International Journal of Research in Agricultural Sciences
Volume 4, Issue 5, ISSN (Online): 2348 – 3997

Absorption Carbon Dioxide Biomass in Community Forest Approach Sub-District Kawedanan, District Magetan

Martin Lukito[1*], Ahadiati Rohmatiah[2] and Rahmanta Setiahadi[3]
[1, 3] Agriculture Faculty, Merdeka University of Madiun
[2] Economic Faculty, Merdeka University of Madiun
*Corresponding author email id: martinlukito@unmer-madiun.ac.id

Date of publication (dd/mm/yyyy): 27/10/2017

Abstract **– Community forest management becomes the global political agenda in the context of mitigation and adaptation to climate change. The concept of Sustainable Forest Management that has grown should facilitate efforts to reduce emissions in the forestry sector more economically than other sectors. Which then became the forerunner of the concept of REDD +. The objectives of this study were to obtain information on the ability of community forests to produce biomass, carbon content and the ability to absorb CO_2 content in the forest management unit (FMU) Argomulyo, sub-district of Kawedanan District Magetan. The procedures performed in this biomass measurement using destructive sampling method on logged stands. Analysis of carbon content using titration method Walkley and Black. The results showed that the average forest biomass content per tree was 189, 944 Kg/tree. Potential of forest biomass of the people is 86, 891, 486 tons. Or 110.347 ton / Ha. Carbon content averaged 57, 983 Ton C/ha or total available for 45, 658, 090 ton Carbon. Absorption ability of CO_2 of community forest is 212,798 Ton C/Ha, with wide of the manageable area of public forest able to absorb CO_2 content equal to 167, 565 ton $C0_2$.**

Keywords **– Biomass, Carbon Content, $C0_2$ Absorption.**

I. INTRODUCTION

Indonesia's commitment to mitigate climate change impacts contributes to 26-41% of GHG emissions reduction by 2020. As a concrete step, the Government adopted Presidential Regulation No. 61/2011 as the basis for the drafting of RAN-GRK. The national commitment should need support from the regions, especially to safeguard and demonstrate the nation's prestige especially in climate change mitigation efforts [1].

The disturbance of the energy balance between the earth and the atmosphere, where the increase of GHG concentration can not be matched by the ability of the earth's ecosystem to absorb it. The result is a global warming event. The impact of global warming is now very real and has reached levels that endanger the earth's climate and the balance of ecosystems [11].

Emissions reduction efforts in the forestry sector are more economical than other sectors. This then becomes the forerunner of the concept known as REDD + (Reducing Emissions from Deforestation and Forest Degradation plus). So the viewpoint of climate change has placed forests the main object in global climate change mitigation. This puts forestry back on the global political agenda. [15]

Sustainable Forest Management has returned to the global political agenda in the context of climate change. Forests play a very important role in mitigation and adaptation to climate change. The focus of mitigation discourse is centered in developing countries. The concept of sustainable Forest Management that has evolved should facilitate the concept and implementation of REDD +. Sustainable Forest Management in a broad sense plays a role in climate change mitigation and improves adaptation to climate change. In the mitigation section, it functions for carbon conservation, sequestration, and substitution. It is in this area of carbon conservation that REDD lies, whereas the Plus is on the carbon sequestration. Sustainable forest management is also intended to improve wood products such as furniture and construction timber or carpentry for carbon storage outside the forest. In the adaptation section, Sustainable Forest Management (SFM) can be used to reduce the exposure or openness of surrounding communities to the effects of climate change, as well as to reduce the sensitivity and increase the adaptive capacity of the community. [10]

One of the natural elements that can absorb CO_2 in large quantities is a forest. This is because the existing vegetation in the forest binds CO_2 in the process of photosynthesis and stores it in the form of biomass so that the existence of forests affects the prevention and handling of global warming on earth. [3] Statement which says that 50% of the biomass present in the forest is composed of carbon. So that Forestry strategic role becomes important in the context of global warming because the forest has a role as one source of emission and absorption.

