248                    | 274   |
| Total      | 42                    | 6,054              | 144                | 17,882                   | 580   |
| Per Ha     | 11                    | 1,513              | 36                 | 4,471                    | 145   |

Caption = N= Number of Trees, V= Volume

Source: Primary data processed in 2021

Table 3: Inventory of Stands Tree Level per Ha Community Forest of Sundul and Banjar Panjang Village FMU Argomulyo Magetan Regency

| Desa       | Acacia auricuriformis | Swietenia mahagoni | Tectona grandis Lf | Dalbergia latifolia roxb | Total |
|------------|-----------------------|--------------------|--------------------|--------------------------|-------|
| Sundul     | 10                    | 5,03               | 34                 | 14,778                   | 119   |
| Bandar panjang | 13              | 14,064             | 6                  | 2,639                    | 43    |
| Total      | 23                    | 19,094             | 40                 | 17,417                   | 162   |
| Per Ha     | 6                     | 4,7735             | 10                 | 4,354                    | 41    |

Caption = N= Number of Trees, V= Volume

Source: Primary data processed in 2021
### Table 4: Inventory of Community Forest Stands per Ha in Sundul Village and Banjar Panjang FMU Argomulyo Magetan Regency

| Village         | Total number | Acacia auricuriformis | Swietenia mahagoni | Tectona grandis Lf | Dalbergia latifolia roxb | Total |
|-----------------|--------------|-----------------------|--------------------|--------------------|--------------------------|-------|
| PU              | N V          | N V                   | N V                | N V                | N V                      |       |
| Sundul          | 32 7,804     | 135 27,413            | 425 100,78         | 40 4,917           | 632 141,6                |       |
| Bandar panjang  | 33 15,018    | 49 7,887              | 317 53,206         |                    | 399 78,43                | 7     |
| Total           | 65 22,822    | 184 35,299            | 742 153,98         | 40 4,917           | 1,03 220,0               | 3     |
| Per Ha          | 16 5,706     | 46 8,825              | 186 38,495         | 10 1,229           | 258 55,00                | 9     |

Caption = \( N = \) Number of Trees, \( V = \) Volume
Source: Primary data processed in 2021

### Table 5: Number of trees Inventory of Community Forest Stands in Sundul and Banjar Panjang Villages, Argomulyo FMU, Magetan Regency

| Village         | District    | Area (Ha) | Acacia auricuriformis | Swietenia mahagoni | Tectona grandis Lf | Dalbergia latifolia roxb | Total |
|-----------------|-------------|-----------|-----------------------|--------------------|--------------------|--------------------------|-------|
|                 |             |           | N N                   | N N                | N N                | N N                      |       |
| Banjar Panjang  | Ngaribo     | 20,501    | 677 1.005             |                    | 6.499              |                         | 8.180 |
| Sundul          | Parang      | 178,643   | 5.717 24.117          | 75.923             | 7.146              |                         | 112.92 |
| **jumlah total**| **199,144** | **6.393** | **25.121**            | **82.422**         | **7.146**          | **121.02**              |       |

Caption = \( N = \) Number of Trees
Source: Primary data processed in 2021

### Table 6: Volume Total Inventory of Community Forest Stands in Sundul and Banjar Panjang Villages, Argomulyo FMU, Magetan Regency

| Village         | District    | Area (Ha) | Acacia auricuriformis | Swietenia mahagoni | Tectona grandis Lf | Dalbergia latifolia roxb | Total |
|-----------------|-------------|-----------|-----------------------|--------------------|--------------------|--------------------------|-------|
|                 |             |           | Volume                | Volume             | Volume             | Volume                   | Volume |
| Banjar Panjang  | Ngaribo     | 20,501    | 307,890               | 161,681            | 1,090,781          |                         | 1,560,35 |
| Sundul          | Parang      | 178,643   | 1,394,163             | 4,897,107          | 18,002,856         | 878,334                  | 25,172,4 |
| **Total Number**| **199,1**   | **1,702,053** | **5,058,789** | **19,093,638** | **878,334** | **26,732,8** | **26,732,8** |

Source: Primary data processed in 2021
C. Potential Biomass of Community Forest Stands

Amount of forest biomass is carried out for all parts. Trees consist of above-ground biomass including stem organs, branches, and leaves, and below-ground biomass including tree roots. The results of the inventory per segment are presented in Table 7 as follows:

Table 7: Biomass (kg) Per Segment of Community Forests in Sundul Village and Bandar Panjang FMU Argomulyo Magetan Regency

| Type             | Dbh (cm) | H (m)  | Vol (M3) | Wet Weight (Kg) | Total (KG) |
|------------------|----------|--------|----------|-----------------|------------|
|                  |          |        |          | Root            | Stem       | Branch | Leaf | Total |
| Acasia auricuriformis | 15,037   | 16,65  | 0,014    | 31,329          | 47,323     | 10,300 | 8,869 | 97,821 |
| Swietenia mahagoni   | 17,957   | 19,75  | 0,020    | 27,169          | 75,848     | 14,706 | 11,273 | 128,996 |
| Tectona grandis Lf   | 20,203   | 19,57  | 0,022    | 50,921          | 95,221     | 12,020 | 10,083 | 168,245 |
| Dalbergia latifolia roxb | 13,630   | 15,63  | 0,012    | 31,329          | 47,323     | 9,585  | 8,869  | 97,106  |
| Average           | 16,707   | 17,90  | 0,017    | 35,187          | 66,429     | 11,653 | 9,774  | 123,042 |

Source: Primary data processed in 2021

The average weight per tree for the Acacia auricuriformis species was 97.821 kg/tree, the Swietenia mahagoni species was 128.996 kg/tree and the Tectona grandis Lf species was 168.245 kg/tree and Dalbergia latifolia roxb 97.106 kg/tree. The average wet weight in the villages of Sundul and Bandar Panjang is 123,042 kg/tree. The average biomass per ha is for Acacia auricuriformis 148.41 tons/ha, Swietenia mahagoni is 213.87 tons/ha and for Tectona grandis Lf is 611.56 tons/ha and Dalbergia latifolia roxb of 21.48 tons/ha, the average biomass per ha of 995.32 tons ha. The Biomass Potential of Community Forests in Sundul and Banjar Panjang Villages in the Argomulyo FMU Management Area is presented in Table 8, figure-4

Table 8: Biomass Potential Per Ha in Sundul Village and Bandar Panjang Management Area of FMU Argomulyo Magetan Regency

| Average per Ha | Total Biomass Total per Hectare Type |
|----------------|-------------------------------------|
|                | N        | V (M3) | Root     | Stem     | Branch   | Leaf     | Total (Ton) |
| Acacia auricuriformis | 16       | 5,706  | 46.199,66| 72.627,07| 16.132,75| 13.450,99| 148,41      |
| Swietenia mahagoni     | 46       | 8,825  | 64.779,76| 121.014,74| 15.479,50| 12.596,20| 213,87      |
| Tectona grandis Lf     | 186      | 38.474 | 132.647,90| 351.388,35| 73.523,74| 53.997,32| 611,56      |
| Dalbergia latifolia roxb| 10       | 1,229  | 6.735,66 | 10.588,63| 2.191,68 | 1.961,08 | 21,48       |
| Total                 | 258      | 54,234 | 250.362,98| 555.618,79| 107.327,68| 82.005,60| 995,32      |

Caption = N= Number of Trees, V= Volume

Source: Primary data processed in 2021
Fig. 4: Biomass Potential Per ha of Community Forests in Sundul Village and Bandar Panjang FMU Argomulyo Kec. Kawedanan, Magetan Regency

The village community forest area Sundul and Banjar length within the territory of the region manage FMU Argomulyo covering an area of 199,144 ha, the distribution of species and potential based on the type of

Table. 9: Total Biomass Potential of Sundul Village and Bandar Panjang Management Area of FMU Argomulyo Magetan Regency

