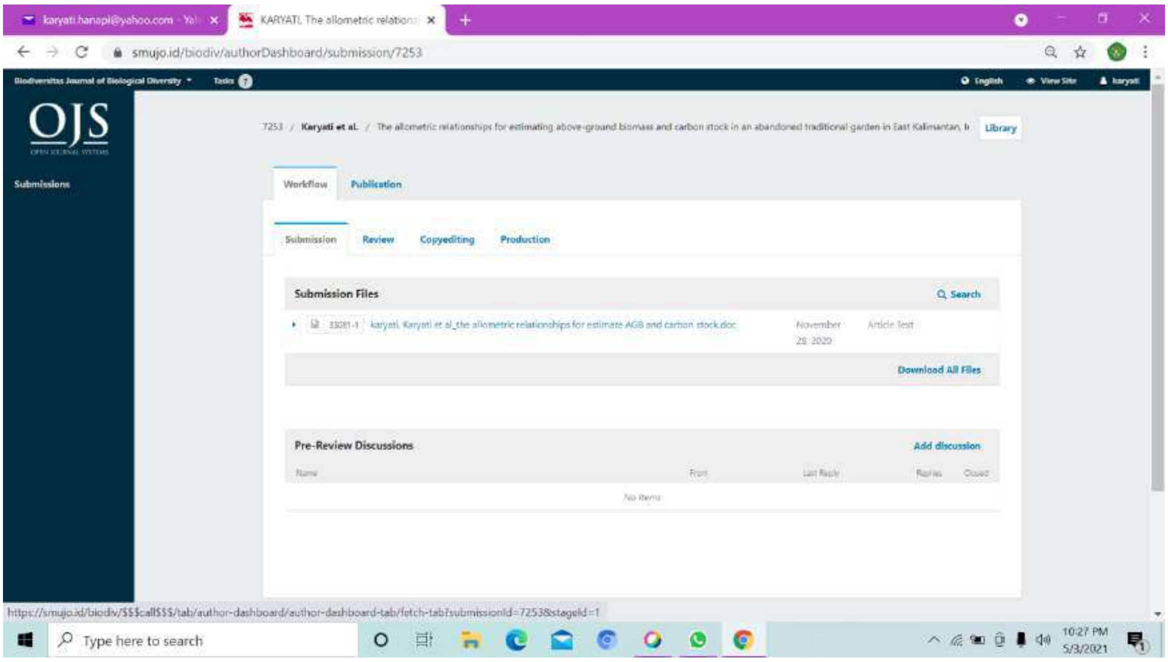
BUKTI-BUKTI PROSES REVIEW (KORESPONDENSI)

Judul	:	The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, Indonesia
Penulis	:	Karyati, Kusno Yuli Widiati, Karmini, dan Rachmad Mulyadi
Nama Jurnal	:	Biodiversitas
Volume/Nomor/Tahun/Halaman	:	22, 2, 2021, 751-762
ISSN	:	1412-033X/ E-ISSN: 2085-4722
Penerbit	:	Society for Indonesian Biodiversity
DOI	:	10.13057/biodiv/d220228



7253 / **Karyati et al.** / The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, I Library

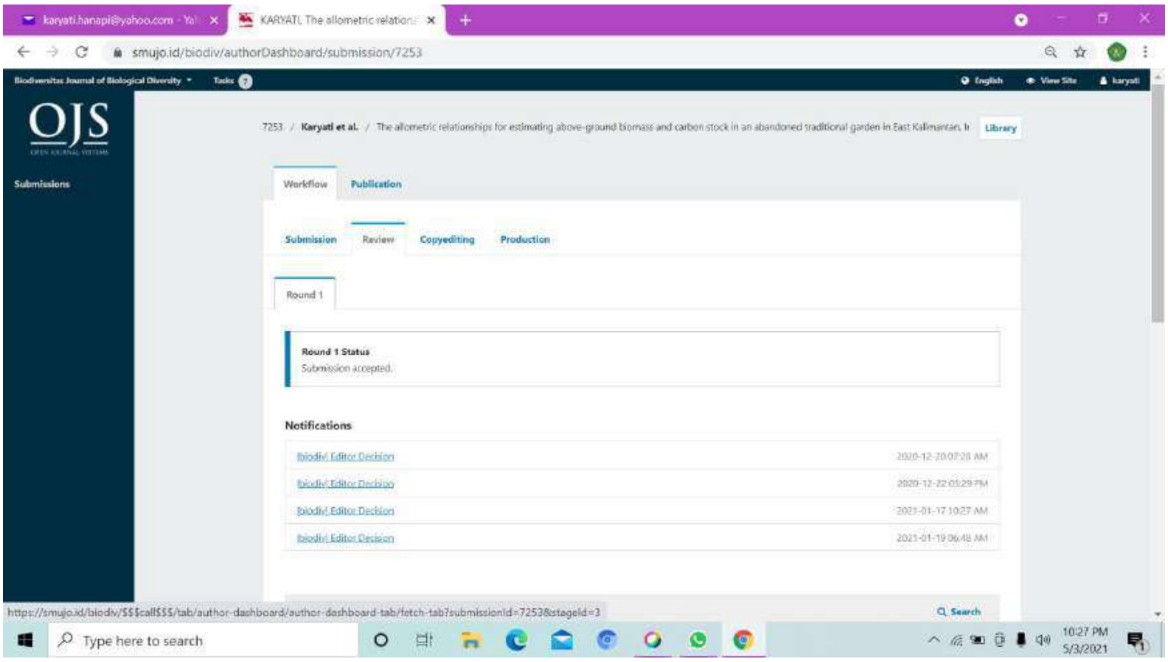
Submission Files

33081-1	karyati, Karyati et al_the allometric relationships for estimate AGB and carbon stock.doc	November 28, 2020	Article Text

Pre-Review Discussions

Name	From	Last Reply	Replies	Closed
No Items				

https://smujo.id/biodiv/$$$call$$$/tab/author-dashboard/author-dashboard-tab/fetch-tab?submissionId=7253&stageId=1



7253 / **Karyati et al.** / The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, I Library

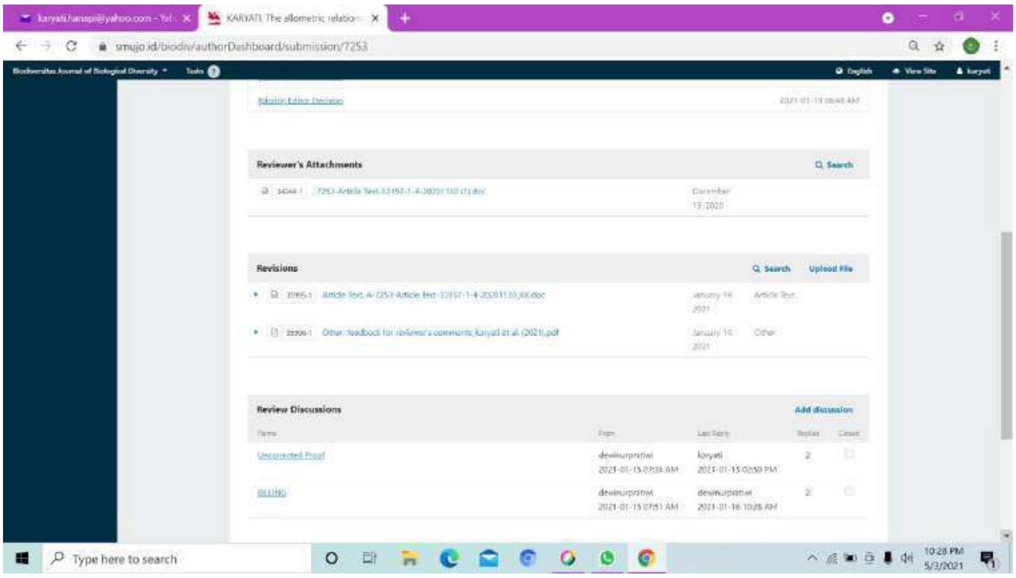
Round 1 Status

Submission accepted.

Notifications

[biodiv] Editor Decision	2020-12-20 07:28 AM
[biodiv] Editor Decision	2020-12-22 03:29 PM
[biodiv] Editor Decision	2021-01-17 10:27 AM
[biodiv] Editor Decision	2021-01-19 06:48 AM

https://smujo.id/biodiv/$$$call$$$/tab/author-dashboard/author-dashboard-tab/fetch-tab?submissionId=7253&stageId=3



[biodiv] Editor Decision 2021-01-19 08:48 AM

Reviewer's Attachments Search

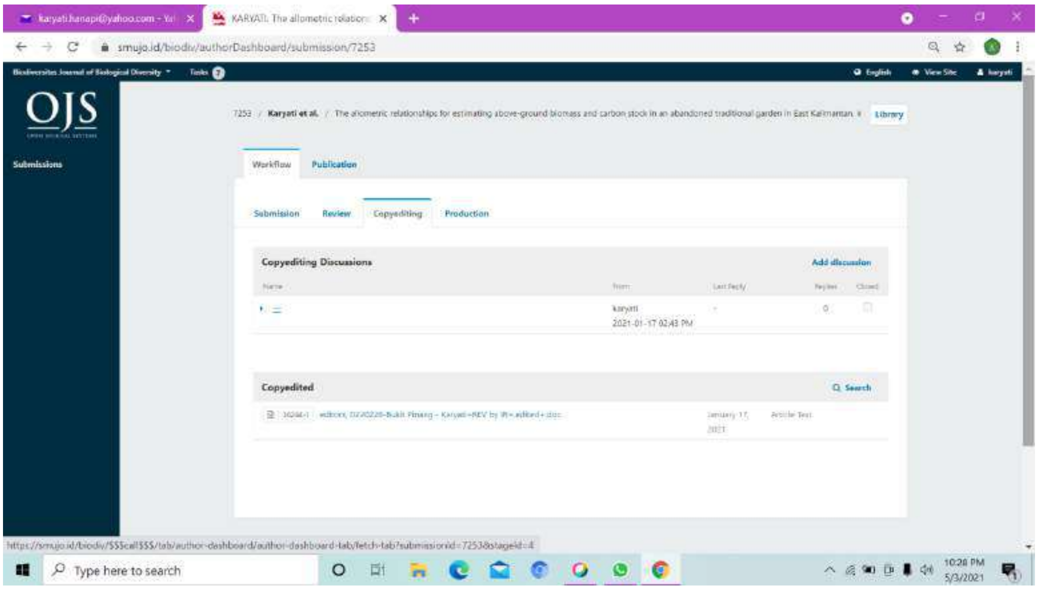
34044-1	7253-Article Text-33157-1-4-20201130 (1).doc	December 19, 2020

Revisions Search Upload File

35995-1	Article Text, A-7253-Article Text-33157-1-4-20201130_KK.doc	January 14, 2021	Article Text
35996-1	Other, feedback for reviewer's comments_karyati et al. (2021).pdf	January 14, 2021	Other

Review Discussions Add discussion

Name	From	Last Reply	Replies	Closed
Uncorrected Proof	dewinurpratiwi 2021-01-15 07:38 AM	karyati 2021-01-15 02:50 PM	2	☐
BILLING	dewinurpratiwi 2021-01-15 07:51 AM	dewinurpratiwi 2021-01-16 10:26 AM	2	☐



7253 / **Karyati et al.** / The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, It

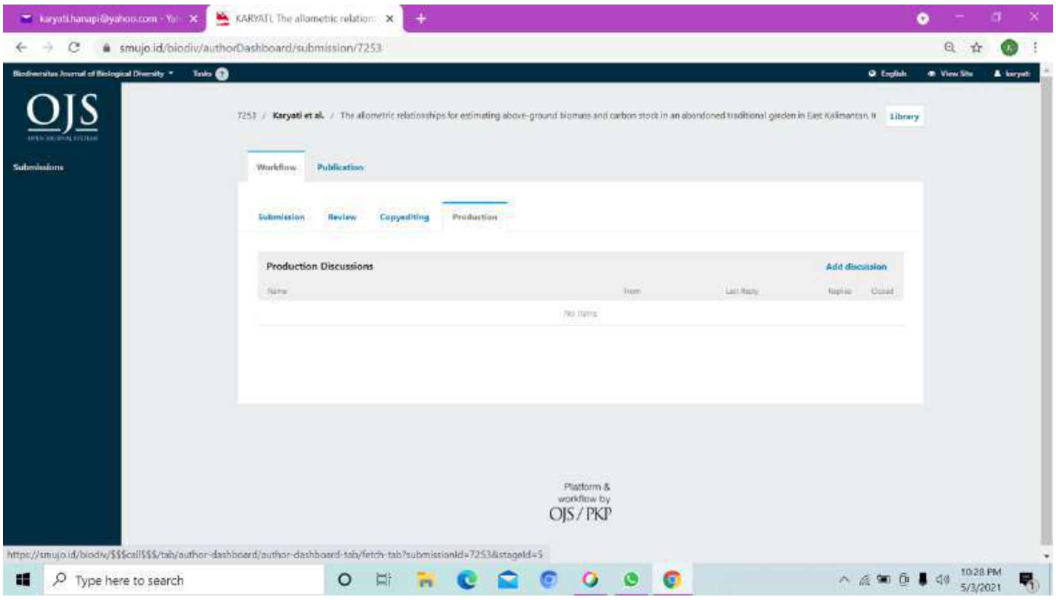
Copyediting Discussions Add discussion

Name	From	Last Reply	Replies	Closed
–	karyati 2021-01-17 02:43 PM	-	0	☐

Copyedited Search

36044-1	editors, D220220-Bukit Pinang - Karyati+REV by IR+ edited+.doc	January 17, 2021	Article Text

https://smujo.id/biodiv/$$$call$$$/tab/author-dashboard/author-dashboard-tab/fetch-tab?submissionId=7253&stageId=4

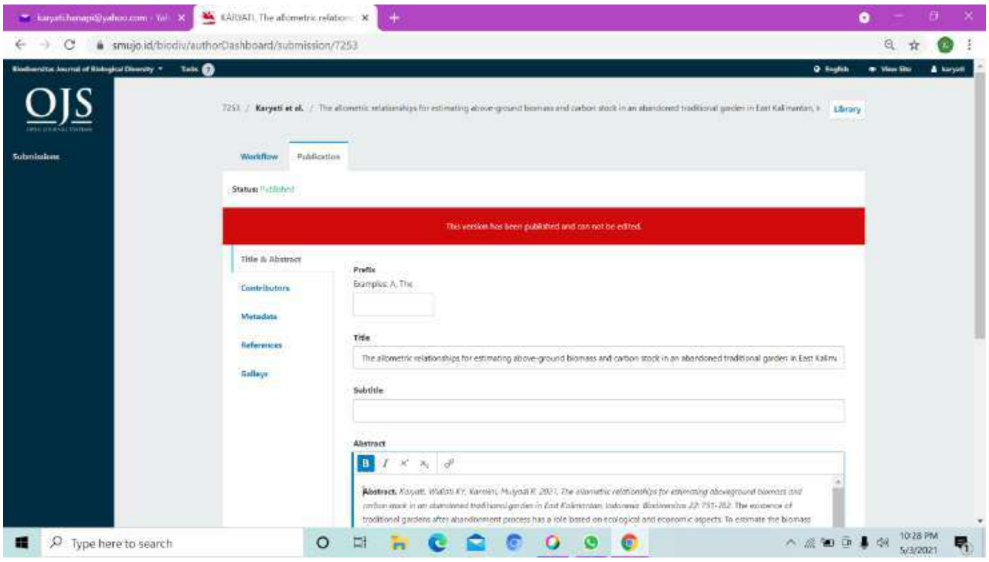


7253 / **Karyati et al.** / The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, It

Production Discussions Add discussion

Name	From	Last Reply	Replies	Closed
No Items				

https://smujo.id/biodiv/$$$call$$$/tab/author-dashboard/author-dashboard-tab/fetch-tab?submissionId=7253&stageId=5



7253 / **Karyati et al.** / The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, I

Status: Published

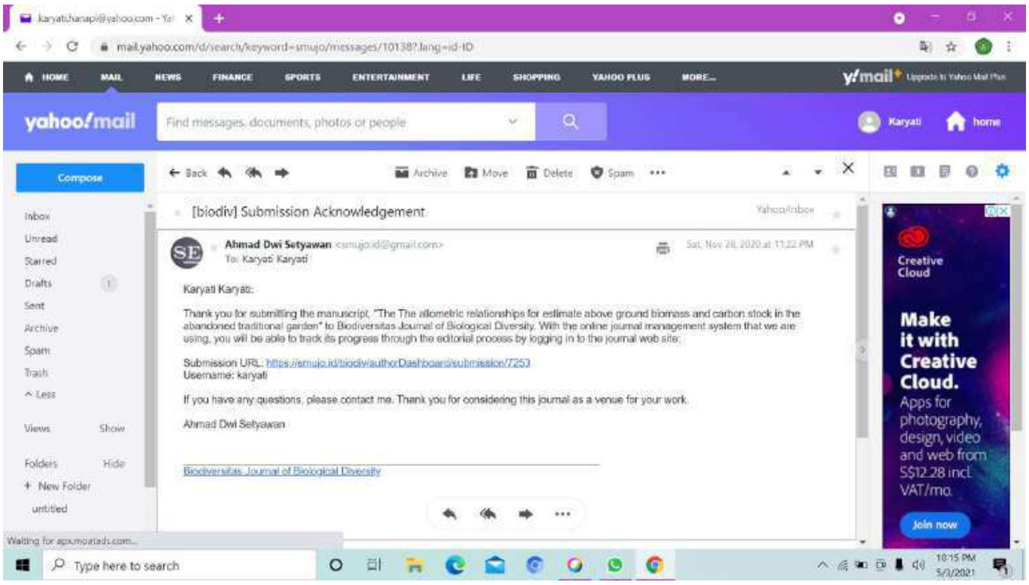
This version has been published and can not be edited.