Activities to reduce emissions from the forestry sector are conducted through two main activities: carbon uptake and forest carbon conservation. To find out the level of uptake or emissions required carbon accounting from the forestry sector is needed. Carbon calculations can also be used to support forestry policies at both national and local levels. By knowing the amount of carbon owned will be determined the right policy direction for sustainable forestry development. Carbon calculation is also one of the facilities to know the real condition of forest in Indonesia is very wide and diverse. The extent and variety of forest types in Indonesia encourage carbon accounting to be carried out in combination with ground survey and remote sensing activities. This is done to maintain the accuracy of carbon calculation figures as well as for resource efficiency. The IPCC already has applications to calculate emission reductions through the IPCC Guidelines (GL)

application [4]

The study of carbon dioxide absorption is focused on the Forest Management Unit (FMU) of Argomulyo sub-district of Kawedanan District Magetan with the objective of knowing the amount of biomass, carbon content and the ability of community forests to absorb carbon dioxide.

II. Methods and Data Analysis

A. Inventory of Community Forest Stands

Inventory of stands is done in every village of community forest area FMU argomulyo Sub-district Kawedanan by making a plot (PU). And its location is adjusted based on field observation by making a measuring plot in the form of an area of 0.05 Ha. Or finger 12.61 meters. Determination of plot with sampling system. Measurements are made for each tree that enters inside the PU, based on the measurement of height and diameter, then the volume is determined. Determination of volume of trees using formulas :

Standing Tree Volume

V = 1/4. Π. d^2.t. f ..... (1)

Where :
V = Tree volume (m3).
Π = Constant (3.14).
D = Tree diameter at breast height (m).
T = Total height (m) and
F = Number of tree shapes (0.7).

Actual Stem Volume

Measurement the actual stem volume is done with a volume formula per segment using the Smallian formula

$$VS = \left[\frac{Lbds\ pkl + Lbds\ ujung}{2}\right] x\ l \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Notes:
Vs : The volume of each wood segment (m^3).
Basal area / LBDS $_{pkl}$: Area of base-base = ¼ π x $_{dpkl}^2$ (m^2).
Basal area / LBDS $_{ujung}$: The area of the tip base = ¼ π x d_{ujung}^2 (m^2).
L : Segment length (meter).

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

Vst = Vs1 + Vs2 + Vs3 + ... + Vstn ..... (3)

Notes:
Vst: Total segment volume (m^3)
Vs1, Vs2, Vs3 ... .Vsn: Volume of each segment (m^3).

B. Measurement of Plant Biomass

Biomass calculation is done on aboveground biomass each Village of manage FMU Argomulyo Sub-district Kawedanan. The selection of biomass sample trees that became the object of the research was conducted by way of destructive sampling for measuring and weighing the wet weight of each tree of stems, branches, leaves, and roots. Further measurements for each dry weight to determine the moisture content and biomass calculations were carried out by drying the samples brought from the field using an oven at a temperature of 103 ± 2 ° C until a constant weight was obtained [6]. Total tree biomass can be calculated by summing all tree component biomass, with the formula.

Total Tree Biomass (WT) = WS + WB + WL + WR. (4)

Weight Stem (WS) = (100% - Water Content (%)) x Total Wet Weight Stem
Weight Branch (WB) = (100% - Water Content (%)) x Total Wet Weight Branch
Weight Leaf (WL) = (100% - Water Content (%)) x Total Leaf Wet weight
Weight Root (WR) = (100% - Water Content (%)) x Total Root Wet Weight

C. Carbon Measurement

The carbon content in plants was calculated using titration method using Walkley and Black method with total carbon content (C-total).

D. Measurement of Carbon Dioxide Absorption

The measurement of carbon dioxide uptake is done by multiplying the stored carbon value by 3.67, so the value of carbon dioxide absorption can be known. [9]

E. Allometric Equations

Various data have been obtained such as tree height, dbh, sought correlation with leaf and wet weight, biomass, carbon content, and CO_2 absorption for later made in an allometric equation with a regression model. From the model that has been developed in Indonesia, the model of tree biomass pendulum model is presented in the form of rank function [5].

$Y = aX^b$.....(5)

Remark
X = Free Variable (Diameter, Height).
Y = Non-free variable (biomass)
a = Coefficient of allometric model.
b = Allometric model exponent.