| Village/Type      | Total Biomass per species (Kg)/Ton | N | V (M3) | Root | Stem | Branch | Leaf | Total (Ton) |
|------------------|----------------------------------|---|--------|------|------|--------|------|-------------|
| **Sundul Village** |                                  |   |        |      |      |        |      |             |
| Acacia auricuriformis |                                | 5.717 | 1,394,163 | 87.677,10 | 137.830,69 | 30.616,52 | 25.527,12 | 281,651 |
| Swietenia mahagonii   |                                | 24.117 | 4,897,107 | 127.079,76 | 238.131,22 | 30.093,08 | 24.470,43 | 419,77  |
| Tectona grandis Lf  |                                | 75.923 | 18,002,856 | 250.162,64 | 662.688,49 | 138.659,52 | 101.834,34 | 1,153,34 |
| Dalbergia latifolia roxb |                        | 7.146 | 878,334 | 13.471,31 | 21.177,26 | 4.383,37 | 3.922,16 | 42,95   |
| **Total-1 (Ton)**   |                                  | **112.902** | **25,172,460** | **478,39** | **1,059,83** | **203,75** | **155,75** | **1,897,72** |
| **Bandar Panjang Village** |                                  |   |        |      |      |        |      |             |
| Acacia auricuriformis |                                | 677 | 307,890 | 4,722,22 | 7,423,45 | 1,648,98 | 1,374,87 | 15 |
| Swietenia mahagonii   |                                | 1.005 | 161,681 | 2,479,76 | 3,898,25 | 865,92 | 721,98 | 8 |
| Tectona grandis Lf  |                                | 6.499 | 1,089,052 | 15.133,16 | 40.088,21 | 8,387,97 | 6,160,29 | 70 |
| **Total-2 (Ton)**   |                                  | **8.180** | **1,558,624** | **22.34** | **51.41** | **10.90** | **8.26** | **92.91** |
| **Total Number**     |                                  | **121.082** | **26,731,084** | **500.73** | **1,111.24** | **214.66** | **164.01** | **1,990.63** |
| **Average**          |                                  | **116.992** | **25,951.772** | **489.56** | **1,085.53** | **209.20** | **159.88** | **1,944.18** |

Caption = N= Number of Trees, V= Volume  
Source: Primary data processed in 2021
Lukito Martin, Rohmatiah, 2013 Plant Biomass JUN (Jati Unggul Nusantara) Krowe Village Kab. Magetan averages 183.870 kg/tree. The total potential biomass content of JUN stands is 27.30 tons per hectare, Lukito Martin, Romatiah (2014) Potential biomass of JUN stands in Trosono Village, Magetan regency amounted to 56.2 tons. Or 17,295 tons per hectare. Judging from the potential for biomass in community forests around the Magetan district, Madiun Regency Rohmatiah, Lukito martin, 2015. The amount of biomass potential of JUN stands in Dungus Village, Kab. 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 the community forest of Jati Unggul Nusantara Kare Village. Madiun regency. JUN's biomass content is 168.35 tons per ha. Total of 6,462.67 Tons.

D. Biomass estimation model

The model for estimating the biomass of Community Forest species on the diameter at breast height (Dbh) in the villages of Sundul and Bandar Panjang FMU Argomulyo, Magetan Regency is described in the form of a scatter plot, presented in Table 10 and Figure -5 as follows:

Table. 10: Biomass Allometry Model for Community Forests in Sundul and Bandar Panjang Villages, Argomulyo FMU, Magetan Regency

| No. | Typepe                     | Model | Equation          | R²    | RSS   | Std Error |
|-----|---------------------------|-------|-------------------|-------|-------|-----------|
| 1.  | Acacia auriculiformis     | Power | Y = 0.50 dbh^2.416 | 0.977 | 1.108 | 0.070     |
| 2.  | Swietenia mahagoni        | Power | Y = 0.092 dbh^2.565 | 0.997 | 0.007 | 0.016     |
| 3.  | Tectona grandis if        | Power | Y = 0.092 dbh^2.565 | 0.997 | 0.007 | 0.016     |
| 4.  | Dalbergia latifolia roxb | Power | Y = 0.115 dbh^2.065 | 0.792 | 1.456 | 0.204     |
| 5.  | Biomass                   | Power | Y = 0.048 dbh^2.442 | 0.979 | 1.121 | 0.064     |

Fig. 5a: Estimation Model of Content (kg) of Community Forest Segments in Sundul Village and Bandar Panjang FMU Argomulyo, Magetan Regency

Carbon Swietenia mahagoni. Power Y = 0.048 dbh^2.564 R² = 0.917, RSS=0.022, Std Error 0.0213

Fig. 5b: Estimation Model of Content (kg) of Community Forest Segments in Sundul Village and Bandar Panjang FMU Argomulyo, Magetan Regency
Carbon *Tectona grandis* Lf. Power $Y = 0.035\, \text{dbh}^{2.710} \quad R^2 = 0.987, \text{RSS} = 0.062, \text{Std Error} 0.058$

*Fig. 5c: Estimation Model of Content (kg) of Community Forest Segments in Sundul Village and Bandar Panjang FMU Argomulyo, Magetan Regency*

Carbon *Dalbergia latifolia roxb.* Power $Y = 0.190\, \text{dbh}^{2.001} \quad R^2 = 0.767, \text{RSS} = 1.586, \text{Std Error} 0.216$

*Fig. 5d: Estimation Model of Content (kg) of Community Forest Segments in Sundul Village and Bandar Panjang FMU Argomulyo, Magetan Regency*