Prefix
Examples: A, The

Title
The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalim

Subtitle

Abstract
Abstract. *Karyati, Widiati KY, Karmini, Mulyadi R. 2021. The allometric relationships for estimating aboveground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, Indonesia. Biodiversitas 22: 751-762.* The existence of traditional gardens after abandonment process has a role based on ecological and economic aspects. To estimate the biomass



[biodiv] Submission Acknowledgement

Ahmad Dwi Setyawan <smujo.id@gmail.com>
To: Karyati Karyati
Sat, Nov 28, 2020 at 11:22 PM

Karyati Karyati:

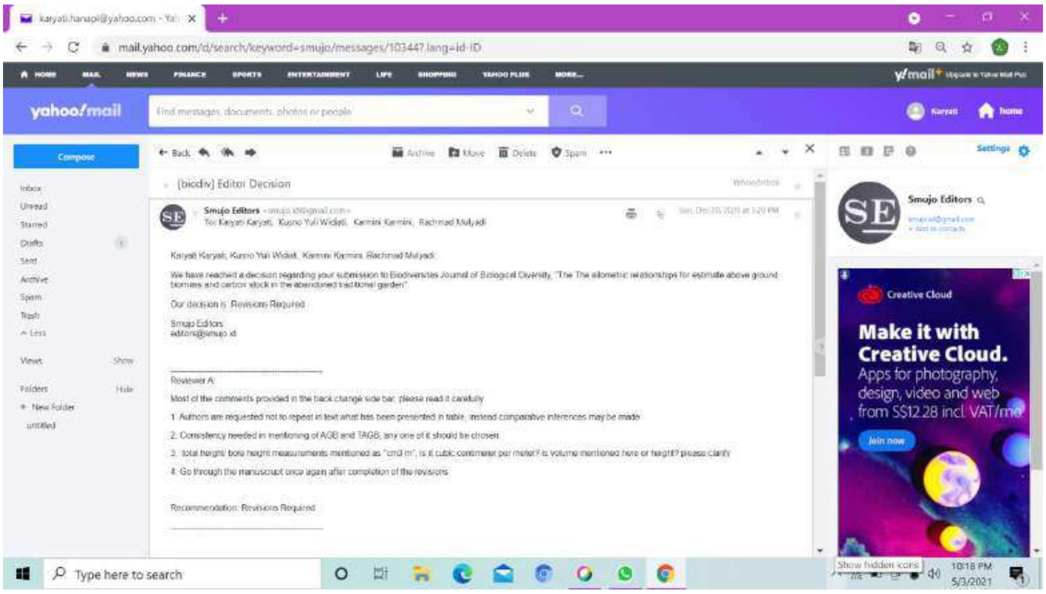
Thank you for submitting the manuscript, "The The allometric relationships for estimate above ground biomass and carbon stock in the abandoned traditional garden" to Biodiversitas Journal of Biological Diversity. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Submission URL: https://smujo.id/biodiv/authorDashboard/submission/7253
Username: karyati

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

Ahmad Dwi Setyawan

Biodiversitas Journal of Biological Diversity



[biodiv] Editor Decision

Smujo Editors <smujo.id@gmail.com>
To: Karyati Karyati, Kusno Yuli Widiati, Karmini Karmini, Rachmad Mulyadi
Sun, Dec 20, 2020 at 1:20 PM

Karyati Karyati, Kusno Yuli Widiati, Karmini Karmini, Rachmad Mulyadi:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "The The allometric relationships for estimate above ground biomass and carbon stock in the abandoned traditional garden".

Our decision is: Revisions Required

Smujo Editors
editors@smujo.id

Reviewer A:

Most of the comments provided in the track change side bar, please read it carefully

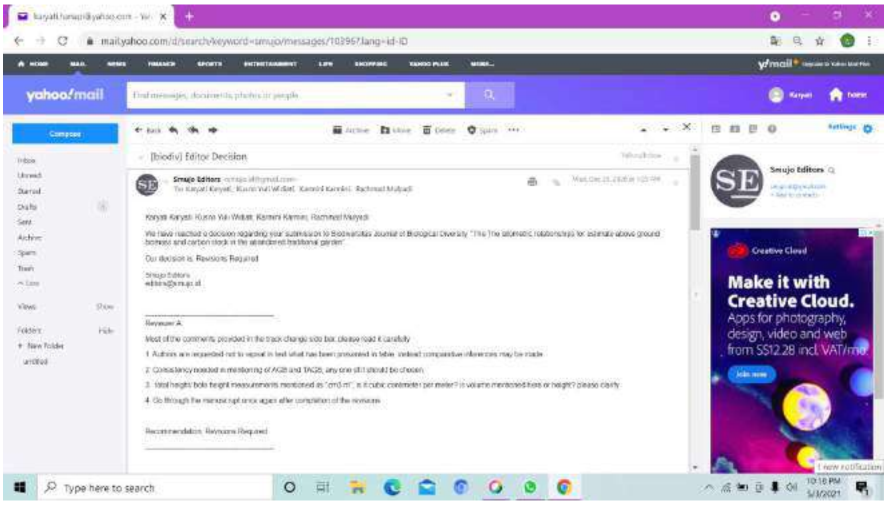
1. Authors are requested not to repeat in text what has been presented in table, instead comparative inferences may be made

2. Consistency needed in mentioning of AGB and TAGB, any one of it should be chosen

3. total height/ bole height measurements mentioned as "cm3 m", is it cubic centimeter per meter? is volume mentioned here or height? please clarify

4. Go through the manuscript once again after completion of the revisions

Recommendation: Revisions Required



[biodiv] Editor Decision

Smujo Editors

To: Karyati Karyati, Kusno Yuli Widiati, Karmini Karmini, Rachmad Mulyadi

Karyati Karyati, Kusno Yuli Widiati, Karmini Karmini, Rachmad Mulyadi:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity "The The allometric relationships for estimate above ground biomass and carbon stock in the abandoned traditional garden".

Our decision is: Revisions Required

Smujo Editors
editors@smujo.id

Reviewer A:

Most of the comments provided in the track change side bar, please read it carefully

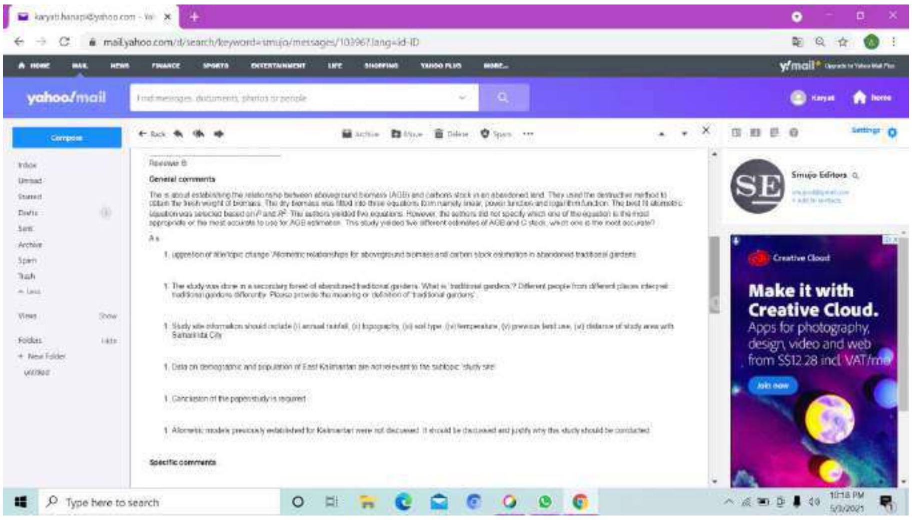
1. Authors are requested not to repeat in text what has been presented in table, instead comparative inferences may be made.

2. Consistency needed in mentioning of AGB and TAGB, any one still should be chosen.

3. total height/ bole height measurements mentioned as "cm3 m", is it cubic centimeter per meter? is volume mentioned here or height? please clarify

4. Go through the manuscript once again after completion of the revisions

Recommendation: Revisions Required



Reviewer B:

General comments

The is about establishing the relationship between aboveground biomass (AGB) and carbons stock in an abandoned land. They used the destructive method to obtain the fresh weight of biomass. The dry biomass was fitted into three equations form namely linear, power function and logarithm function. The best fit allometric equation was selected based on r and R². The authors yielded five equations. However, the authors did not specify which one of the equation is the most appropriate or the most accurate to use for AGB estimation. This study yielded five different estimates of AGB and C stock, which one is the most accurate?

A s

1. uggestion of title/topic change 'Allometric relationships for aboveground biomass and carbon stock estimation in abandoned traditional gardens'

1. The study was done in a secondary forest of abandoned traditional gardens. What is 'traditional gardens'? Different people from different places interpret traditional gardens differently. Please provide the meaning or definition of 'traditional gardens'.

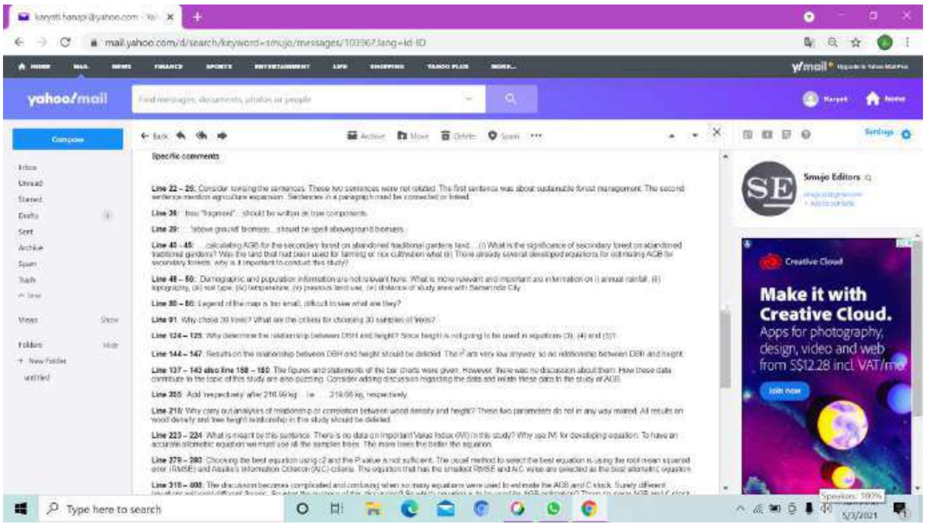
1. Study site information should include (i) annual rainfall, (ii) topography, (iii) soil type, (iv) temperature, (v) previous land use, (vi) distance of study area with Samarinda City

1. Data on demographic and population of East Kalimantan are not relevant to the subtopic 'study site'

1. Conclusion of the paper/study is required

1. Allometric models previously established for Kalimantan were not discussed. It should be discussed and justify why this study should be conducted.

Specific comments



Specific comments

Line 22 – 26: Consider revising the sentences. These two sentences were not related. The first sentence was about sustainable forest management. The second sentence mention agriculture expansion. Sentences in a paragraph must be connected or linked.

Line 28: tree "fragment"... should be written as tree components

Line 29: ..."above ground" biomass... should be spelt aboveground biomass

Line 40 - 45: ... calculating AGB for the secondary forest on abandoned traditional gardens land ... (i) What is the significance of secondary forest on abandoned traditional gardens? Was the land that had been used for farming or rice cultivation what (ii) There already several developed equations for estimating AGB for secondary forests, why is it important to conduct this study?

Line 48 – 59: Demographic and population information are not relevant here. What is more relevant and important are information on i) annual rainfall, (ii) topography, (iii) soil type, (iv) temperature, (v) previous land use, (vi) distance of study area with Samarinda City

Line 80 – 86: Legend of the map is too small, difficult to see what are they?

Line 91: Why chose 30 trees? What are the criteria for choosing 30 samples of trees?

Line 124 – 125: Why determine the relationship between DBH and height? Since height is not going to be used in equations (3), (4) and (5)?

Line 144 – 147: Results on the relationship between DBH and height should be deleted. The r² are very low anyway, so no relationship between DBH and height.

Line 137 – 143 also line 158 – 180: The figures and statements of the bar charts were given. However, there was no discussion about them. How these data contribute to the topic of this study are also puzzling. Consider adding discussion regarding the data and relate these data to the study of AGB.

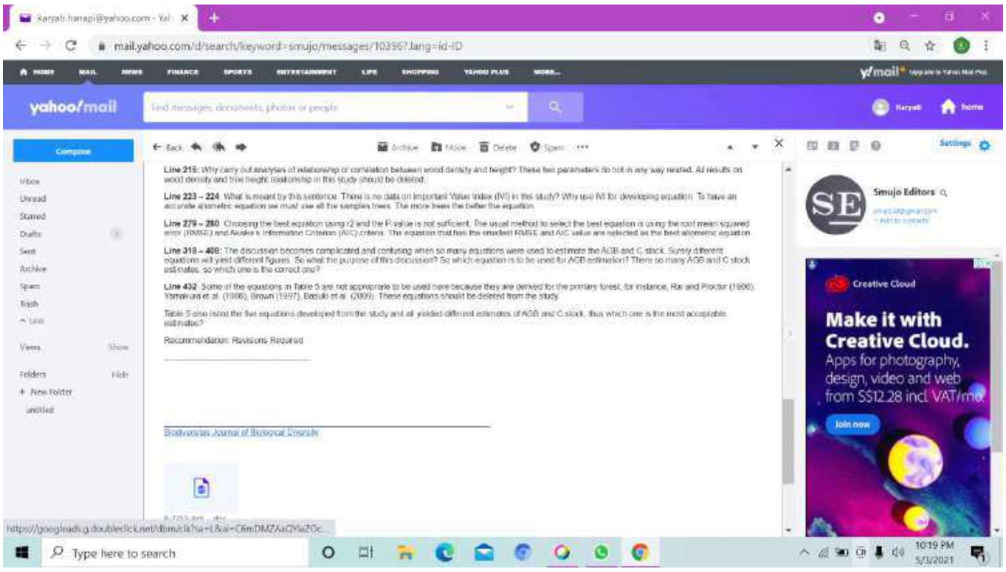
Line 205: Add 'respectively' after 216.99 kg ... i.e. ... 219.08 kg, respectively

Line 216: Why carry out analysis of relationship or correlation between wood density and height? These two parameters do not in any way related. All results on wood density and tree height relationship in this study should be deleted.

Line 223 – 224: What is meant by this sentence. There is no data on Important Value Index (IVI) in this study? Why use IVI for developing equation. To have an accurate allometric equation we must use all the samples trees. The more trees the better the equation.

Line 279 – 280: Choosing the best equation using r2 and the P value is not sufficient. The usual method to select the best equation is using the root mean squared error (RMSE) and Akaike's Information Criterion (AIC) criteria. The equation that has the smallest RMSE and AIC value are selected as the best allometric equation.

Line 318 – 408: The discussion becomes complicated and confusing when so many equations were used to estimate the AGB and C stock. Surely different



Line 215: Why carry out analyses of relationship or correlation between wood density and height? These two parameters do not in any way related. All results on wood density and tree height relationship in this study should be deleted.

Line 223 – 224: What is meant by this sentence. There is no data on Important Value Index (IVI) in this study? Why use IVI for developing equation. To have an accurate allometric equation we must use all the samples trees. The more trees the better the equation.

Line 279 – 280: Choosing the best equation using r2 and the P-value is not sufficient. The usual method to select the best equation is using the root mean squared error (RMSE) and Akaike's Information Criterion (AIC) criteria. The equation that has the smallest RMSE and AIC value are selected as the best allometric equation.