III. Result and Discussion

A. Work Area Fmu Argomulyo

By the agreement of members of FMU Argomulyo, the temporary working area of FMU Argomulyo in Sub-district Kawedanan District Magetan is Balerejo, Garon, Giripurno, Ngentep Village and Tladan Villages. The width of community forest area of each village in Sub-district Kawedanan is presented in Table 1 [2]:

Table 1. Recapitulation of Community Forest Area FMU Argomulyo Sub-district Kawedanan, District Magetan

Village	Hamlet	Large (HA)
Balerejo	Pager Gunung	79.054
Garon	Sambiroto	117.862
Giripurno	Santren	57.171
	Soco	11.751
	Sendung Suci	69.746
	Amount	138.668
Ngentep	Pencol	99.319
Tladan	Jatisari	177.506
	Tladan Barat	81.595
	Amount	259.101
Total		**694.004**

Inventory of stands on community forest area FMU Argomulyo Sub-district Kawedanan. District Magetan

obtained the potential of community forest/Ha for teak stands for 2, 217 Trees with standing stock volume 215, 898 m^3, while the potential for acacia of 0.697 m^3 and mahogany with 38 trees per Ha with sanding stock 8, 107 m^3. As seen in Table-2.

Table 2. Inventory of stands/Ha Community Forest FMU Argomulyo Sub-district Kawedanan, District Magetan

Village	Total Trees and Volume (m^3)					
	Teaks		Acacia		Mahogany	
	Total	volume	Total	Volume	Total	volume
Balerejo	348	24.069	-	-	-	-
Garon	503	28.430	7	0.697	14	1.842
Giripurno	383	19.969	-	-	-	-
Ngentep	275	16.713	-	-	24	6.265
Tladan	708	126.717	-	-	-	-
Total	**2,217**	**215.898**	**7**	**0.697**	**38**	**8.107**

The width of community forest in the area of FMU Argomulyo 694 Ha, the distribution of species and potency based on the type of Teak dominates the community forest and is almost evenly distributed in each village of 175, 254 trees with total standing stock of 17, 067.6 M^3, Acacia is 69 trees (6, 969 M^3) only in Giripurno Village, and for Mahogany of 376 trees with standing stock volume of 81, 068 M^3. There is Giripurno and Ngentep Village show in Table 3.

Table 3. Potential stands of Community Forest FMU Argomulyo sub-district Kawedanan District Magetan

Village	Large (HA)	Total Trees and VOLUME (m^3)					
		Teak		Acacia		Mahogany	
		Total	volume	Total	volume	Total	volume
Balerejo	79.054	27,474	1,903	-	-	-	-
Garon	117.862	39,756	2,248	69	6.969	138	18.42
Giripurno	138.668	30,291	1,579	-	-	-	-
Ngentep	99.319	21,752	1,321	-	-	238	62.65
Tladan	259.101	55,982	10,017	-	-	-	-
Total number	694.004	175,254	17,067	69	6.969	376	81.07

B. Biomass Potential of Community Forest Standing

The measurements of forest biomass in this study were conducted in all parts of the tree consisting of above-ground biomass covering stems, branches and leaves, and below-ground biomass covering tree roots. The magnitude of the results per Inventory per segment is presented in Table 4 as follows:

Table 4. Biomass (kg) every Segment FMU Argomulyo Community Forest Sub-district Kawedanan, District Magetan

Trees Species	**Dbh (cm)**	**Vol (M3)**	**Biomass (Kg)**				**Total (kg)**
			Root	**Stem**	**Branch**	**Leaf**	
Acasia	14,984	0,014	14,60	38,97	15,24	11,6	80,41
Teak	17,782	0,019	46,92	151,5	27,31	21,7	247,40
Mohagoni	19,992	0,021	54,40	151,9	19,13	16,6	242,02
Average	*17,586*	*0,018*	38,64	114,1	20,56	16,6	189,94

Note: Dbh: Diameter breast High, H: High

The average weight of biomass per tree for Acacia species of 80.41 kg/tree, Type of Teak 247.40 Kg/tree and Mahogany type of 242.02 kg/tree or an average of total biomass/tree area Manage FMU Argomulyo Sub-district Kawedanan equal to 189.94 kg/tree. The amount of biomass/Ha. Teak stem organ is 70,288 ton/Ha, root 20,802 Ton/Ha, Branch 12,108 Ton/Ha is smallest in Leaf organ of 9,617 ton/Ha or total equal to 109,7 ton/Ha. Divided into teak plants average of 247.4 kg/tree, acacia as much as 80.41 kg/tree average and mahogany type is 242.02 kg/tree. The average of Biomass/ Ha is 109,691 ton/ha; Acacia is 0,555 ton/Ha, and Mahogany is 4,550 ton/Ha, or the average of Biomass is 114,796 ton Ha. Biomass Potency Community Forest of Manage FMU Argomulyo Sub-district Kawedanan District Magetan is presented in Table 5.