### Table 11. Carbon Content (kg) Per Segment of Community Forests in Sundul Village and Bandar Panjang FMU Argomulyo Magetan Regency

| Average Per Ha | Root (Kg) | Stem (Kg) | Branch (Kg) | Leaf (Kg) | Total (Ton) |
|---------------|-----------|-----------|-------------|-----------|-------------|
| *Acacia auricuriformis* | 43.42 | 68.26 | 15.16 | 12.64 | 139.5 |
| | 7.68 | 9.45 | 4.78 | 3.93 | 1 |
| *Swietenia mahagoni* | 60.89 | 113.7 | 14.55 | 11.84 | 201.0 |
| | 2.98 | 53.85 | 0.73 | 0.43 | 4 |
| *Tectona grandis Lf* | 124.6 | 330.3 | 69.11 | 50.75 | 574.8 |
| | 89.03 | 05.05 | 2.32 | 7.48 | 6 |
| *Dalbergia latifolia roxb* | 6.33 | 9.953 | 2.060 | 1.843 | 20.19 |
| | 52 | 31 | 18 | .42 | |
| Total | 235.3 | 522.2 | 100.8 | 77.08 | 935.6 |

*Source: Primary data processed in 2021*
Research on the carbon content of community forest stands is limited to living plants. The measurement method used, the carbon value is calculated by multiplying the tree biomass, 47% (Anonymous, 2011). The results of the calculation of the carbon content are presented in Table 11 as follows:

**Table 12. Total Carbon Content (Tons) of Community Forest FMU Argomulyo Magetan Regency**

| Village/type | N | V (M3) | Root | Stem | Branch | Leaf | Total (Ton) |
|--------------|---|--------|------|------|--------|------|-------------|
| **Sundul Village** | | | | | | | | |
| Acacia auricuriformis | 5.717 | 1.394,163 | 41,208,24 | 64,780,43 | 14,389,76 | 11,997,75 | 132,38 |
| Swietenia mahagoni | 24.117 | 4,897,107 | 59,727,49 | 111,921,67 | 14,143,75 | 11,501,10 | 197,29 |
| Tectona grandis Lf | 75.923 | 18,002,856 | 117,576,44 | 311,463,59 | 65,169,97 | 47,862,14 | 542,07 |
| Dalbergia latifolia roxb | 7.146 | 878,334 | 6,331,52 | 9,953,31 | 2,060,18 | 1,843,42 | 20,19 |
| Total-1 (Ton) | 112.902 | 25,172,460 | 224,84 | 498,12 | 95,76 | 73,20 | 891,93 |
| **Bandar Panjang Village** | | | | | | | | |
| Acacia auricuriformis | 677 | 307,890 | 2,219,44 | 3,489,02 | 775,02 | 646,19 | 7,13 |
| Swietenia mahagoni | 1,005 | 161,681 | 1,165,49 | 1,832,18 | 406,98 | 339,33 | 3,74 |
| Tectona grandis Lf | 6.499 | 1,089,052 | 7,112,59 | 18,841,46 | 3,942,35 | 2,895,34 | 32,79 |
| Total-2 (Ton) | 8,180 | 1,558,624 | 10,50 | 24,16 | 5,12 | 3,88 | 43,67 |
| Total Number | 121,082 | 26,731,084 | 235,34 | 522,28 | 100,89 | 77,09 | 935,60 |
| Average | 116,992 | 25,951,772 | 230,09 | 510,20 | 98,33 | 75,14 | 913,76 |

Source: Primary data processed in 2021
The carbon content of stands Jun Krowe Village, Magetan Regency averaged 13.65 tons Ca/Ha, Lukito Martin, Rohmatiah, 2013. The carbon potential of Jati Unggul Nusantara Trosono Village, Magetan Regency was 8.73 tons carbon/ha. The total is 26.1 tons. Rohmatiah, Lukito Martin, 2015 said the total potential carbon content of the JUN (Jati Unggul Nusantara) stands of Dungus Village, District. Madiun amounted to 46.61 tons of carbon. volume per hectare 12.45 – 13.65 tons of carbon per hectare. Rohmatiah, Lukito Martin, 2015 said the total potential carbon content of the JUN stands of the community forest of Kare Village, Madiun Regency is 3,180.71 tons of carbon. Per hectare is around 84.175 tons. The carbon content of the UPHR Kare Lestari community forest covering an area of 625.82 hectares totaling 48,709.92 tons or an average of 77.833 tons carbon/ha. Setiahadi, et al (2014).