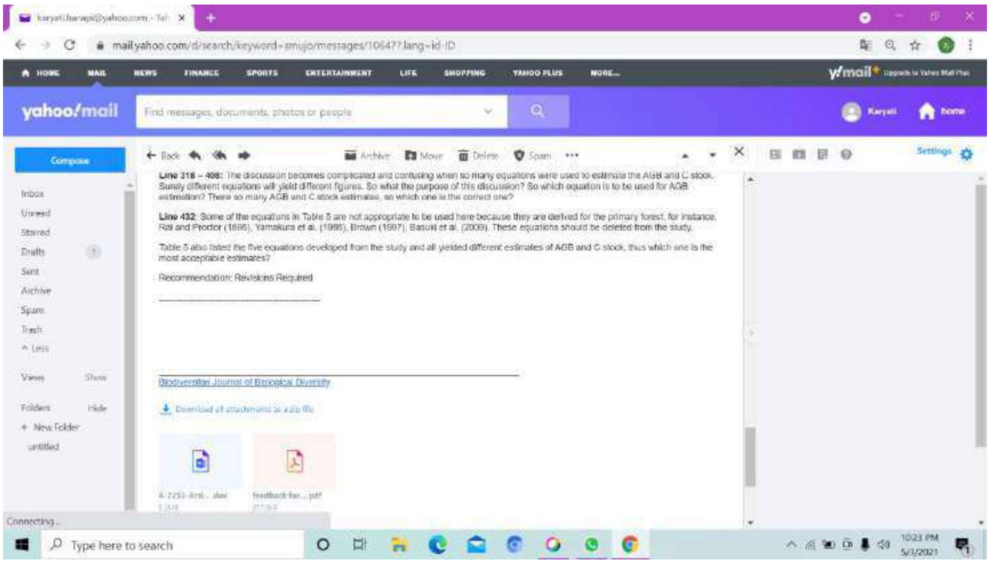
Line 318 – 408: The discussion becomes complicated and confusing when so many equations were used to estimate the AGB and C stock. Surely different equations will yield different figures. So what the purpose of this discussion? So which equation is to be used for AGB estimation? There so many AGB and C stock estimates, so which one is the correct one?

Line 432: Some of the equations in Table 5 are not appropriate to be used here because they are derived for the primary forest, for instance, Rai and Proctor (1986), Yamakura et al. (1986), Brown (1997), Basuki et al. (2009). These equations should be deleted from the study.

Table 5 also listed the five equations developed from the study and all yielded different estimates of AGB and C stock, thus which one is the most acceptable estimates?

Recommendation: Revisions Required

Biodiversitas Journal of Biological Diversity



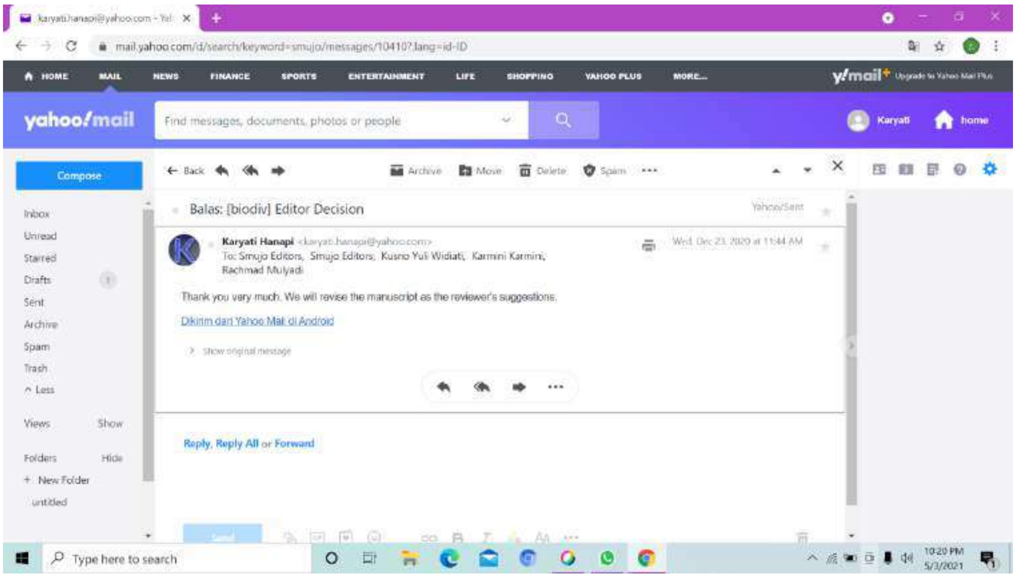
Line 318 – 408: The discussion becomes complicated and confusing when so many equations were used to estimate the AGB and C stock. Surely different equations will yield different figures. So what the purpose of this discussion? So which equation is to be used for AGB estimation? There so many AGB and C stock estimates, so which one is the correct one?

Line 432: Some of the equations in Table 5 are not appropriate to be used here because they are derived for the primary forest, for instance, Rai and Proctor (1986), Yamakura et al. (1986), Brown (1997), Basuki et al. (2009). These equations should be deleted from the study.

Table 5 also listed the five equations developed from the study and all yielded different estimates of AGB and C stock, thus which one is the most acceptable estimates?

Recommendation: Revisions Required

Biodiversitas Journal of Biological Diversity



Balas: [biodiv] Editor Decision

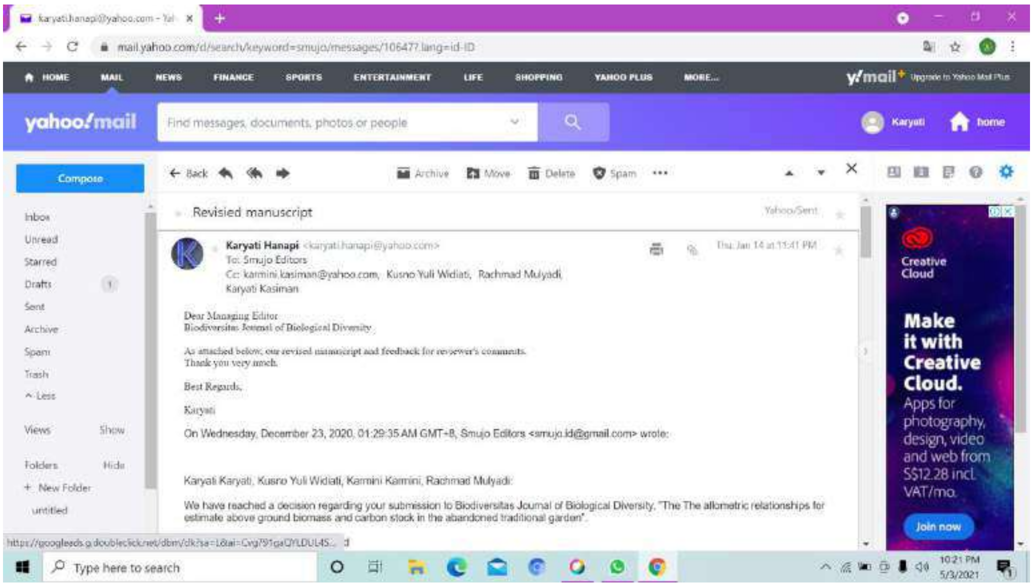
Karyati Hanapi <karyati.hanapi@yahoo.com>
To: Smujo Editors, Smujo Editors, Kusno Yuli Widiati, Karmini Karmini, Rachmad Mulyadi

Wed, Dec 23, 2020 at 11:44 AM

Thank you very much. We will revise the manuscript as the reviewer's suggestions.

Dikirim dari Yahoo Mail di Android

Reply, **Reply All** or **Forward**



Revisied manuscript

Karyati Hanapi <karyati.hanapi@yahoo.com>
To: Smujo Editors
Cc: karmini.kasiman@yahoo.com, Kusno Yuli Widiati, Rachmad Mulyadi, Karyati Kasiman

Thu, Jan 14 at 11:41 PM

Dear Managing Editor
Biodiversitas Journal of Biological Diversity

As attached below, our revised manuscript and feedback for reviewer's comments.
Thank you very much.

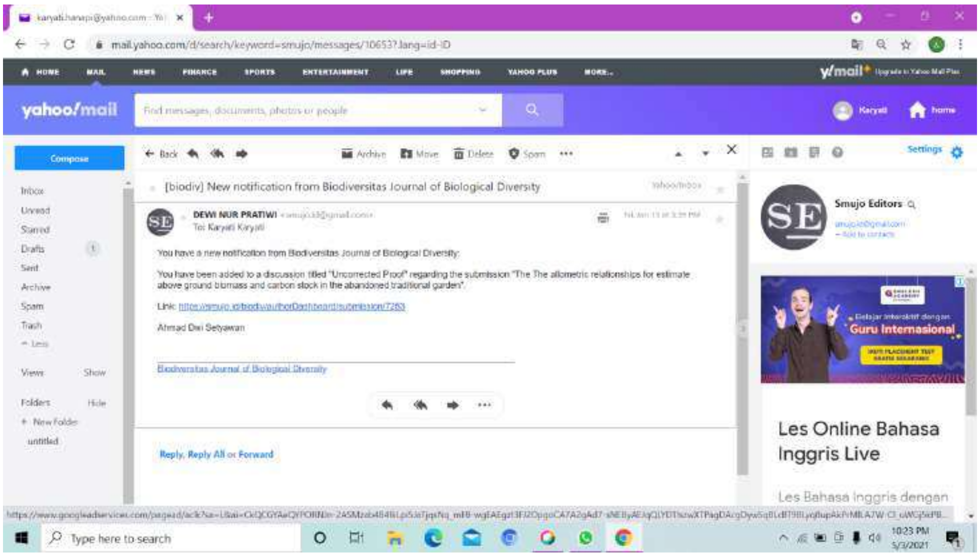
Best Regards,

Karyati

On Wednesday, December 23, 2020, 01:29:35 AM GMT+8, Smujo Editors <smujo.id@gmail.com> wrote:

Karyati Karyati, Kusno Yuli Widiati, Karmini Karmini, Rachmad Mulyadi:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "The The allometric relationships for estimate above ground biomass and carbon stock in the abandoned traditional garden".



[biodiv] New notification from Biodiversitas Journal of Biological Diversity

DEWI NUR PRATIWI <smujo.id@gmail.com>
To: Karyati Karyati

Fri, Jan 15 at 3:39 PM

You have a new notification from Biodiversitas Journal of Biological Diversity:

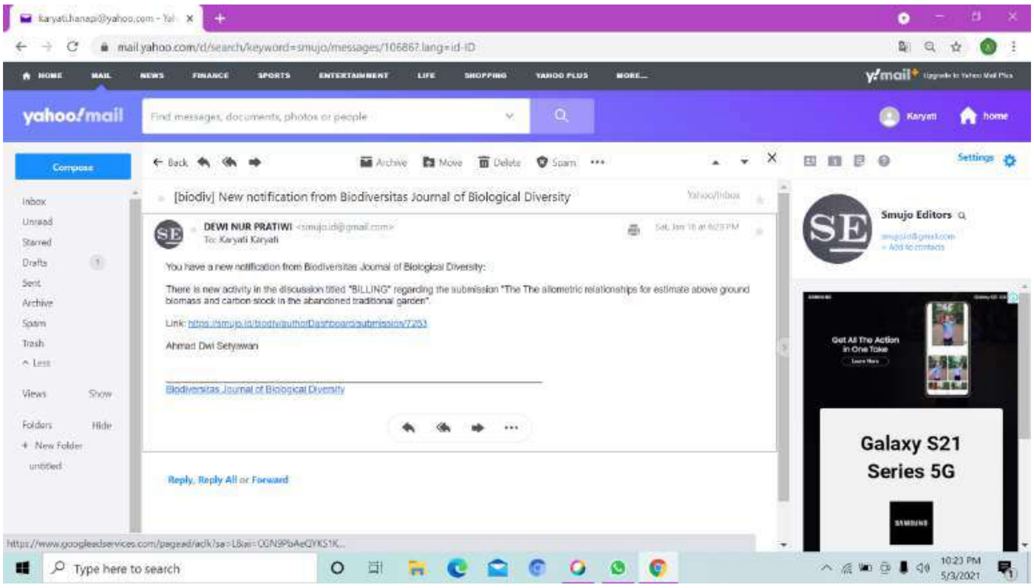
You have been added to a discussion titled "Uncorrected Proof" regarding the submission "The The allometric relationships for estimate above ground biomass and carbon stock in the abandoned traditional garden".

Link: https://smujo.id/biodiv/authorDashboard/submission/7263

Ahmad Dwi Setyawan

Biodiversitas Journal of Biological Diversity

Reply, Reply All or Forward



[biodiv] New notification from Biodiversitas Journal of Biological Diversity

DEWI NUR PRATIWI <smujo.id@gmail.com>
To: Karyati Karyati

Sat, Jan 16 at 6:23 PM

You have a new notification from Biodiversitas Journal of Biological Diversity:

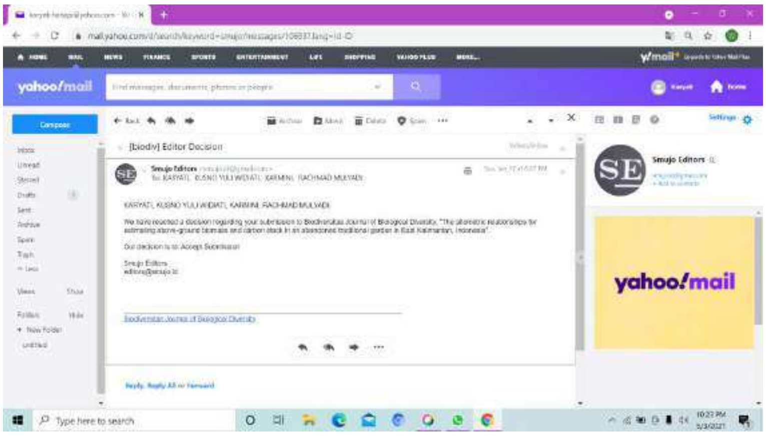
There is new activity in the discussion titled "BILLING" regarding the submission "The The allometric relationships for estimate above ground biomass and carbon stock in the abandoned traditional garden".

Link: https://smujo.id/biodiv/authorDashboard/submission/7263

Ahmad Dwi Setyawan

Biodiversitas Journal of Biological Diversity

Reply, Reply All or Forward



[biodiv] Editor Decision

Smujo Editors
To: KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI

KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI:

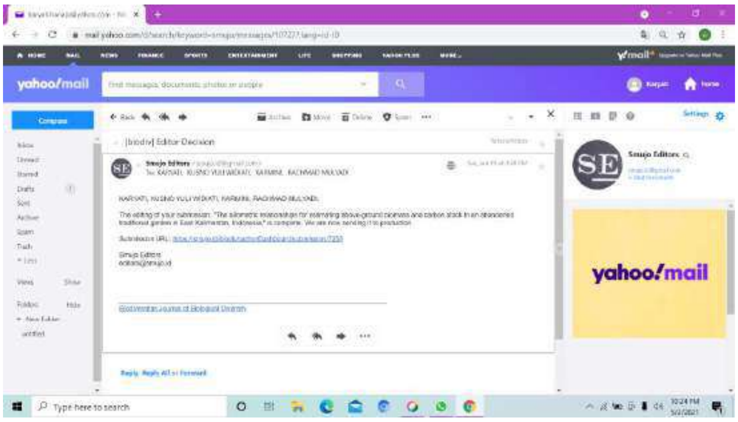
We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, Indonesia".

Our decision is to: Accept Submission

Smujo Editors
editors@smujo.id

Biodiversitas Journal of Biological Diversity

Reply, Reply All or Forward



[biodiv] Editor Decision

Smujo Editors
To: KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI

KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI:

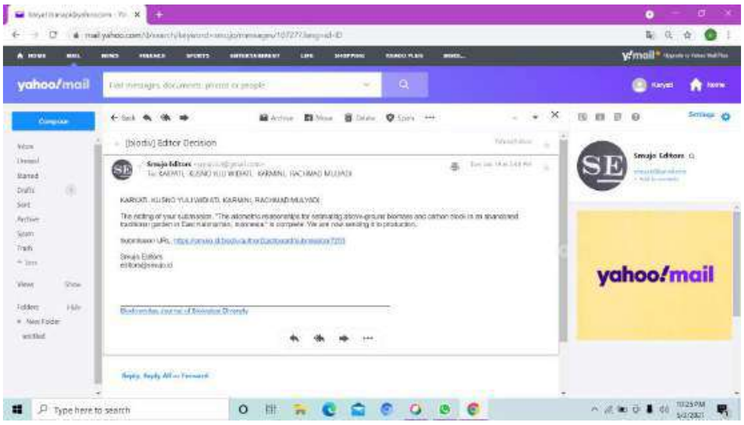
The editing of your submission, "The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, Indonesia," is complete. We are now sending it to production.

Submission URL: https://smujo.id/biodiv/author/Dashboard/submission/7253

Smujo Editors
editors@smujo.id

Biodiversitas Journal of Biological Diversity

Reply, Reply All or Forward



[biodiv] Editor Decision

Smujo Editors
To: KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI

KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI:

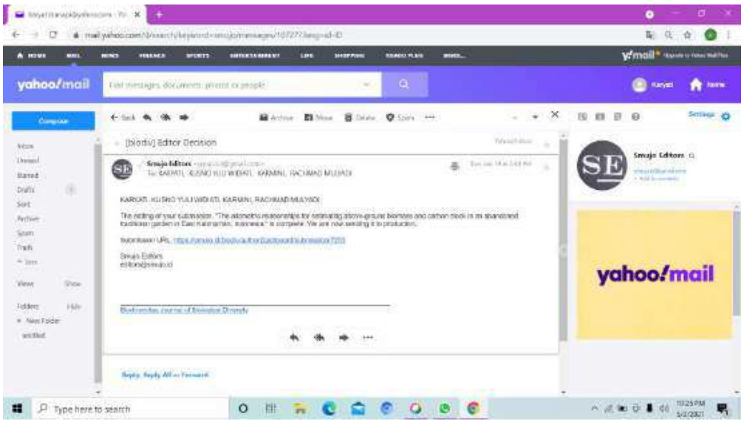
The editing of your submission, "The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, Indonesia," is complete. We are now sending it to production.