Table 5. Potential of Biomass Per Village Manager FMU Argomulyo Sub-district Kawedanan District Magetan

Village	**Large CF (Ha)**	**Biomass (ton)**			
		Teak	**Acasia**	**Mohagony**	**Total**
Tladan	259.101	45,393	-	-	45,393.30
Giripurno	138.668	13,145	-	-	13,145.11
Garon	117.862	14,664	9.48	49.8	14,723.03
Balerejo	79.054	6,797	-	-	6,796.92
Ngentep	99.319	6,761	-	72.4	6,833.13
Total Number	**694.004**	**86,760**	**9.477**	**122.163**	**86,891.486**

Note : CF = Community Forest

C. Biomass Estimation Model

The model for estimating total forest biomass for the diameter at breast height (Dbh) of management area of FMU Argomulyo Sub-district Kawedanan District Magetan is depicted in the form of scatter plot, shown in Figure 1 - 3 as follows:

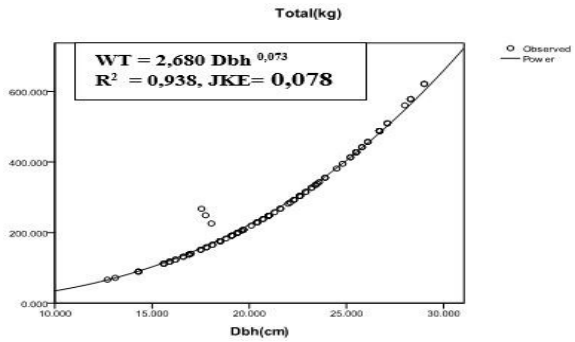


Fig. 1. The Teak Biomass Estimation Model (*Tectona grandis* LF)

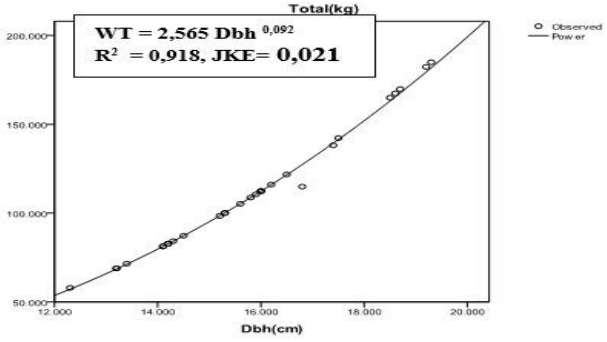
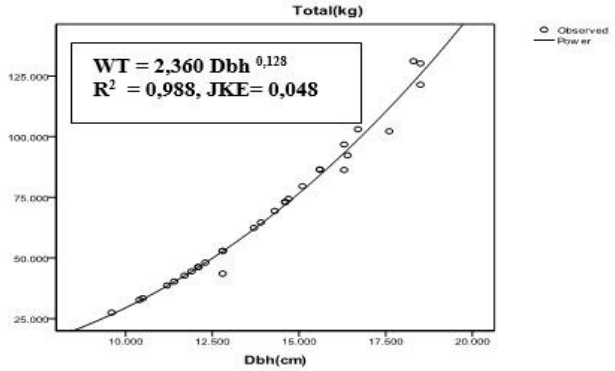


Fig. 2. The Mahogany Estimation Biomassa Model (*Swietenia mahagoni*)



Note: WT: Weight Total, Dbh: Diameter Breast High, JKE (Residual Sum of Square).
R^2 = Coefficient of determination.

Fig. 3. The Acacia Estimation Biomass Model (*Acacia auricuriformis*)

D. Carbon Potential

The amount of carbon content of community forests is limited only to living plants. The measurement method is direct measurement using Titration Method as presented in Table 6.

Table 6. Total Carbon Content by Using the Community Forest Titration Method FMU Argomulyo

No	Organ	Weight Sample Grams	Titration Sample ml	Titration Control Ml	Levels of C Total %
1	Stem	0,0252	5,0806	7,6667	50,3052
2	Roots	0,0253	5,0032	7,6667	54,7870
Average		**0,0252**	**5,0419**	**7,6667**	**52,5461**

The percentage of carbon content in the biomass plant organ of community forests in FMU Argomulyo Sub-district Kawedanan of 52.55%. Yuniawati 2011 [15] says that carbon mass is considered to be equal to 50% biomass or its conversion factor is equal to 0.5 in estimating the carbon mass potential of a stand regardless of the type of biomass and stand age. Based on the content of each organ Carbon community forest plants for stem Organ by 61.23%, to root organ of 18.98% to 11.03% Branch organ and for organ leaves 8.76%.