F. Carbon Estimation Model

The carbon estimation model for Sundul and Bandar Panjang villages in the Argomulyo FMU area, Magetan district for the total carbon of community forest species against diameter at Breast height (Dbh) is presented in Table 13, and the scatter plot is shown in Figure 7:

| No | Type                          | Model | Equation          | R²  | RSS  | Std Error |
|----|-------------------------------|-------|-------------------|-----|------|-----------|
| 1  | Acacia auriculiformis         | Power | Y = 0.0540 dbh 2.416 | 0.990 | 0.057 | 0.045     |
| 2  | Swietenia mahagoni            | Power | Y = 0.048 dbh 2.564 | 0.917 | 0.022 | 0.021     |
| 3  | Tectona grandis lf            | Power | Y = 0.035 dbh 2.703 | 0.987 | 0.062 | 0.058     |
| 4  | Dalbergia latifolia roxb      | Power | Y = 0.190 dbh 2.001 | 0.767 | 1.586 | 0.216     |
| 5  | Carbon                        | Power | Y = 0.021 dbh 2.873 | 0.971 | 1.876 | 0.093     |

![Acacia auriculiformis](image1.png)  
Carbon Acacia auriculiformis, Power Y = 0.0540 dbh 2.416  
R² = 0.990, RSS 0.057, Std Error

![Swietenia mahagoni](image2.png)  
Carbon Swietenia mahagoni. Power Y = 0.048 dbh 2.564  
R² = 0.917, RSS=0.022, Std Error 0.0213

Fig. 6a: Estimation Model of Content (kg) of Community Forest Segments in Sundul Village and Bandar Panjang FMU Argomulyo, Magetan Regency

Fig. 6b: Estimation Model of Content (kg) of Community Forest Segments in Sundul Village and Bandar Panjang FMU Argomulyo, Magetan Regency
**IV. CONCLUSION**

1. Average standing stock of 54.25 m³/ha with a total volume of 26,732,831 m³ consisting of *Acacia auricuriformis* stands potential of 5,706 m³/ha, total volume of 1,702,053 m³, *Swietenia mahagoni* of 8,825 m³/ha, total volume of 5,508,789 m³, *Tectona grandis* Lf of 38,495 m³/ha total volume of 19,093,638 m³, and *Dalbergia latifolia roxb* of 1,229 m³/ha total volume of 878,334 m³.

2. Biomass content per hectare is 955.32 tons/ha, during from *Acacia auricuriformis* is 148.41 tons/ha, *Swietenia mahagoni* is 213.87 tons/ha, *Tectona grandis* Lf is 611.56 tons/ha, and *Dalbergia latifolia roxb* of 21.48 tons/ha. Total Biomass based on Community forest area 1,944,178 tons.

3. The average carbon content is 467.80 tons C/ha with an area of 199.44 ha, so the potential available carbon dioxide is 913,763 tons of carbon.

4. The carbon absorption capacity of the community forests of Sundul Village and Bandar Panjang FMU Argomulyo to absorb carbon dioxide is 1,716.82 tons C/ha, or is able to absorb CO2 content of 3,353,512 tons C.

5. Relationship of Biomass, Carbon, and Carbon Uptake with Variable Diameter at Breast height (Dbh) Allometric power model with model:

| Model Equation | Allometrik | $R^2$ | RSS |
|----------------|------------|-------|-----|
| Biomass Allometry | $WT = 0.048$ $Dbh^{2.442}$ | 0.979 | 0.064 |
| Carbon Allometry | $WT = 0.021$ $Dbh^{2.873}$ | 0.971 | 0.093 |
| CO2 absorption allometry | $WT = 0.021$ $Dbh^{2.6358}$ | 0.973 | 0.086 |

Caption: WT = Total Wight, Dbh = Diameter Brigt High, $R = Koef Diterminasi$, RSS = Residual Some Of Square

Measurement of carbon potential in people's forests, when this research was carried out only used the above and bellows ground methods. In the future, it is necessary to measure all aspects (trees, soil, necro-mass, litter) and carbon analysis using all organs/variables with the creation of a comprehensive allometric model.
V. ACKNOWLEDGEMENTS

This research was funded by Contract Agreement for the Assignment of Multiple Basic Research Programs for Leading Higher Education Research Programs for Fiscal Year 2021. Nomor 008/SKP2DJ/PFUPT/Unmer.Mdn/LPPM/IV/2021, date April 6, 2021.

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