Submission URL: https://smujo.id/biodiv/author/Dashboard/submission/7253

Smujo Editors
editors@smujo.id

Biodiversitas Journal of Biological Diversity

Reply, Reply All or Forward



[biodiv] Editor Decision

Smujo Editors
To: KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI

KARYATI, KUSNO YULI WIDIATI, KARMINI, RACHMAD MULYADI:

The editing of your submission, "The allometric relationships for estimating above-ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, Indonesia," is complete. We are now sending it to production.

Submission URL: https://smujo.id/biodiv/author/Dashboard/submission/7253

Smujo Editors
editors@smujo.id

Biodiversitas Journal of Biological Diversity

Reply, Reply All or Forward

Dear Managing Editor
Biodiversitas Journal of Biological Diversity,

We would like to say thanks and appreciate for constructive suggestions from reviewers.

As attached below, our feedback for the reviewer's comments on our manuscript entitled "The allometric relationships for estimating above ground biomass and carbon stock in an abandoned traditional garden"

No.	Page/ Line	Review	Feedback and revision
Reviewer A			
1		Most of the comments provided in the track change side bar, please read it carefully	Done.
2		1. Authors are requested not to repeat in text what has been presented in table, instead comparative inferences may be made	Done.
3		2. Consistency needed in mentioning of AGB and TAGB, any one of it should be chosen.	Done. We've chosen to use "AGB".
4		3. total height/ bole height measurements mentioned as "cm3 m", is it cubic centimeter per meter? is volume mentioned here or height? please clarify	We use the unit for total height /bole height is m (meters) and did not calculate the volume in this study.
5		4. Go through the manuscript once again after completion of the revisions	Done.
6	P2/L102	Comment 1: It is preferred to include make and model of the instrument along with its sensitivity	We've revised sentence "appropriate scales" with "digital balance of precision at least 1 gram".
7	P3/L116	Comment 2: It is preferred to include make and model of the instrument along with its sensitivity	We've added sentence "of precision at least 0.01 grams".
8	P3/L139	Comment 3: Only the **original reference** where the formula was proposed may be required, whole list is not necessary	We've changed the references to IPPC (2008). We've also corrected all carbon stock calculations (Table 5).
9	P7/L305	Comment 4: Full reference not found, please insert it	We've inserted the reference.
10	P8/L345	Comment 5: Full reference not found, please insert it	We've inserted the reference.
11	P10/L431	Comment 6: Indicate in the first instance what 'Mg' stands for	We've given understanding of 'Mg'.
12	P10/L461-462	Comment 7: How can we infer which was the pioneer species in the current case? Which species is it? All of a sudden pioneer species concept cannot be introduced, please delineate appropriately in introduction, materials and methods	We had revised the sentences.
13	P13/L559-560	Comment 8: DOI not valid, please check	We've provided online link.
14	P13/L579	Comment 9: Please provide online link for the document, if any	Online link not available.
15	P13/P592-594	Comment 10: Please provide online link for the document, if any	We've provided online link.

No.	Page/ Line	Review	Feedback and revision
16	P13/L595-597	Comment 11: Please provide online link for the document, if any	This reference is not used.
Reviewer B			
General comments			
17	P9, P14	This study yielded five different estimates of AGB and C stock, which one is the most accurate?	We've selected the one most accurate equation for each tree dimension variable (DBH, $DBH^2 \times Ht$, or $DBH^2 \times Hb$) and dry biomass variable (branch, trunk, or AGB) (Tables 3 and 4).
18		1. Suggestion of title/topic change 'Allometric relationships for aboveground biomass and carbon stock estimation in abandoned traditional gardens.	Article title becomes "The allometric relationships for estimating above ground biomass and carbon stock in an abandoned traditional garden in East Kalimantan, Indonesia".
19	P2	2. The study was done in a secondary forest of abandoned traditional gardens. What is 'traditional gardens'? Different people from different places interpret traditional gardens differently. Please provide the meaning or definition of 'traditional gardens'.	We've provided definition of 'traditional garden' in the subtopic 'study site'
20	P2	3. Study site information should include (i) annual rainfall, (ii) topography, (iii) soil type, (iv) temperature, (v) previous land use, (vi) distance of study area with Samarinda City	We've added that information
21	P2	4. Data on demographic and population of East Kalimantan are not relevant to the subtopic 'study site'.	We've deleted that information
22	P12	5. Conclusion of the paper/study is required.	We've added 'conclusion'.
23	P1	6. Allometric models previously established for Kalimantan were not discussed. It should be discussed and justify why this study should be conducted.	We've added that information.
Specific comments			
24	P1	**Line 22 – 25:** Consider revising the sentences. These two sentences were not related. The first sentence was about sustainable forest management. The second sentence mention agriculture expansion. Sentences in a paragraph must be connected or linked.	We've added the sentence between the two sentences.
25	P1	**Line 26:** ..tree "fragment"…should be written as tree components.	We've revised this word.
26		**Line 29:** ….'above ground' biomass…should be spelt aboveground biomass.	We've fixed all the words 'above ground' to be 'aboveground'.
27	P2	**Line 40 - 45:** ….calculating AGB for the secondary forest on abandoned traditional gardens land….(i) What is the significance	We've added the explanation.

No.	Page/ Line	Review	Feedback and revision
		of secondary forest on abandoned traditional gardens? Was the land that had been used for farming or rice cultivation what (ii) There already several developed equations for estimating AGB for secondary forests, why is it important to conduct this study?	
28	P2	**Line 48 – 59:** Demographic and population information are not relevant here. What is more relevant and important are information on i) annual rainfall, (ii) topography, (iii) soil type, (iv) temperature, (v) previous land use, (vi) distance of study area with Samarinda City	We've deleted information about demographic and population. We've also added information about climate, previous land use, and distance of study area with Samarinda City.
29	P2	**Line 80 – 86:** Legend of the map is too small, difficult to see what are they?	The font size in the legend of Figure 1 is adjusted. We will enlarge Figure 1.
30	P3	**Line 91**: Why chose 30 trees? What are the criteria for choosing 30 samples of trees?	We've added the explanation.
31	P3	**Line 124 – 125**: Why determine the relationship between DBH and height? Since height is not going to be used in equations (3), (4) and (5)?	We need to determine relationship between DBH and height because in equations (3), (4), and (5) the variable 'x' = diameter at breast height (DBH, cm), tree total height (Ht, meter), tree bole height (Hb, meter), and (DBH^2×H) (cm^2 m).
32	P4	**Line 144 – 147**: Results on the relationship between DBH and height should be deleted. The r^2 are very low anyway, so no relationship between DBH and height.	We've deleted the R^2. We've also revised Figure 3.
33	P4-5	**Line 137 – 143 also line 158 – 180**: The figures and statements of the bar charts were given. However, there was no discussion about them. How these data contribute to the topic of this study are also puzzling. Consider adding discussion regarding the data and relate these data to the study of AGB.	We've added the discussion.
34	P5	**Line 205**: Add 'respectively' after 216.99 kg….i.e. …..219.66 kg, respectively.	We've added word 'respectively'.
35	P6	**Line 215:** Why carry out analyses of relationship or correlation between wood density and height? These two parameters do not in any way related. All results on wood density and tree height relationship in this study should be deleted.	We've deleted that sentence.
36	P6	**Line 223 – 224**: What is meant by this sentence. There is no data on Important Value Index (IVI) in this study? Why use IVI for developing equation. To have an accurate allometric equation we must use all the samples trees. The more trees the better the equation.	We selected sample trees to developing allometric equations based on the vegetation survey that was carried out in previous studies (Karmini et al. 2020b). The selected trees represent the dominant and rare trees (in terms of IVi values) and DBH distribution in the study plot.
37	P9	**Line 279 – 280**: Choosing the best equation using r*2* and the P-value is not sufficient.	We've added the root mean squared error (RMSE) criteria to choose the best equation

No.	Page/ Line	Review	Feedback and revision
		The usual method to select the best equation is using the root mean squared error (RMSE) and Akaike's Information Criterion (AIC) criteria. The equation that has the smallest RMSE and AIC value are selected as the best allometric equation.	(Table 3).
38	P13-14	**Line 318 – 408:** The discussion becomes complicated and confusing when so many equations were used to estimate the AGB and C stock. Surely different equations will yield different figures. So what the purpose of this discussion? So which equation is to be used for AGB estimation? There so many AGB and C stock estimates, so which one is the correct one?	We've selected an equation to estimate AGB and C stock by using DBH as well as (DBH^2×Ht) (Table 4).
39	P13-14	**Line 432**: Some of the equations in Table 5 are not appropriate to be used here because they are derived for the primary forest, for instance, Rai and Proctor (1986), Yamakura et al. (1986), Brown (1997), Basuki et al. (2009). These equations should be deleted from the study. Table 5 also listed the five equations developed from the study and all yielded different estimates of AGB and C stock, thus which one is the most acceptable estimates?	We've deleted equations of Rai and Proctor (1986), Yamakura et al. (1986), Brown (1997), Basuki et al. (2009). We've selected two equations to estimate AGB and C stock by using DBH and (DBH^2×Ht) variables (Table 4).

Samarinda, 14 January 2021

Karyati

The allometric relationships for estimating~~e~~ above~~-~~ground biomass and carbon stock in an~~the~~ abandoned traditional garden in East Kalimantan, Indonesia

Abstract. *Karyati, Widiati KY, Karmini, Mulyadi R. 2021~~0~~. The allometric relationships for estimat~~e~~ing above~~-~~ground biomass and carbon stock in ~~the~~ an abandoned traditional garden in East Kalimantan, Indonesia. Biodiversitas x: xx-xx.* The existence of traditional gardens after abandonment process have a role based on ecological and economic aspects. ~~A specific allometric equation~~ T~~t~~o estimate the biomass and carbon stock in the abandoned traditional gardens, specific allometric equations are~~is~~ required. The aim of this study was to develope~~d~~ allometric equations to estimate biomass of plant parts (leaf, branch, trunk, and ~~total~~ above~~-~~ground biomass (~~T~~AGB)) through tree dimensions variables (diameter at breast height (DBH), total tree height, and tree bole height). The relationships between stem biomass, ~~and T~~AGB and tree dimensions were very strong indicated by the relatively high adjusted R^2 value. The moderately strong relationships were shown between branch biomass and tree dimensions, meanwhile the relationship between leaf biomass and tree dimensions was very weak. The specific allometric equations for estimating biomass and carbon stocks that are suitable for tree species and/~~-~~or forest stands at a particular site are very useful for calculating the carbon stocks and sequestration. The appropriate biomass and carbon stock calculation is needed to determine policies related to global climate change.

Key words: ~~Abandoned land, allometric equation, biomass,~~ Bukit Pinang area, destructive method, regression, tropics, wood

Running title: Allometric equations for abandoned traditional garden

INTRODUCTION

Sustainable forest management plays an important role in increasing the resilience of ecosystems and communities, optimizing the benefits of trees in the forest to absorb and store carbon, and provide other environmental services (FAO 2016). One of the causes of the increase in secondary forest area is the use of forests for agricultural purposes (Lanly 1982). Agricultural expansion is the main cause of reduction of~~ed~~ forested areas, on the other hand, addition~~al~~ of forested area may~~can~~ also occur due to natural expansion of forests, e.g., ~~for example~~ ecological succession on~~f~~ abandoned agricultural land, or through reforestation or afforestation activities (FAO and UNEP 2020). Most of the above~~-~~ground biomass (AGB) in tropical forests is stored in tree ~~fragments~~components. Tree biomass is described as ~~description of~~ wood volume which is influenced by tree diameter and height, physiognomy, and wood density (Vieira et al. 2008). In addition, tree biomass varies from region to region where its ~~the amount of~~ content varies according to ~~is influenced by~~ species density, climatic factors, and soil properties (Agevi et al. 2017). The difference in above~~-~~ground biomass values ~~in~~ of a secondary forest area with other areas is due to difference~~t~~ in ~~types of~~ disturbance and~~,~~ recovery time~~, and different types of natural forest~~ (Stas 2011).

The application of allometric models to estimate above~~-~~ground biomass in the tropical forests is required ~~in research~~ for studying ~~on~~ carbon storage and exchange (Vieira et al. 2008). The use of different allometric models will result in variations in the calculation of the amount of biomass in secondary forest. This shows that the allometric model is very specific ~~based on~~ for location and forest type (Stas 2011). One of the reasons for the formation of secondary forest i~~s~~n abandoned and undisturbed traditional gardens is that they have not been managed by the owner for a long time. The existence of abandoned land with a history of land use after shifting cultivation and traditional gardening has high ecological and economic value (Karmini et al. 2020a; Karmini et al. 2020b; Karyati et al. 2013; Karyati et al. 2018).

Apart from its ecological and economic roles, abandoned land after shifting cultivation in the tropics also has a high potential for carbon sequestration through biomass in tree parts. Several previous studies have built allometric equations to estimate aboveground biomass in secondary forest with mixed types in East Kalimantan Province (Hashimoto et al. 2004; Kiyono and Hastaniah 2005; Basuki et al. 2009). In addition, ~~A~~allometric equations for estimating above~~-~~ground biomass on abandoned land formed after shifting cultivation in Kalimantan have already been reported (Karyati et al. 2019a; 2019b). The area of secondary forest that was previously used as traditional gardens and then not properly managed or

Field Code Changed

Field Code Changed

Field Code Changed

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

tends to be abandoned is increasing. These traditional gardens were owned by individuals or local residents and previously planted with various types of fruit trees and multi-purpose tree species (MPTS). However, still limited studies which focused on the allometric equation to estimate above-ground biomass in abandoned traditional garden, the equation for calculating above-ground biomass specifically used for secondary forest on abandoned traditional garden land is deemed necessary. This study aims to develop allometric equations to estimate above-ground biomass and carbon stock in abandoned traditional gardens in the tropics. Information on allometric equations specifically for estimating above-ground biomass and carbon stock in abandoned traditional gardens can be used as consideration and decision-making in the management of the large number of traditional gardens in tropical areas in general, especially East Kalimantan.

MATERIALS AND METHODS

Study site

The study was carried out on an abandoned land in Bukit Pinang area, Samarinda Ulu sub district, Samarinda City, East Kalimantan Province, Indonesia. The study site was an abandoned traditional garden more than 44 years ago.

Traditional garden is defined as land planted with various beneficial trees that can be integrated into forest ecosystems such as fruit and other multi-purpose tree species (MPTS) that are owned and managed by individuals or local residents. The study plot was located at the coordinate points of $0^{\circ}25'32.8''$S $117^{\circ}05'56.8''$E (Figure 1). The same sites had been studied previously for ecological and economic value (Karmini et al. 2020b). During 20 years (2009-2019), the study site receives average annual 2,306.7 mm year-1 of rainfall, 27.75°C of average temperature, and 81.64% of average relative humidity (BMKG 2020). A total of 56.51% of the total area of 71,800 ha of Kota Samarinda is included in the slope class of less than 15%, followed by slope class 15- <25% (14.81%), 25-40% (15.67%), and> 40% (13.02%) (BPS Kota Samarinda 2020). According to the Schmidt-Ferguson classification system (1951), the climate of Samarinda City is characterized as type A with Q (Quotient) of 8.9% where very humid area with vegetation of tropical rain forest. The study site is situated approximately 20 km southeast, half an hour drive, from Samarinda City. The previous land use history was also traditional garden as informed by land owners. ~~As the capital city of East Kalimantan Province, Samarinda City has an area of 718 km^2 with a population of 872.768 people consisting of 451.099 male and 421.669 female. The sex ratio of population is 106.979. The area of Samarinda City is only 0.56 percent of the area of East Kalimantan Province, making this city the third smallest area after Bontang City and Balikpapan City. The boundaries of Kota Samarinda are entirely surrounded by Kutai Kartanegara Regency. Samarinda City consists of 10 districts, 59 sub-districts, and 1989 neighborhood association. City dwellers Samarinda is experiencing growth of 0.017 percent compared to 2018. Population density in Samarinda in 2019 reached 1,216 people/ km^2 (BPS 2020).~~

Data collection

Assessment on biomass in the field

A total of 30 tree samples with DBH of > 10 cm were selected to representive species and DBH classes in abandoned traditional garden land (Table 2). The determination of 30 sample trees is considered sufficient to represent the population of the number of trees in the study location to create an allometric regression equation. The number of trees with DBH>5 cm were 192 trees in the 0.4 hectare research plot (Karmini et al. 2020b). The diameters at breast height (DBH) of standing sample trees were measured using standard diameter tape. The felling of sample trees was done by chainsaw following proper harvesting rules. After the tree had fallen, the measurement of total height and bole height were conducted by using tape. Following the procedure of BSN (2011) the trunk of the fallen trees were divided into several fractions where each fraction measured 1 meter in length. Furthermore, the tree parts were separated into leaves, branches and trunks

The fresh weight of all fractions of tree parts were weighed using digital balance of precision at least 1 gram at the earliest after felling of the trees in the field. To calculate the dry weight of tree trunks, three samples of 2-5 cm thick stem disks were taken when the felled trees had less than 10 fractions, and four disk samples were taken when there were more than 10 fractions. Further, five samples of branches with a length of 20-30 cm and five samples of leaves weighing 100-300 grams each were collected from each sample tree. For the purposes of measuring the density of wood for each sample tree, samples of stem disks were also taken and fresh weight measured in the field.