Total potential of carbon content of community forest stands FMU Argomulyo Sub-district Kawedanan District Magetan is 57,983 tons/Ha. The total area of FMU Argomulyo Sub-district Kawedanan is 694 Ha by looking at the type of standing stands in the area of management, the amount of Carbon content is 46,130,7 Ton. Tlagan village has the greatest potential of 52.24%. As seen in Table 7.

Table 7. Total Content of Carbon (Ton) of Community Forest FMU Argomulyo Sub-district Kawedanan, District Magetan

Village	Large CF (Ha)	Carbon (ton) Teak	Acasia	Mohagony	Total
Tladan	259.101	23,852.4	-	-	23,852.41
Giripurno	138.668	6,907.2	-	-	6,907.24
Garon	117.862	7,705.2	34.36	206.85	7,946.44
Balerejo	79.054	3,571.5	-	-	3,571.52
Ngentep	99.319	3,552.5	-	300.61	3,853.13
Total Number	**694.004**	**45,589**	**34.361**	**507.462**	**46,130.741**

Note : CF = Community Forest.

Total Potential of Carbon Capacity of Jati Ungggul Nusantara (JUN) of Krowe Village, Lembeyan Sub-district District Magetan average of 13.65 tons Ca/Ha, [7], The potential of JUN stands Village Trosono Parang sub-district District Magetan of 8.73 tons Carbon/Ha. Or a total of 26.1 tons. [8]. The total potential of carbon content of JUN stands Dungus Village, Madiun sub-district is 46.61 tons Carbon. When converted into units of volume/Ha ranges from 12.45 to 13.65 tons of carbon/Ha [12], the total potential of carbon content of stands of community forest teak Kare Village, Kare sub-district Madiun district is 3,180.71 ton Carbon. When converted into units of volume per hectare ranges between 84.175 tons of carbon per hectare [13]. The content of Carbon in community forest area of UPHR Kare Lestari covering 625.82 hectares of 48.709,92 tons of carbon with an average of 77.833 tons of carbon/ha [14].

E. Model Estimates of Carbon

Model estimation of Carbon in District FMU Argomulyo Sub-district Kawedanan District Magetan for total community forest Carbon against diameter at breast height (Dbh) is depicted in graph form, as shown in Figure 4 – 6.

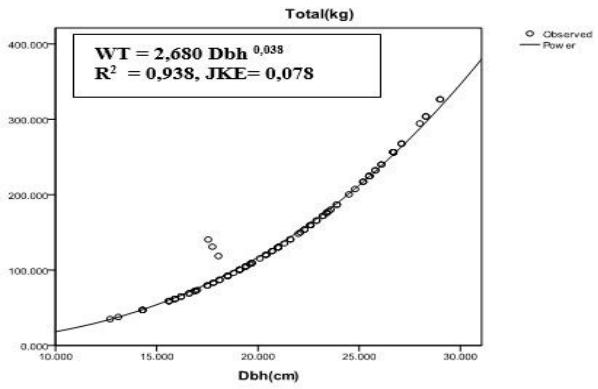


Fig. 4. Model Estimation of Carbon Type Teak (*Tectona grandis* LF)

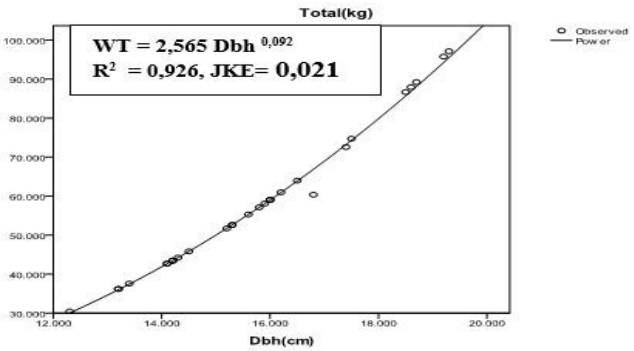
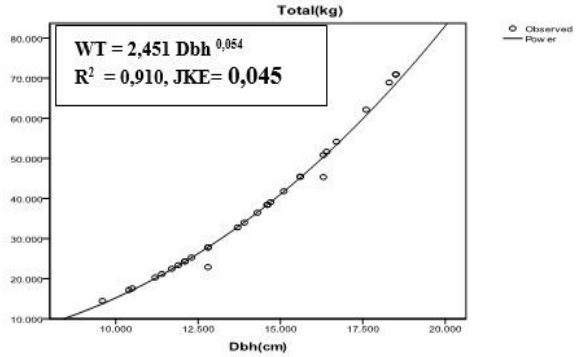