Formatted: Not Highlight

Formatted: Superscript

Formatted: Not Highlight

Formatted: Indent: First line: 0"

Comment [Rev1]: It is preferred to include make and model of the instrument along with its sensitivity

Comment [KK2]: We've revised sentence "appropriate scales" with "digital balance of precision at least 1 gram".

Formatted: Indent: First line: 0"

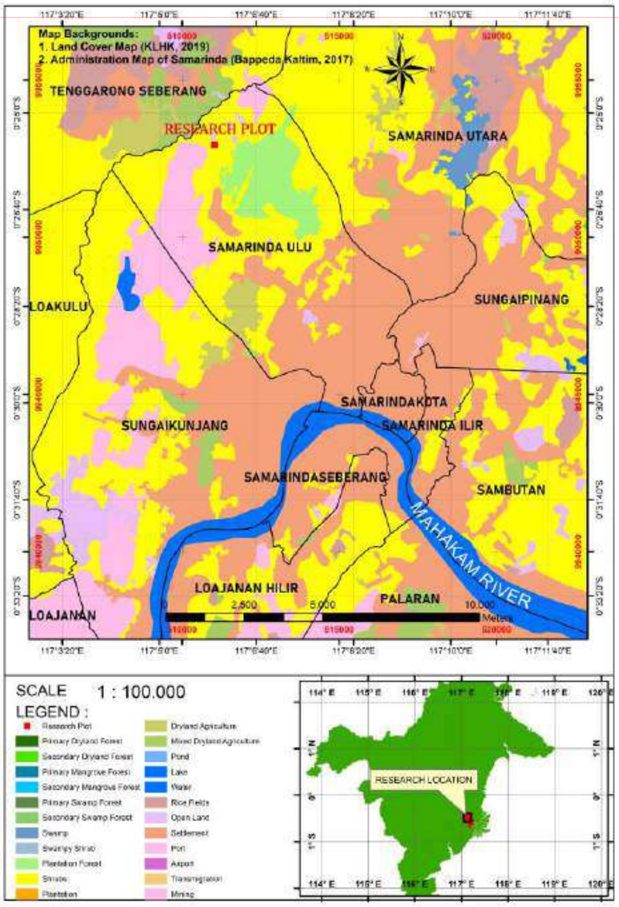


Figure 1. Map of study site in Bukit Pinang area, Samarinda, East Kalimantan Province, Indonesia.

~~Data collection~~

~~Assessment on biomass in the field~~

~~A total of Thirty 30 sample trees samples with DBH of > 10 cm were selected to representive the composition species and DBH classes in abandoned traditional garden land (Table 2). The diameters at breast height (DBH) of standing sample trees were measured using standard diameter tape. The felling of sample trees was done by chainsaw following proper harvesting rules. After the tree had fallen, the measurement of total height and bole height were conducted by using tape. Following the criteria of Ministry of Forestry Indonesia (2011) Tthe trunk of the fallen trees is were divided into several fractions where each fraction measuresd 1 meter in length. Furthermore, the tree parts weare separated into leaves, branches and trunks. The division of the tree part sample fractions follows the criteria by Ministry of Forestry Indonesia (2011).~~

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

~~The fresh weight of all fractions of tree parts were weighed using appropriate scales at the earliest after felling of the trees as soon as possible after the sample tree was felled in the field. To calculate the dry weight of tree trunks, three samples of stem disks 2-5 cm thick stem disks were taken when the if the trees felled trees had less than 10 fractions, and four disk samples were taken when if there were more than 10 fractions. Further, Ffive samples of branches with a length of 20-30 cm and five samples of leaves weighing 100-300 grams each were collected forom each sample tree. For the purposes of measuring the density of wood for each sample tree, a samples of stem disks wereas also taken and fresh weight was measured in the field.~~

Analysis of dry-weight in the laboratory

All samples of stem and branch fractions were dried in an oven in the laboratory at 105°C for 96 hours until constant weight was achieved. Meanwhile, leaf samples were roasted in an oven at 80°C for 48 hours until their weight was constant. After drying in the oven, the process of weighing all samples of leaf, branch and stem fractions wa~~i~~s carried out a~~s~~t the earliest ~~soon as possible~~ using a digital analytical balance of precision at least 0.01 grams.

Wood density was measured for each dis~~c~~k sample that was taken using the water-displacememt method (Bowyer et al. 2003; Chave 2006). The saturated volume of each sample wa~~i~~s measured using a container filled with water and ~~the weight is~~ weighed using a digital scale that ha~~s~~d a precision of at least 0.01 grams. Weighing of ~~O~~oven dried~~y~~ ~~weight of the~~ sample ~~i~~was carried out by drying the sample in a well-ventilated oven at 105°C for 48-72 hours until it reache~~s~~d a constant weight.

Data analysis

The wood density of each disk sample was determined using the formula (Bowyer et al. 2003; Chave 2006; Marklund 1986):

$$WD = dw / V \qquad (1)$$

The total oven-dry weight of each tree parts were measured using the following formula (Hairiah et al. 2001; Hairiah & Rahayu 2007; ~~Ministry of Forestry Indonesia~~ BSN2011):

$$dw = (sdw \times fw) / sfw \qquad (2)$$

where: WD = wood density (g cm^{-3}); dw = total dry weight (kg); V = saturated volume (cm^3); sdw = dry weight of the sample (g); fw = total fresh weight (kg); sfw = fresh weight of the sample (g).

The three selected allometric equations of AGB were tested (Equations 3-~~5~~4):

~~$y = a + b\,x$ (3)~~

$y = ax^b$ (~~4~~3)

$(\ln y) = a + b\,(\ln x)$ (~~5~~4)

where: y = total dry weight or biomass of each plant part, such as trunk, branch, leaf, and ~~total~~ above~~-~~ground biomass (~~T~~AGB) (kg); x = diameter at breast height (DBH, cm), tree total height (Ht, meter), tree bole height (Hb, meter), and (DBH^2×H) (cm^2 m); ‘a’ and ‘b’ = coefficients estimated by regression.

~~The best regression was selected based on the goodness of fit with focusing on the suitable scatter plot, good *P* value and the high value of adjustedusted R^2 among all tested regressions. All r~~Regression analysis was carried out using SPSS version 18 for windows (SPSS Japan, Tokyo, Japan). The evaluation of precision among all tested allometric equations were determined by R^2 value and *P* value. The best regression was selected based on the goodness of fit with focusing on the suitable scatter plot, good *P* value, ~~and~~ the high value of adjusted~~usted~~ R^2, and the smallest root mean squared error (RMSE0 among two~~all~~ tested regressions.

Accumulation of carbon stock were estimated using the following formula (~~Brown 1997; Brown and Lugo 1982; Cannell and Milne 1995; Dixon et al. 1994; Lamlom and Savidge 2003; Lasco et al. 2001; Morikawa et al. 2001~~IPPC 2008):

Carbon stock = ~~Total~~ AGB × 0.~~50~~47 (~~6~~5)

RESULTS AND DISCUSSION

Selected samples of trees

~~A total of 30 trees with a DBH of ≥ 10 cm were felled and their biomass measured to develop allometric equations in the study site as presented in Table 2.~~ The distributions of DBH classes, total height classes, bole height classes, and wood density classes of sample trees to developed allometric equations are illustrated in Figure 2 and Table 2. 10, 8 and 7 ~~The~~ number of sample trees had ~~in~~ DBH class~~es~~ distribution in the range of 15.1-20.0 cm, 10.0-15.0 cm, and 25.1-30.0 cm were 10, 8, and 7 trees, respectively. ~~Meanw~~While, ~~three~~3 and ~~two~~2 sample trees were belonging to DBH classes of 20.1-25.0 cm and ≥30.0 cm respectively. The number of selected trees were~~as~~ dominated by total height class 10.1-15.0 m (11 trees), followed by total height class 5.0-10.0 m (10 trees) and ≥15.0 m (9 trees). The bole height class was distributed into three classes, i.e., ~~namely~~ 5.1-8.0 m (12 trees), ≥8.0 m (10 trees), and 2.0-5.0 m (8 trees). The wood density classes of the

Comment [Rev3]: It is preferred to include make and model of the instrument along with its sensitivity

Comment [KK4]: We’ve added sentence “of precision at least 0.01 grams”.

Comment [Rev5]: It is preferred to include make and model of the instrument along with its sensitivity

Comment [KK6]: We’ve added sentence “of precision at least 0.01 grams”.

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Font color: Red

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Comment [Rev7]: Only the **original reference** where the formula was proposed may be required, whole list is not necessary

Comment [KK8]: We’ve changed the references to IPPC (2008). We’ve also corrected all carbon stock calculations (Table 5).

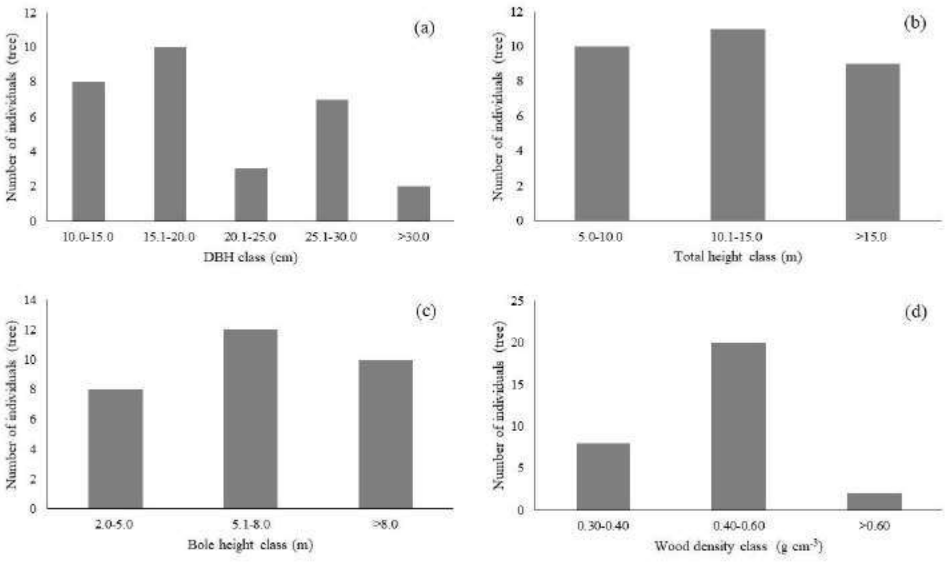
Formatted: Not Highlight

Formatted: English (U.S.)

sample trees were divided into 0.4-0.6 cm g^{-3} (20 trees), 0.3-0.4 cm g^{-3} (8 trees), and $\geq$0.60 cm g^{-3} (2 trees). The relationships between DBH-total height and DBH-bole height of sample trees which were~~to~~ developed into allometric equations were illustrated in Figure 3.

The increase in DBH (cm) of sample trees was followed by an increase in total height and bole height as described in Figure 3.The relationship between DBH and total height wa~~i~~s explained by the equation "Ht=0.3658(DBH)+4.9457" (n=30~~; R^2=0.4763~~), while the relationship between DBH and bole height wa~~i~~s "Hb=0.0975(DBH)+4.5065" (n=30~~; R^2=0.1042~~),~~.~~ where, ~~As stated~~ Ht ~~is~~= total height (m)~~, DBH is diameter at breast height (cm),~~ and Hb =~~is~~ bole height (m).

The largest number of sample trees was in the diameter distribution class (15.1-20.0 cm), the total height class (10.1-15.0 m), the bole height class (5.1-8.0 m), and wood density (0.40-0.60 g cm-3). In general, the larger the tree size both in diameter and height, the aboveground biomass and individual carbon stocks tend to be higher. There is a positive correlation between tree height and aboveground biomass as well as the relationship between height and diameter of trees and lianas in early succession (Selaya et al. 2007). The amount of carbon sequestrated in a forest changes constantly according to growth, mortality, vegetation decomposition (Gorte 2007), species composition, age structure and forest health (Harmon et al. 1990). Conversely, wood basic density is not a significant predictor of AGB in species-specific models, implying that the variation in wood basic density within a species is narrow (Tetemke et al. 2019).



Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Indent: First line: 0"

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: Indent: First line: 0.2"

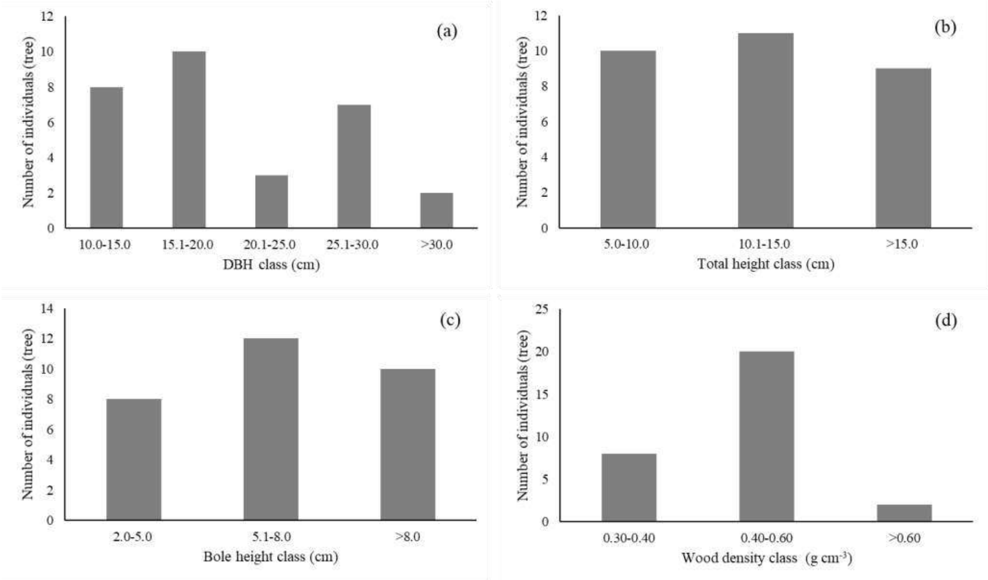


Figure 2. The distributions of (a) DBH classes, (b) total height classes, (c) bole height classes, (d) wood density classes of sample<u>d</u> trees~~ to developed allometric equations~~.

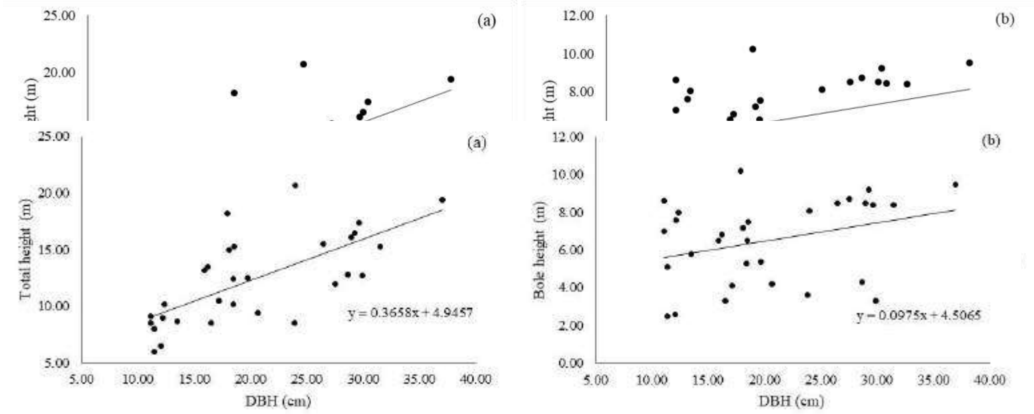


Figure 3. The relationship between (a) DBH and total height, (b) DBH and bole height of sample<u>d</u> trees<u>.</u>~~ to developed allometric equations.~~

Tree variables

The biomass of leaves, branches, stems, and ~~T~~AGB of the selected sample trees ranged from 3.32-24.07 kg, 6.57-50.65 kg, 18.47-146.17 kg, and 28.83-216.~~-~~99 kg<u> respectively</u>. The selected sample trees had a DBH range of 11.14-37.00 cm, a total height of 6.00-20.70 m, a bole height of 2.5-10.20 m, and a wood density of 0.30-0.77 g cm^{-3}. The Pearson's correlation <u>coefficients </u>between DBH, total height, bole height, wood density and leaves biomass, branches biomass, trunk biomass, ~~T~~AGB and parameters of destructive biomass are summarized in Table 1. All biomass of tree parts (leaves, branches, trunk, and total biomass) had a strong correlation with DBH (*P*<0.01). In line with these results, branch, trunk and ~~T~~AGB also strongly correlated with total tree height (P<0.01), except that there was no correlation between leaf biomass and tree total height.

The results showed that there was no correlation between the biomass of all tree parts (leaves, branches, stems, and total biomass) on bole height and wood density. The relationship between tree parameters showed that the correlation between DBH - total height and total height - bole height was very strong (P<0.01). ~~Similarly, there was a correlation between total height and bole height to wood density (P<0.05). On the other hand, the relationships between DBH to bole height and wood density weare not correlated~~.

Table 1. Results of Pearson's correlation between DBH, total height, bole height, wood density and leaves biomass, branches biomass, trunk biomass, ~~T~~AGB and parameters of destructive biomass. ns = not significant at the 0.05 level (P>0.05); * and ** = correlation significant at the 0.05 and 0.01 level (2-tailed) respectively.

	Pearson's correlation (n=30)				Mean	Standard Deviation	Range
	DBH (cm)	**Total height (m)**	**Bole height (m)**	**Wood density (g cm^{-3})**			
Leaf biomass (kg)	0.518**	0.286^{ns}	0.001^{ns}	-0.154^{ns}	9.40	6.50	3.32 – 24.07
Branch biomass (kg)	0.784**	0.529**	0.077^{ns}	-0.080^{ns}	27.26	13.65	6.57 – 50.65
Trunk biomass (kg)	0.911**	0.579**	0.316^{ns}	-0.176^{ns}	72.48	45.40	18.47 – 146.17
~~T~~AGB (kg)	0.904**	0.577**	0.252^{ns}	-0.165^{ns}	109.14	61.30	28.83 – 216.99
DBH (cm)	1	0.690**	0.323^{ns}	-0.275^{ns}	20.34	7.36	11.14 - 37.00
Total height (m)	0.690**	1	0.703**	-0.398*	12.39	3.90	6.00 - 20.70
Bole height (m)	0.323^{ns}	0.703**	1	-0.418*	6.49	2.22	2.50 – 10.20
Wood density (g cm^{-3})	-0.275^{ns}	-0.398*	-0.418*	1	0.47	0.10	0.30 - 0.77

~~Note: ^{ns} is not significant at the 0.05 level (P>0.05) ; * and **Correlation are significant at the 0.05 and 0.01 level (2-tailed) respectively~~

Folowing Karmini et al. (2020b) ~~T~~the sample tree species (both dominant and rare) sampled to develop allometric equation were selected in terms of Importance Value Index (IVI) ~~both dominant and rare trees in the study plot as reported by Karmini et al. (2020b)~~. The basis for selection wai~~i~~s also based on the representation of the DBH distribution. Thirty selected ~~sample~~ trees samples included 13 species from 10 genera from 8 different families. The four sample trees were *Trema orientalis* (Cannabaceae) as presented in Table 2. Three sample trees each belonged to ~~were identified as~~ *Vernonia arborea* (Asteraceae), *Macaranga tanarius* (Euphorbiaceae), *Artocarpus lacu~~koo~~cha* (Moraceae)~~,~~ and *Artocarpus odoratissimus* (Moraceae). The trees of *Oroxylum indicum* (Bignoniaceae), *Eusideroxylon zwageri* (Lauraceae), *Artocarpus tamaran* (Moraceae), *Baccaurea parvifolia* (Phyllanthaceae)~~,~~ and Glochidion obscurum (Pyllenthaceae) were selected two sample trees each, respectively. Four other species, namely *Macaranga gigantea* (Euphorbiaceae), *Mallotus paniculatus* (Euphorbiaceae), *Cratoxylum arborescens* (Hypericaceae)~~,~~ and *Artocarpus anisophyllus* (Moraceae) were selected for one sample tree each.

The different tree species tend to cause differences in tree structure and physiognomy in terms of growth, stratification and canopy cover (Karyati et al. 2019b), leading ~~. This will lead~~ to differences in the tree ~~parts~~ biomass (tree parts/ total)~~or the total biomass~~. The difference in biomass is also indicated by different tree individuals from the same species. The largest sample tree (*Artocarpus anisophyllus*) with DBH of 37.00 cm had the largest trunk biomass (146.17 kg) and ~~T~~AGB (216.99 kg) as well. On the other hand, *Macaranga tanarius* with DBH of 11.14 cm was the smallest sample tree having ~~containing~~ the smallest ~~leaf~~ biomass of leaves (3.32 kg) and branches ~~biomasaa~~ (6.57 kg) among the sampled trees. In addition, the smallest trunk biomass (18.47 kg) and ~~T~~AGB (28.83 kg) were observed from *Oroxylum anisophyllus* with DBH 11.14 as well. The highest total height (20.70 m) and bole height (10.20 m) were measured from two sample trees *Trema orientalis* with DBH of 24.00 cm and 17.92 cm, respectively. *Eusideroxylon zwageri* with DBH 11.46 cm wa~~i~~s the shortest tree based on total height and bole height. The largest leaf biomass (24.07 kg) was from the sample trees *Artocarpus lacu~~koo~~cha* (DBH of 29.28 cm), while the largest branch biomass (50.65 kg) was measured ~~shown by~~ from~~the sample tree~~ *Artocarpus tamaran* (DBH of 31.50 cm).

Table 2. Dataset of biomass, density and tree dimension variables derived from sampled trees ~~All data sets for develop allometric equations~~ in abandoned traditional garden ~~lands~~

Tree No.	Species	Family	DBH (cm)	Total height (m)	Bole height (m)	Leaves (kg)	Branches (kg)	Trunk (kg)	~~T~~AGB (kg)	WD (g cm^{-3})
1	*Artocarpus tamaran*	Moraceae	12.41	10.20	8.00	3.38	6.60	22.70	32.68	0.38
2	*Trema orientalis*	Cannabaceae	29.67	17.40	8.40	6.29	36.85	127.51	170.65	0.44
3	*Trema orientalis*	Cannabaceae	17.92	18.20	10.20	8.75	18.88	56.52	84.15	0.41
4	*Macaranga tanarius*	Euphorbiaceae	11.14	8.50	7.00	3.32	6.57	39.28	49.18	0.51
5	*Macaranga tanarius*	Euphorbiaceae	13.53	8.70	5.80	3.91	19.73	37.74	61.39	0.49
6	*Trema orientalis*	Cannabaceae	18.56	15.30	7.50	3.72	29.91	51.68	85.31	0.46
7	*Trema orientalis*	Cannabaceae	24.00	20.70	8.10	9.11	31.38	93.29	133.79	0.56

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Superscript

Formatted: Superscript

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Font: Italic

Formatted: Not Highlight

Formatted: Not Highlight

Tree No.	Species	Family	DBH (cm)	Total height (m)	Bole height (m)	Leaves (kg)	Branches (kg)	Trunk (kg)	~~T~~AGB (kg)	WD (g cm^{-3})
8	*Macaranga tanarius*	Euphorbiaceae	12.20	9.00	7.60	4.45	8.50	22.11	35.05	0.55
9	*Mallotus paniculatus*	Euphorbiaceae	18.50	12.40	6.50	6.09	24.13	37.93	68.15	0.51
10	*Artocarpus tamaran*	Moraceae	31.50	15.30	8.38	3.40	50.65	144.02	198.07	0.48
11	*Oroxylum indicum*	Bignoniaceae	16.23	13.50	6.80	4.02	8.94	28.64	41.59	0.46
12	*Oroxylum indicum*	Bignoniaceae	11.14	9.10	8.60	3.56	6.80	18.47	28.83	0.46
13	*Artocarpus anisophyllus*	Moraceae	37.00	19.40	9.50	24.05	46.77	146.17	216.99	0.47
14	*Artocarpus odoratissimus*	Moraceae	23.87	8.50	3.60	18.50	29.71	76.98	125.18	0.48
15	*Artocarpus odoratissimus*	Moraceae	16.55	8.50	3.30	17.80	27.56	53.07	98.43	0.45
16	*Artocarpus odoratissimus*	Moraceae	11.46	8.00	5.10	3.43	7.96	19.89	31.27	0.39
17	*Vernonia arborea*	Asteraceae	19.74	12.50	5.40	9.85	48.40	77.52	135.77	0.51
18	*Vernonia arborea*	Asteraceae	28.65	12.80	4.30	4.96	29.19	71.04	105.19	0.54
19	*Vernonia arborea*	Asteraceae	17.19	10.50	4.10	4.77	20.76	38.97	64.50	0.56
20	*Cratoxylum arborescens*	Hypericaceae	20.69	9.40	4.20	9.83	32.93	97.96	140.72	0.54
21	*Baccaurea parvifolia*	Phyllanthaceae	18.14	15.00	7.20	8.09	37.55	51.29	96.93	0.36
22	*Artocarpus lacu~~koo~~cha*	Moraceae	29.28	16.50	9.20	24.07	48.26	143.03	215.36	0.39
23	*Artocarpus lacu~~koo~~cha*	Moraceae	28.97	16.10	8.50	21.04	41.23	140.98	203.25	0.38
24	*Artocarpus lacu~~koo~~cha*	Moraceae	26.48	15.50	8.50	16.92	38.29	134.66	189.87	0.40
25	*Baccaurea parvifolia*	Phyllanthaceae	15.92	13.20	6.50	10.95	23.48	32.75	67.18	0.31
26	*Glochidion obscurum*	Phyllanthaceae	27.53	12.00	8.70	4.19	26.70	141.81	172.70	0.49
27	*Eusideroxylon zwageri*	Lauraceae	11.46	6.00	2.50	10.40	26.40	47.24	84.04	0.72
28	*Eusideroxylon zwageri*	Lauraceae	12.10	6.50	2.60	12.48	28.12	50.95	91.55	0.77
29	*Macaranga ~~gigantea~~gigantean*	Euphorbiaceae	29.92	12.70	3.30	15.34	43.12	134.97	193.43	0.30
30	*Glochidion obscurum*	Phyllanthaceae	18.46	10.20	5.30	5.49	12.31	35.26	53.06	0.41
	Total		610.21	371.60	194.68	282.15	817.70	2174.42	3274.27	14.19
	Average		20.34	12.39	6.49	9.40	27.26	72.48	109.14	0.47
	Minimum		11.14	6.00	2.50	3.32	6.57	18.47	28.83	0.30
	Maximum		37.00	20.70	10.20	24.07	50.65	146.17	216.99	0.77
	Standard deviation		7.36	3.90	2.22	6.50	13.65	45.40	61.30	0.10

Note: DBH=diameter at breast height; ~~T~~AGB=~~total~~ above~~-~~ground biomass; WD=wood density.

The developed allometric equations

The developed allometric equations for predicting plant part biomass of subject trees in the study plot are shown in Table 3. The results of the regression analysis on tree dimensions such as DBH, (DBH^2×Ht), (DBH^2×Hb), Ht, and Hb as independent variables and leaf dry biomass as the dependent variable using the three tested equations showed very weak correlation. The relationship between DBH, (DBH^2×Ht), and (DBH^2×Hb) to leaf dry biomass was very significant (P <0.01) and significant (P<0.05), except the relationship between (DBH^2×Hb) and leaf dry biomass (P>0.05). Meanwhile, the relationship between Ht and Hb to leaf dry biomass was not significant (P>0.05). Testing between tree and leaf dry biomass dimensions with ~~linear (y = a + bx),~~ exponential (y = ax^b)~~,~~ and log-linear (ln y = a + b.lnx) equations showed the ~~highest~~ adjusted R^2 value of less than ~~0.248, 0.190, and~~ 0.198~~, respectively~~.

The relationships between tree dimensions and branch dry biomass were very significant (P<0.001 and P<0.01), except the relationship between Hb and branch dry biomass was not significant (P>0.05). The correlation between tree dimensions and branch dry biomass had the highest adjusted R^2 values of ~~0.601,~~ 0.526~~,~~ and 0.~~,~~571 for ~~linear,~~ exponential~~,~~ and log-linear equations~~, respectively~~. Similarly, there were very significant relationships between DBH, (DBH^2×Ht), and (DBH^2×Hb) to trunk dry biomass (P<0.001) as well as the relationship between Ht and trunk dry biomass (P<0.01). In contrast, there was no significant relationship between Hb and trunk dry biomass (P>0.05). The correlations between DBH (DBH^2×Ht), and (DBH^2×Hb) to trunk dry biomass by using ~~three~~two tested equations showed high values of adjusted R^2 (~~0.708-0.823 for linear equations;~~ 0.579-0.783 for exponential equations~~;~~ and 0.563-0.782 for log-linear equations).

The regression analysis between DBH, (DBH^2×Ht), and (DBH^2×Hb) to ~~T~~AGB showed very significant relationships (P<0.001) with high adjusted R^2 values. The relationships between DBH and ~~T~~AGB using two~~three~~ tested regression equations had a~~A~~djusted R^2 values ranging from 0.733 to 0.~~811~~748. The adjusted R^2 values for the relationship between (DBH^2×Ht) and ~~T~~AGB ranged from 0.579 to 0.~~708~~651. The adjusted R^2 ranged between 0.492-0.~~672~~515 was analyzed for the relationships between (DBH^2×Hb) and ~~T~~AGB. Although the relationships between Ht and ~~T~~AGB were very significant (P<0.01), but these relationships had very low adjusted R^2 (0.253-0.~~309~~280). However, there was no significant relationship between Hb and ~~T~~AGB (P>0.05).

The best selected allometric equations

From all the regression analysis results that have been tested, the best allometric equations are selected in terms of P value (<0.001), ~~and~~ adjusted R^2 (>0.400), and the smallest root mean squared error (RMSE). The selected allometric equations for predicting plant part biomass of subject trees in the study plot was presented in bold figures in Table 3. ~~Seven~~Two equations were selected for the relationship between tree dimensions and branch dry biomass. These two equations are "(branch dry biomass)=6.121×$DBH^{0.065}$ (P<0.001; adjusted R^2=0.526; RMSE=4.454) and "ln(branch dry biomass)=0.813-0.472×ln(DBH^2×Ht)" (P<0.001; adjusted R^2=0.500; RMSE=5.216).~~The equation of "(branch dry biomass)=2.310-1.454(DBH)" shows the highest adjusted R^2 (0.601). Meanwhile the smallest adjusted R^2 (0.420) is shown in the equation "(branch dry biomass)=17.497+0.003(DBH^2×Hb)" in the regression analysis.~~ A total of ~~nine~~three

Formatted: Superscript
Formatted: Font: Bold
Formatted: Font: Bold
Formatted: Justified
Formatted: Justified, Indent: First line: 0.19"
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Superscript
Formatted: Superscript
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Superscript
Formatted: Superscript
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Superscript
Formatted: Font: Italic
Formatted: Superscript
Formatted: Font: Italic
Formatted: Superscript
Formatted: Superscript

allometric equations were selected to estimate trunk dry biomass using tree dimensions as well as the relationship between ~~T~~TAGB and tree dimensions. ~~The relationships between tree dimensions and trunk dry biomass have Adj R^2 of 0.563 to 0.823.~~ These selected equations describes relationships between DBH and trunk dry biomass had the high ~~A~~adjusted R^2 such as ~~"(trunk dry biomass)=41.759-5.616(DBH)" ($P<0.001$; Adj R^2=0.823),~~ "(trunk dry biomass)=11.458×(DBH)$^{0.081}$" ($P<0.001$; ~~A~~adjusted R^2=0.783; RMSE=7.611), "(trunk dry biomass)=32.989×(DBH^2×Ht)$^{0.001}$" ($P<0.001$; adjusted R^2=0.628; RMSE=6.262), and "(trunk dry biomass)=33.932×(DBH^2×Hb)$^{0.001}$ ($P<0.001$; adjusted R^2=0.579; RMSE=6.188). ~~and "ln(trunk dry biomass)=0.697-1.619×ln(DBH)" ($P<0.001$; Adj R^2=0.782). The other two equations were also had high adjusted R^2. These two equations were "(trunk dry biomass)=30.308+0.006(DBH^2×Ht)" ($P<0.001$; Adj R^2=0.717) and "(trunk dry biomass)=31.013+0.013(DBH^2×Hb)" ($P<0.001$; Adj R^2=0.708).~~

~~The high values of adjusted R^2 (0.492-0.811) are indicated by the relationship between the tree dimensions and TAGB.~~ The best recommended allometric equations between the tree dimensions and AGB ~~are "AGB = 20.523×DBH0.074" ($P<0.001$; Adj R^2=0.733),~~ "ln(AGB)=1.492×ln(DBH)+0.117" ($P<0.001$; ~~A~~adjusted R^2=0.748; RMSE=1.963), ~~"AGB=52.539+0.009×(DBH^2×Ht)" ($P<0.001$; Adj R^2=0.708), "AGB=54.088×(DBH^2×Ht)0.001" ($P<0.001$; Adj R^2=0,579), dan~~ "ln(AGB)=0.515×ln(DBH^2×Ht)+0.207" ($P<0.001$; ~~A~~adjusted R^2=0.651; RMSE=2.447), and "ln(AGB)=0.485×ln(DBH^2×Hb)+0.788" ($P<0.001$; adjusted R^2=0.492; RMSE=2.809). The significant correlations showed by mixed-species allometric equations that related AGB and diameter at stump height (R^2=0.78; $P<0.01$) and tree height (R^2=0.41, $P<0.05$) (Mokria et al. 2018). The strong correlations (a~~A~~djusted R^2= 0.59-0.95) were showed by relationships between trunk dry biomass and AGB with diameter at breast height (DBH) and height in the different age secondary forests (5, 10, and 20 years after abandonment). The correlations between leaf and branch dry biomass with height were relatively weak (~~A~~adjusted R^2=0.36-0.50) (Karyati et al. 2019a). The very weak relationships between leaves and branches dry biomass of trees and plant dimensions were reported in the abandoned land after shifting cultivation. The developed allometric equations showed relatively low R^2 (<0.60) (Karyati et al. 2019b).