Fig. 5. Model Estimation of Carbon type Mahogany (*Swietenia mahagoni*)



Note : (WT): Wight Total, ($R^{2)}$ Coefficient determination, JKE = Residual sum of error.

Fig. 6. Model Estimation of Carbon type Acacia (*Acacia auricuriformis*)

F. Potential Absorption of Co_2 Community Forest Area FMU Argomulyo Sub-District Kawedanan, District Magetan

Measurement of CO_2 gas absorption potential is done by using the weight ratio of the mass of CO_2 with the weight of atomic period C. The average potential of CO_2 absorption from the community forest plant FMU Argomulyo Sub-district Kawedanan District Magetan as presented in Table 8.

Table 8. Total Carbondioxsida Absorption (Ton) of Community Forest FMU Argomulyo. Sub- District Kawedanan, District Magetan

Village	Large CF (Ha)	Karbondioxsida (ton)			
		Teak	Acasia	Mohagony	Total
Tladan	259.101	87,538	-	-	87,538.34
Giripurno	138.668	25,350	-	-	25,349.58
Garon	117.862	28,278	126	759	29,163.45
Balerejo	79.054	13,107	-	-	13,107.46
Ngentep	99.319	13,038	-	1,103	14,140.99
Total Number	**694.004**	**167,311**	**126.106**	**1,862.386**	**169,299.821**

Note : CF = Community Forest.

The potential for absorption of CO_2 of the community forest in Sub-district Kawedanan of District Magetan is influenced by the ability of the leaves to absorb CO_2 in the process of photosynthesis when viewed from the number of plants in the community forest equivalent to 169,299,821 tons of CO_2. The amount of CO_2 absorption potential when converted to the number of plants/Ha average JUN Plant Krowe Village Lembeyan sub-district District Magetan 50,113 tons CO_2/ha [7]. Total potential JUN carbon dioxide content averaged 13.65 tons Carbon/Ha, equivalent to 240.55 tons of carbon dioxide. [8] Potential absorption of CO_2 JUN Plant Trosono Village, sub-district Parang, District Magetan when converted to the number of plants equivalent to 367.17 tons of carbon throughout the JUN plant. The amount of potency of CO_2 plant absorption JUN Dungus Village sub-district Dagangan amounted to 11,656 tons CO_2 [13].

G. Model Estimation of Carbondioxside Absorption

Model estimation of Carbon dioxide Absorption at FMU Argomulyo Area Sub-district Kawedanan District Magetan for total Carbondioxsida absorption to diameter at breast height (Dbh) as presented in Figure 7-9.

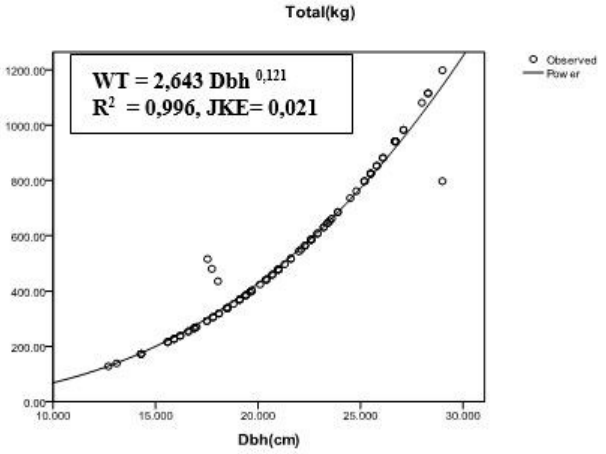


Fig. 7. Model of Carbon dioxide Absorption Type Teak (*Tectona grandis* LF)