The allometric equation which was constructed to estimate the biomass of plant parts in secondary forest is thought to be due to the various types of plants that grow. Differences in plant species and individuals tend to cause differences in plant structure and physiognomy. The carbon content varies greatly between species and between individual trees (Lamlom and Savidge 2003). The growth of different tree species varies at the level of certain species and characters based on site conditions (Parlucha 2017). The regression between the trunk biomass and tree dimensions by using ~~linear,~~ exponential~~,~~ and natural logarithm's equations were illustrated in Figure 4. Figure 5 illustrated regression between the total above~~-~~ground biomass and tree dimensions by using ~~linear,~~ exponential~~,~~ and natural logarithm's equations.

Formatted ...

Formatted: Justified

Formatted ...

Comment [Rev9]: Full reference not found, please insert it

Comment [KK10]: We've inserted the reference.

Formatted ...

Formatted: Not Highlight

Table 3. The ~~developed~~ allometric equations for predicting plant part biomass of subject trees in the study plot; best selected equations ($P<0.001$), ~~and~~ adjusted R^2 (>0.400), and the smallest root mean squared error (RMSE) are indicated in bold.

Formatted: Font: Italic

Formatted: Font: Italic

Formatted ...

Formatted Table

Dependent variable (y)	**Independent variable (x)**	**Equations**		
		~~**y = a + b x**~~	**y = ax^b**	**(ln y) = a + b (ln x)**
Leaf dry biomass (kg)	DBH (cm)	~~y = 0.099 + 0.458 x (P<0.01; Adj R^2= 0.2~~	y = 3.211 x$^{0.042}$ ($P<0.01$; Adj R^2=0.190; RMSE=2.402)	ln y = 0.518 – 0.862 ln x ($P<0.01$; Adj R^2=0.198; RMSE=3.044)

Dependent variable (y)	Independent variable (x)	Equations		
		~~$y = a + bx$~~	$y = ax^b$	$(\ln y) = a + b (\ln x)$
		~~42)~~		
	(DBH^2×Ht) (cm^{2}m)	~~$y = 5.700 + 0.001x$ ($P<0.01$; Adj R^2=0.248)~~	$y = 5.485\ x^{0.046}$ ($P<0.05$; Adj R^2=0.169; RMSE=1.157)	$\ln y = 0.340 – 0.283 \ln x$ ($P<0.05$; Adj R^2=0.149; RMSE=3.044)
	(DBH^2×Hb) (cm^{2}m)	~~$y = 6.031 + 0.001x$ ($P<0.01$; Adj R^2=0.205)~~	$y = 5.774\ x^{0.001}$ ($P<0.05$; Adj R^2=0.112; RMSE=1.894)	$\ln y = 0.396 + 0.211 \ln x$ ($P>0.05$; Adj R^2=0.054; RMSE=1.313)
	Ht (m)	~~$y = 3.503$~~	$y = 4.262\ x^{0.046}$ ($P>0.05$; Adj R^2=0.041; RMSE=2.152)	$\ln y = 0.908 + 0.452 \ln x$ ($P>0.05$; Adj R^2=0.015; RMSE=17.127)

Formatted Table

Dependent variable (y)	Independent variable (x)	Equations		
		~~y = a + b x~~	y = ax^b	(ln y) = a + b (ln x)
	Hb (m)	~~+ 0.476 x (*P* > 0.05; Adj *R*² = 0.049) y = 9.389 + 0.003 x (*P* > 0.05; Adj *R*² = -0.036)~~	y = 9.248 $x^{-0.031}$ ($P>0.05$; Adj R^2=-0.025; RMSE=0.811)	ln y = 2.578 – 0.308 ln x ($P>0.05$; Adj R^2=0.000; RMSE=1.336)
Branch dry biomass (kg)	DBH (cm)	~~y = 2.310 – 1.454 x~~	**y = 6.121 $x^{0.065}$** **($P<0.001$; Adj R^2=0.526; RMSE=4.454)**	ln y = 0.883 – 1.363 ln x ($P<0.001$; Adj R^2=0.571; RMSE=5.216)

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Not Bold

Dependent variable (y)	Independent variable (x)	Equations		
		~~y = a + b x~~	**$y = ax^b$**	**(ln y) = a + b (ln x)**
		~~($P<0.001$; Adj $R^2=0.601$)~~		
	$(DBH^2 \times Ht)$ (cm^2m)	~~$y = 16.532 + 0.002x$ ($P<0.001$; Adj $R^2=0.503$)~~	$y = 14.616\ x^{0.001}$ ($P<0.001$; Adj $R^2=0.389$; RMSE=3.538)	**ln y = 0.813 – 0.472 ln x** **($P<0.001$; Adj $R^2=0.500$; RMSE=5.216)**
	$(DBH^2 \times Hb)$ (cm^2m)	~~$y = 17.497 + 0.003x$ ($P<0.$~~	$y = 15.389\ x^{0.001}$ ($P<0.01$; Adj $R^2=0.305$; RMSE=3.428)	ln y = 0.034 + 0.403 ln x ($P<0.01$; Adj $R^2=0.303$; RMSE=1.629)

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Dependent variable (y)	Independent variable (x)	Equations		
		~~$y = a + b x$~~	$y = ax^b$	$(\ln y) = a + b (\ln x)$
	Ht (m)	~~001; Adj R^2=0.420)~~ ~~$y = 16.532 + 0.002 x$ (*P*<0.001; Adj R^2 = 0.503)~~	$y = 14.616\ x^{0.001}$ (*P*<0.001; Adj R^2=0.389; RMSE=3.550)	$\ln y = 0.806 + 0.945 \ln x$ (*P*<0.01; Adj R^2=0.194; RMSE-1.780)
	Hb (m)	~~$y = 24.188 + 0.473 x$ (*P*>0.05; A~~	$y = 24.05\ x^{-0.009}$ (*P*>0.05; Adj R^2=0.035; RMSE=1.896)	$\ln y = 3.366 – 0.127 \ln x$ (*P*>0.05; Adj R^2=-0.029; RMSE=2.046)

Formatted Table

Formatted: Font: Bold

		Equations		
Dependent variable (y)	**Independent variable (x)**	~~**y = a + b x**~~	**y = ax^{b}**	**(ln y) = a + b (ln x)**
Trunk dry biomass (kg)	DBH (cm)	~~dj *R*^{2}= - 0.030)~~ ~~y = 41.759 – 5.616 x (*P* < 0.001; Adj *R*^{2}= 0.823)~~	**y = 11.458 x$^{0.081}$** **(*P*<0.001; Adj *R*^{2}=0.783; RMSE=7.611)**	ln y = 0.697 – 1.619 ln x (*P*<0.001; Adj *R*^{2}=0.782; RMSE=8.512)
	(DBH^{2}×Ht) (cm^{2}m)	~~**y = 30.308 + 0.006 x (*P* < 0.001; Adj *R***~~	**y = 32.989 x$^{0.001}$** **(*P*<0.001; Adj *R*^{2}=0.628; RMSE=6.262)**	ln y = 0.619 – 0.562 ln x (*P*<0.001; Adj *R*^{2}=0.687; RMSE=8.512)

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Not Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Not Bold

Formatted: Font: Bold

Dependent variable (y)	Independent variable (x)	Equations		
		~~y = a + b x ²~~	**y = ax^b**	**(ln y) = a + b (ln x)**
	(DBH^2×Hb) (cm^{2}m)	~~= 0.717) y = 31.013 + 0.013 x (*P* < 0.001; Adj *R*^{2}= 0.708)~~	**y = 33.932 x$^{0.001}$ (*P*<0.001; Adj *R*^{2}=0.579; RMSE=6.188)**	ln y = 0.145 – 0.549 ln x (*P*<0.001; Adj *R*^{2}=0.563; RMSE=8.512)
	Ht (m)	~~y = 10.919 – 6.733 x (*P* < 0.01; Adj *R*^{2}= 0.31~~	y = 17.636 x$^{0.098}$ (*P*<0.01; Adj *R*^{2}=0.301; RMSE=7.072)	ln y = 1.295 + 1.128 ln x (*P*<0.01; Adj *R*^{2}=0.278; RMSE=3.105)

Formatted Table

Formatted: Font: Bold

Formatted: Font: Not Bold

Formatted: Font: Bold

Formatted: Font: Bold

		Equations		
Dependent variable (y)	**Independent variable (x)**	~~**y = a + b x**~~	**$y = ax^{b}$**	**(ln y) = a + b (ln x)**
	Hb (m)	~~1) y = 30.554 + 6.461 x (*P* > 0.05; Adj *R*² = 0.068)~~	$y = 40.192\ x^{0.059}$ (*P*>0.05; Adj R^2=0.005; RMSE=5.270)	ln y = 3.669 + 0.227 ln x (*P*>0.05; Adj R^2=-0.016; RMSE=3.638)
Above ground biomass (kg)	DBH (cm)	~~y = 43.971 – 7.528 x (*P* < 0.001; Adj *R*² = 0.811)~~	$y = 20.523\ x^{0.074}$ (*P*<0.001; Adj R^2=0.733; RMSE=9.144)	**ln y = 0.117 + 1.492 ln x** **(*P*<0.001; Adj R^2=0.748; RMSE=1.963)**
	(DBH^2×Ht) (cm^2m)	~~y = 5~~	$y =54.088\ x^{0.001}$ (*P*<0.001; Adj R^2=0.579; RMSE=7.389)	**ln y = 0.207 + 0.515 ln x** **(*P*<0.001; Adj R^2=0.651; RMSE=2.447)**

Formatted Table

Formatted: Font: Bold

Formatted: Font: Not Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Not Bold

Formatted: Font: Bold

Dependent variable (y)	Independent variable (x)	Equations		
		~~y = a + b x~~	y = ax^b	(ln y) = a + b (ln x)
	(DBH^2×Hb) (cm^{2}m)	~~2.539 + 0.009 x (P<0.001; Adj R^2=0.708)~~ ~~y = 54.540 + 0.017 x (P<0.001; Adj R^2=0.672)~~	y =55.927 $x^{0.001}$ (P<0.001; Adj R^2=0.515; RMSE=7.265)	**ln y = 0.788 + 0.485 ln x (P<0.001; Adj R^2=0.492; RMSE=2.809)**
	Ht (m)	~~y = 3.082 –~~	y = 30.480 $x^{0.089}$ (P<0.01; Adj R^2=0.280; RMSE=8.436)	ln y = 2.002 + 1.020 ln x (P<0.01; Adj R^2=0.253; RMSE=3.550)

Formatted Table

Formatted: Font: Bold

Formatted: Font: Not Bold

Formatted: Font: Bold

Dependent variable (y)	**Independent variable (x)**	**Equations**		
		~~**y = a + b x**~~	**y = ax^b**	**(ln y) = a + b (ln x)**
	Hb (m)	~~9.060 x (*P*<0.01; Adj R^2=0.309)~~ ~~y = 64.126 + 6.937 x (*P*>0.05; Adj R^2=0.030)~~	y = 72.981 x$^{0.035}$ (*P*>0.05; Adj R^2=0.020; RMSE=5.604)	ln y = 4.346 + 0.096 ln x (*P*>0.05; Adj R^2=-0.032; RMSE=4.165)

Note: *P* values of the regression analysis are shown, R^2 coefficient of determination, DBH =diameter at breast height, Ht =total tree height, Hb bole tree height, RMSE root mean squared error.

~~The selected allometric equations~~

~~From all the regression analysis results that have been tested, the best allometric equations are selected in terms of *P* value (<0.001) and adjusted R^2 (>0.400). The selected allometric equations for predicting plant part biomass of subject trees in the study plot is presented in Table 4. Seven equations were selected for the relationship between tree dimensions and branch dry biomass. The equation of "(branch dry biomass)=2.310-1.454(DBH)" shows the highest adjusted R^2 (0.601). Meanwhile the smallest adjusted R^2 (0.420) is shown in the equation "(branch dry biomass)=17.497+0.003(DBH^2×Hb)" in the regression analysis. A total of nine allometric equations were selected to estimate trunk dry biomass using tree dimensions as well as the relationship between TAGB and tree dimensions. The relationships between tree dimensions and trunk dry biomass have Adj R^2 of 0.563 to 0.823. The equations describes~~

~~relationships between DBH and trunk dry biomass had the high Adj R^2 such as "(trunk dry biomass)=41.759-5.616(DBH)" (P<0.001; Adj R^2=0.823), "(trunk dry biomass)=11.458(DBH)$^{0.081}$" (P<0.001; Adj R^2=0.783), and "ln(trunk dry biomass)=0.697-1.619×ln(DBH)" (P<0.001; Adj R^2=0.782). The other two equations were also had high adjusted R^2. These two equations were "(trunk dry biomass)=30.308+0.006(DBH^2×Ht)" (P<0.001; Adj R^2=0.717) and "(trunk dry biomass)=31.013+0.013(DBH^2×Hb)" (P<0.001; Adj R^2=0.708).~~

~~The high values of adjusted R^2 (0.492-0.811) are indicated by the relationship between the tree dimensions and TAGB. The best recommended allometroic equations are "AGB = 20.523×DBH$^{0.074}$" (P<0.001; Adj R2=0,733), "ln(AGB)=1.492×ln(DBH)+0.117" (P<0.001; Adj R^2=0.748), "AGB=52.539+0.009×(DBH^2×Ht)" (P<0.001; Adj R^2=0.708), "AGB=54.088×(DBH^2×Ht)$^{0.001}$" (P<0.001; Adj R^2=0,579), dan "ln(AGB)=0.515×ln(DBH^2×Ht)+0.207" (P<0.001; Adj R^2=0.651). The significant correlations showed by mixed-species allometric equations that related AGB and diameter at stump height (R^2=0.78; P<0.01) and tree height (R^2=0.41, P<0.05) (Mokria et al. 2018). The strong correlations (Adj R^2= 0.59-0.95) were showed by relationships between trunk dry biomass and AGB with diameter at breast height (DBH) and height in the different age secondary forests (5, 10, and 20 years after abandonment). The correlations between leaf and branch dry biomass with height were relatively weak (Adj R^2=0.36-0.50) (Karyati et al. 2019a). The very weak relationships between leaves and branches dry biomass of trees and plant dimensions were reported in the abandoned land after shifting cultivation. The developed allometric equations showed relatively low R^2 (<0.60) (Karyati et al. 2019b).~~

~~The allometric equation which is constructed to estimate the biomass of plant parts in secondary forest is thought to be due to the various types of plants that grow. Differences in plant species and individuals tend to cause differences in plant structure and physiognomy. The carbon content varies greatly between species and between individual trees (Lamlom and Savidge 2003). The growth of different tree species varies at the level of certain species and characters based on site conditions (Parlucha 2017). The regression between the trunk biomass and tree dimensions by using linear, exponential, and natural logarithm's equations were illustrated in Figure 4. Figure 5 illustrated regression between the total above ground biomass and tree dimensions by using linear, exponential, and natural logarithm's equations.~~

~~**Table 4.** The selected allometric equations for predicting plant part biomass of subject trees in the study plot~~

~~**Dependent variable (y)**~~	~~**Independent variable (x)**~~	~~**Equation**~~	~~***P* value**~~	~~**Adj *R*²**~~
~~Branch dry biomass (kg)~~	~~DBH (cm)~~	~~y = 2.310 – 1.454 x~~	~~<0.001~~	~~0.601~~
	~~DBH (cm)~~	~~$y = 6.121\ x^{0.065}$~~	~~<0.001~~	~~0.526~~
	~~DBH (cm)~~	~~ln y = 0.883 – 1.363 ln x~~	~~<0.001~~	~~0.571~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~y = 16.532 + 0.002 x~~	~~<0.001~~	~~0.503~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~ln y = 0.813 – 0.472 ln x~~	~~<0.001~~	~~0.500~~
	~~(DBH^2×Hb) (cm^{2}m)~~	~~y = 17.497 + 0.003 x~~	~~<0.001~~	~~0.420~~
	~~Ht (m)~~	~~y = 16.532 + 0.002 x~~	~~<0.001~~	~~0.503~~
~~Trunk dry biomass (kg)~~	~~DBH (cm)~~	~~y = 41.759 – 5.616 x~~	~~<0.001~~	~~0.823~~
	~~DBH (cm)~~	~~$y = 11.458\ x^{0.081}$~~	~~<0.001~~	~~0.783~~
	~~DBH (cm)~~	~~ln y = 0.697 – 1.619 ln x~~	~~<0.001~~	~~0.782~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~y = 30.308 + 0.006 x~~	~~<0.001~~	~~0.717~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~$y = 32.989\ x^{0.001}$~~	~~<0.001~~	~~0.628~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~ln y = 0.619 – 0.562 ln x~~	~~<0.001~~	~~0.687~~
	~~(DBH^2×Hb) (cm^{2}m)~~	~~y = 31.013 + 0.013 x~~	~~<0.001~~	~~0.708~~
	~~(DBH^2×Hb) (cm^{2}m)~~	~~$y = 33.932\ x^{0.001}$~~	~~<0.001~~	~~0.579~~
	~~(DBH^2×Hb) (cm^{2}m)~~	~~ln y = 0.145 – 0.549 ln x~~	~~<0.001~~	~~0.563~~
~~Above ground biomass (kg)~~	~~DBH (cm)~~	~~y = 43.971 – 7.528 x~~	~~<0.001~~	~~0.811~~
	~~DBH (cm)~~	~~$y = 20.523\ x^{0.074}$~~	~~<0.001~~	~~0.733~~
	~~DBH (cm)~~	~~ln y = 0.117 + 1.492 ln x~~	~~<0.001~~	~~0.748~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~y = 52.539 + 0.009 x~~	~~<0.001~~	~~0.708~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~$y =54.088\ x^{0.001}$~~	~~<0.001~~	~~0.579~~
	~~(DBH^2×Ht) (cm^{2}m)~~	~~ln y = 0.207 + 0.515 ln x~~	~~<0.001~~	~~0.651~~
	~~(DBH^2×Hb) (cm^{2}m)~~	~~y = 54.540 + 0.017 x~~	~~<0.001~~	~~0.672~~
	~~(DBH^2×Hb) (cm^{2}m)~~	~~$y =55.927\ x^{0.001}$~~	~~<0.001~~	~~0.515~~
	~~(DBH^2×Hb) (cm^{2}m)~~	~~ln y = 0.788 + 0.485 ln x~~	~~<0.001~~	~~0.492~~

~~Note: *P* values of the regression analysis are shown, R^2 coefficient of determination, DBH diameter at breast height, Ht total tree height, Hb bole tree height.~~

Comment [Rev11]: Full reference not found, please insert it

Comment [KK12]: We've inserted the reference.