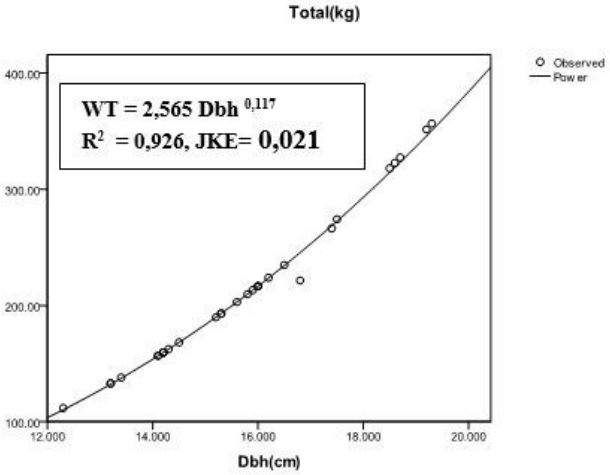
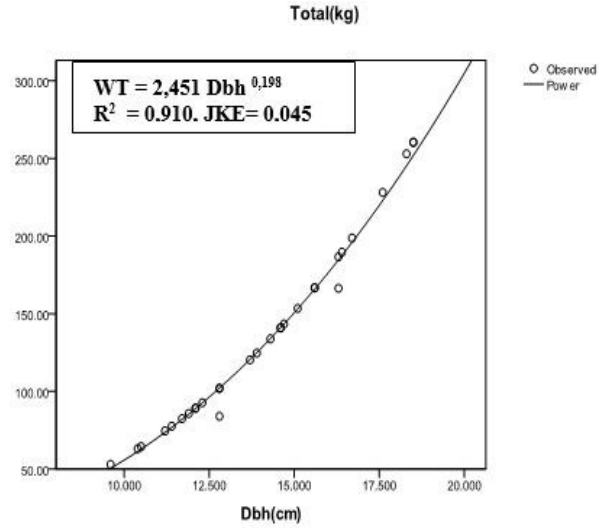


Fig. 8. Model of Carbon dioxide Absorption Type Mohagony (*Swietenia mahagoni*)



Note : (WT): Wight Total, ($R^{2)}$ Coefficient determination, JKE = Residual sum of error

Fig. 9. Model of Carbon dioxide Absorption Type Acacia (*Acacia auricuriformis*)

IV. CONCLUSIONS

1. Potential standing stock for Community Forest area FMU Argomulyo Sub-district Kawedanan, District Magetan average 43,781 m^3/ ha, with area of 694 hectare area consisting of 5 villages, the potential of stand for the type of teak is 175,254 trees or 17,067.6 M^3, Acacia type 69 trees or equal to 6,969 M^3 and Mahogany type 376 trees Or equal to 81,068 M^3.
2. The average forest biomass content per tree is 189.944 Kg/trees. Area of FMU Argomulyo Sub-district Kawedanan. District Magetan area of 604 Ha, the total biomass potential for community forest stands is 86,891,486 tons. Or if declared in units per hectare then the biomass of FMU Argomulyo region 110,347 tons/Ha.
3. The average carbon content of 57,983 Ton C/Ha with the area of FMU Argomulyo covering an area of 604 ha, then the amount of available Carbon potential is 45,658,090 tons C.
4. The absorption capacity of community forest carbon FMU Argomulyo Sub-district Kawedanan in absorbing Carbondioxsida is equal to 212,798 Ton CO_2/Ha, with a wide area of 694 hectares of forest area can absorb the CO_2 content of 167,565 ton CO_2.
5. Relation of Biomass, Carbon content and Carbondioxsida Absorption with Diameter at breast height (Dbh) is a power model with Allometric models.
6. Allometric Model, Koefisien Determination (R^2) and Residual Sum of Eror (JKE).

Model	**Allometric**	**R^2**	**JKE**
B. Teak (*Tectona grandis* LF)	WT = 2,680 Dbh ^{0,073}	0,938	0,078
B.Mohagony(*Swietenia mahagoni*)	WT = 2,565 Dbh ^{0,092}	0,926	0,021
B. Acasia (*Acasia auricuriformis*)	WT = 2,360 Dbh ^{0,128}	0,918	0,048
C. Teak (*Tectona grandis* LF)	WT = 2,680 Dbh ^{0,038}	0,938	0,078
C.Mohagony(*Swietenia mahagoni*)	WT = 2,565 Dbh ^{0,092}	0,926	0,021
C. Acasia (*Acasia auricuriformis*)	WT = 2,451 Dbh ^{0,054}	0,910	0,045
A. Teak (*Tectona grandis* LF)	WT = 2,565 Dbh ^{0,121}	0,936	0,021
A.Mohagony(*Swietenia mahagoni*)	WT = 2,565 Dbh ^{0,177}	0,926	0,021
A. Acasia (*Acasia auricuriformis*)	WT = 2,451 Dbh ^{0,198}	0,910	0,045

Note : B = Biomass, C = Carbon, A = Absorption.

.

ACKNOWLEDGMENT

This research was funded by the Ministry of Technology research and higher education of Republic Indonesia on the applied product research scheme for 2017 No. 009/SP2H/HB-PPT/Unmer. Mdn/LPPM/V/2017, date May 5, 2017.

REFERENCES

[1] Annonymous 2012, Estimation of Allometric Models for estimating forest biomass and forest stock in Indonesia. Regulation of the Head of Forestry Research and Development Agency, Number: P.01/VIII-P3KR/2012 Ministry of Forestry.

[2] Anonymous, 2014. Forest Management Unit of Argomulyo, Certification of Sustainable Community-Based Forest Management (CBFM), Book I, Book II and Book III, Forestry and Plantation Service, District Magetan.

[3] Brown, S. 1997. Estimating biomass and biomass change of tropical forest. A primary, FAO. Forestry paper No. 134. FAO, USA

[4] International Panel on Climate Change. 2003. IPPC guidelines for nationwide greenhouse inventories: Reference manual IPCC.

[5] Krisnawati H., W.C, Adinugroho, R. Imanuddin. 2012, Monograph Allometric model for estimating tree biomass in different types of forest ecosystems in Indonesia, Center for Research and Development Conservation and Rehabilitation, Forestry Research and Development Agency, Bogor, Indonesia.

[6] Losi, C.J. Thomas, G.S. Richard, C. Juan, E.M., 2003. Analysis of Alternative Methods for Estimating Carbon Stock in Young Tropical Plantations, Forest Ecology and Management 184, 355 – 368.

[7] Lukito Martin, Rohmatiah A. 2013. Estimation of Biomass and Carbon Plant Teak Age 5 Years (Case Plant Forest Region Jati Unggul Nusantara (JUN) Krowe Village, District Lembeyan Magetan) Agri-Text Journal Volume 14 No. March 1, 2013 ISSN: 1411-533.

[8] Lukito Martin, Rohmatiah A. 2014. Biomass and Carbon Estimation Model Community Forest Jati Unggul Nusantara (People's Forest Case Jati Unggul Nusantara (JUN) Age 5 Years Trosono Village, District Parang Magetan) Agri-Text Journal Volume 15 No. March 1, 2014, ISSN: 1411-5336.

[9] Manuri, S., C.A.S. Son and A.D. Saputra (2011). Techniques for Estimating Forest Carbon Reserves. Merang REDD Pilot Project, German International Cooperation - GIZ. Palembang.

[10] Purbawiyatna, et al. (2012), Study of Preparation of Preparation of Natural Forest Management Unit for Development of Redd + Program, Jakarta.

[11] Rahayu S and Hairiah K, 2007, Practical guidelines for measuring the carbon stored in various land uses. World Agroforestry Center ICRAF Southeast Asia Regional Office. Bogor.

[12] Rohmatiah A, Lukito Martin 2015. Estimation, Biomass and Carbon Plant Teak Forest People In absorbs carbon dioxide (CO_2) Village Kare, Kare subdistrict, Madiun district. Agri-Text Journal Volume 16 Number 2 September 2015 ISSN: 1411-5336.

[13] Rohmatiah A, Lukito Martin 2015. Estimated Volume, Biomass, and Carbon for High-Quality Teak of Nusantara Village Dungus Village Dagangan Sub-district Madiun district JURNAL AGRI-TEK, Vol 16, No 1 (2015) ISSN: 1411-5336.

[14] Setiahadi R, Martono, Lukito, 2014. Carbon Stock Certified SVLK (Timber Legality Verification) Model for Compilation of Project Document Design (DDD), Competitive Grant Research Report 2014.

[15] Stern N. 2007. The Economics of Climate Change: The Stern Review. Cambridge, UK: Cambridge University Press.

[16] Yuniawati, Ahmad Budiaman and Elias, 2011. Estimation of the Potential of Biomass and Acacia Forest Carbon Acacia Crassicarpa on Peatland (Case Study in HTI Wood Fibers in Pelalawan, Riau Province) Journal of Forest Product Research Vol. 29 No. 4, December 2011: 343-355.