Formatted: Not Highlight

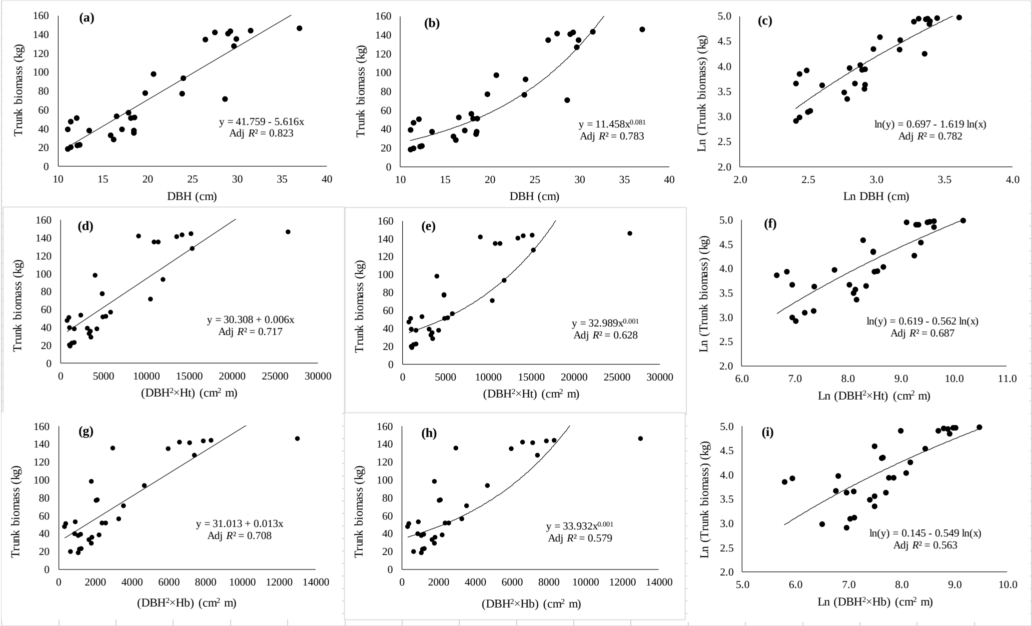
Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Indent: First line: 0.19"

Formatted: English (U.S.)



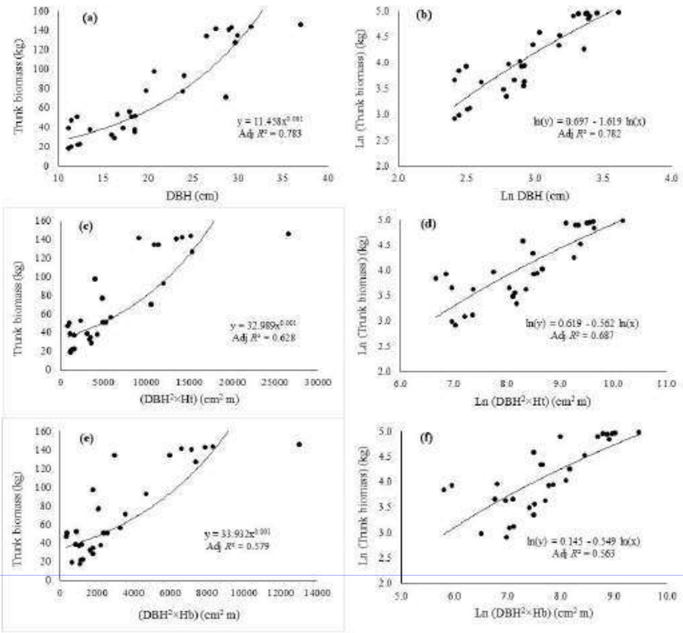
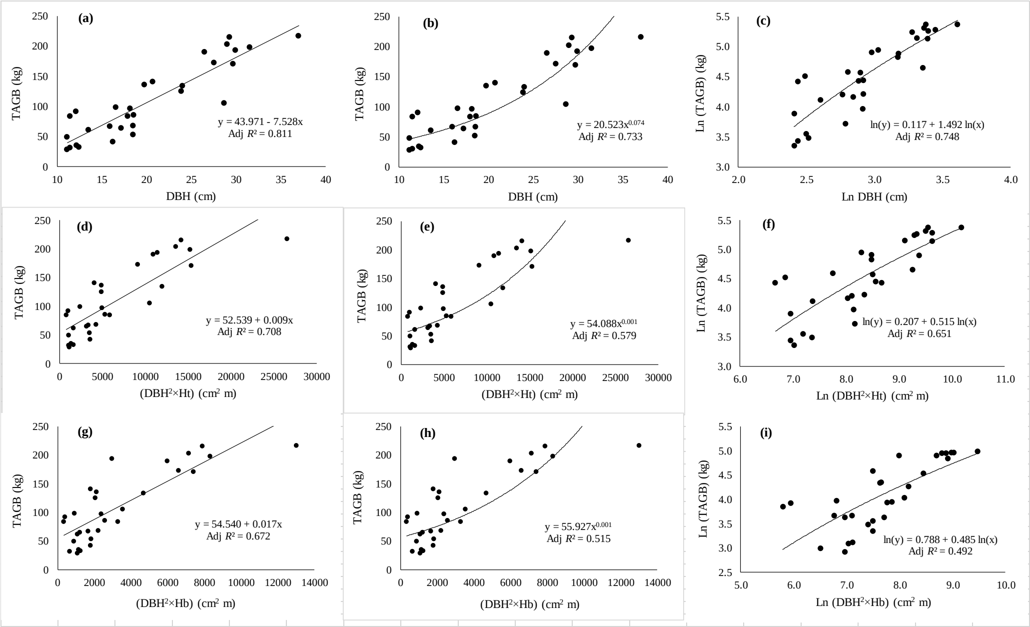


Figure 4. Regression between the trunk biomass (kg) and DBH (cm) (a-~~c~~b); the product of square DBH and total height (cm^2 m) (c~~d~~-~~f~~d) and the product of square DBH and bole height (cm^2 m) (e~~g~~-f~~i~~) by using ~~linear,~~ exponential~~,~~ and natural logarithm’s equations.

Formatted: English (U.S.)

Formatted: Font color: Red

Formatted: Font color: Red



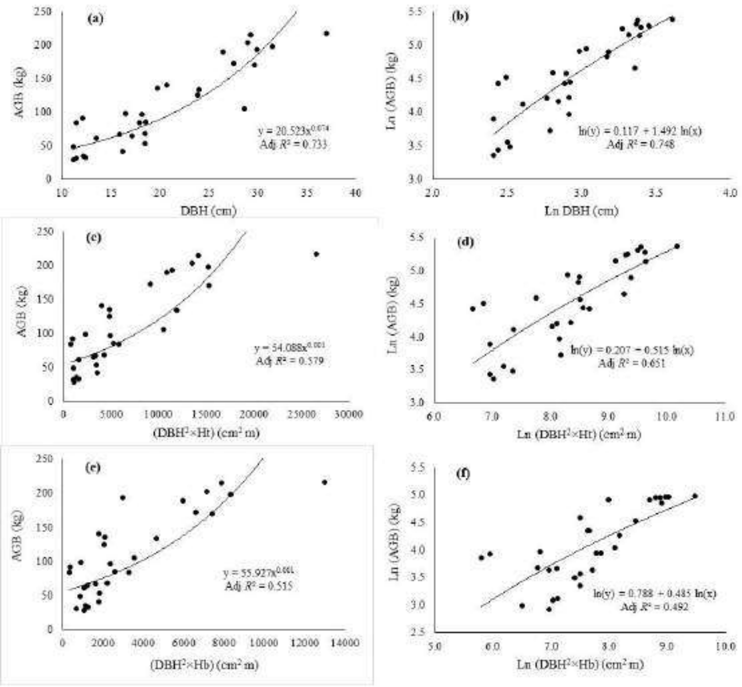


Figure 5. Regression between the ~~total~~ above~~-~~ground biomass (~~T~~AGB) (kg) and DBH (cm) (a-b~~c~~); the product of square DBH and total height (cm^2 m) (c-d~~d-f~~) and the product of square DBH and bole height (cm^2 m) (e-f~~g-i~~) by using ~~linear,~~ exponential~~,~~ and natural logarithm's equations.

Formatted: Font color: Red

Formatted: Font color: Red

Comparison among various allometric equations

The estimation of AGB and carbon stock using various reported relationshops in the study plot is presented in Table 4~~5~~. The AGB estimation using two selected allometric equations in the study location ranged from ~~11.85~~29.98 to ~~38.76~~30.30 Megagram per hectare (Mg ha^{-1}), while the carbon stock range was ~~5.93~~14.09-~~19.38~~14.24 Mg ha^{-1}. The largest AGB (3~~8.76~~0.30 Mg ha^{-1}) and carbon stock (~~19.38~~14.24 Mg ha^{-1}) wa~~s~~ere estimated using log-linear equations with ~~variables~~ (DBH^2×Ht) as predictors variables for AGB. The other~~two~~ selected log-linear allometric equation~~s~~ also estimate~~s~~ relatively high AGB and carbon stock. Th~~is~~ese equation~~s~~ applied ~~(DBH^2×Ht) and~~ DBH as predictors of AGB. The use of (DBH^2×Ht) as the independent variable estimates AGB and stock carbon of 30.30 and ~~15.15~~14.24 Mg ha^{-1}. Meanwhile the estimation of AGB through DBH in the log-linear equation yields AGB of 29.98 Mg ha^{-1} and carbon stock of ~~14.99~~14.09 Mg ha^{-1}. ~~The selected exponential equation using (DBH^2×Ht) as the predictor of AGB estimates relatively high AGB (26.15 Mg ha^{-1}) and carbon stock (13.08 Mg ha^{-1}). Contrastly, the use of DBH as a predictor of AGB in the exponential equation estimates the lowest AGB (11.85 Mg ha^{-1}) and carbon stock (5.93 Mg ha^{-1}) compared to other selected allometric equations.~~

Generally, the estimation of AGB and carbon stock use the selected developed allometric equations is lower than the estimation using the previous reported equations of ~~Rai and Proctor (1986) (111.91 and 55.96 Mg ha^{-1}),~~ Chambers et al. (2001) (87.55 and ~~43.78~~41.15 Mg ha^{-1}), ~~Yamakura et al. (1986) (81.62 and 40.81 (Mg ha^{-1}),~~ ~~Brown (1997) (72.94 and 36.47 Mg ha^{-1}),~~ Manuri et al. (2017) (67.02 and ~~33., 51~~31.50 Mg ha^{-1}), ~~Basuki et al. (2009) (65.63 and 32.82 Mg ha^{-1}),~~ and Kiyono and Hastaniah (200~~8~~5) (61.18 and ~~30.59~~28.75 Mg ha^{-1}). The application of equations of Nelson et al. (1999), Kenzo et al. (2009b), Kettering et al. (2001), Sierra et al. (2007), and Karyati et al. (2019a) also estimate higher AGB and carbon stock compared to using the selected equations. The use of these equations estimates AGB and stock carbon of (57.84 and ~~28.92~~27.18 Mg ha^{-1}), (51.82 and ~~25.91~~24.36 Mg ha^{-1}), (47.36 and ~~23.68~~22.26 Mg ha^{-1}), (47.03 and ~~23.52~~22.10 Mg ha^{-1}), and (48.36 and ~~24.18~~22.73 Mg ha^{-1}), respectively.

The estimation of AGB and carbon stock using the selected allometric equation yields similar values with using equations of Hashimoto et al. (2004) and Kenzo et al. (2009a). The equation of Hashimoto et al. (2004) estimates AGB of 37.66 Mg ha^{-1} and stock carbon of ~~18.83~~17.70 Mg ha^{-1}. Meanwhile, AGB (37.24 Mg ha^{-1}) and carbon stock (~~18.62~~17.50 Mg ha^{-1}) were estimated using the Kenzo et al. (2009a). However, the application of the selected equations ~~"AGB=20.523×DBH^{0,074}" estimates AGB (14.03 Mg ha^{-1}) and carbon stock (7.02 Mg ha^{-1}) that are~~estimated the higher AGB and stock carbon than ~~similar by~~ using Karyati et al. (2019b)'s equation (AGB of 14.03 Mg ha^{-1} and stock carbon of 6.59 Mg ha^{-1}). The comparison among various allometric relationships between AGB and DBH estimated in the study plot was illustrated in Figure 6.

The use of several previous reported allometric equations estimated the higher biomass and carbon stock than using developed allometric~~s~~ equations in the study site. This may related to variation of wood density of the sample trees. The wood density is a basic property of woody plants which are important for demonstrating ecological characteristics and performance in plant communities. The wood density ~~is~~ also determines~~ing~~ tree and forest biomass in carbon cycle studies (Vieilledent 2018). ~~The selected sample trees dominated by pioneer species. Generally, the pioneer species usually have the low wood density.~~ The variation of sample trees tend~~s~~ to cause~~d~~ variation of wood density. The wood density of sample trees ranged from 0.30 to 0.77 cm g^{-3}. Most of the tree samples had a low wood density, which was less than 0.56 cm g^{-3}, except for two samples of *Eusideroxylon zwageri* having a density of 0.72 and 0.77 cm g^{-3} respectively (Table 2). The low wood density of ~~pioneer~~ tree species may differ in allometric equations significantly (Hashimoto et al. 2004).

The application of Hashimoto et al. (2004) and Kenzo et al. (2009a)'s equations estimate the similar AGB and carbon stock using the developed allometric equation. The wood density of sample trees used to develop~~ed~~ Kenzo et al. (2009a)'s equations were 0.35 cm g^{-3}. Meanwhile, the wood densities of sample trees in ~~Brown's equation (1997),~~ Basuki et al.'s equation (2009), and Kiyono and Hastaniah's equation (200~~8~~5) were 0.40-0.79 cm g^{-3}, 0.32-0.86 cm g^{-3}, and 0.67 cm g^{-3}, respectively. The allometric equation for mixed species in the tropical forest of Kalimantan reported by Kenzo et al. (2009a) with wood density of 0.35 cm g^{-3}, Kettering et al. (2001) with wood density of 0.35 to 0.91 cm g^{-3}, Karyati et al. (2019a) with wood density of 0.24-0.44 cm g^{-3}, and Kenzo et al. (2009b) with wood density of 0.35 cm g^{-3}. The tree species, stand characteristics, wood density, and tree height affect the AGB estimation directly, while the characteristics of the biogeographical area have only a slight effect on the developed AGB equation (Manuri et al. 2017).

This study developed allometric equations for abandoned lands, especially pioneer tree species in abandoned traditional gardens. The selection of a suitable allometric equation will result in accurate estimates of biomass and carbon stock. ~~The developing~~ These ~~of~~ specific allometric equations for abandoned traditional garden on tropical land~~s~~ would supplement~~complete~~ the previously reported allometric equations and ~~hopefully~~ sha~~wi~~ll provide an alternative ~~allometric~~ to the existing equations ~~as the suitable purpose and users~~.

Table 4~~5~~. Estimation of AGB and carbon stock for trees using various reported relationships, with reference ~~for trees in~~ to the current study plot

No.	Equation	Author	Estimate of AGB (Mg ha^{-1})	Estimate of C stock (Mg ha^{-1})
~~1~~	~~ln(AGB)=2.12×ln(DBH)-0.435~~	~~Rai and Proctor (1986)~~	~~111.91~~	~~55.96~~

Comment [Rev13]: Indicate in the first instance what 'Mg' stands for

Comment [KK14]: We've given understanding of 'Mg'.

Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Superscript
Formatted: Superscript
Formatted: Not Highlight
Formatted: Not Highlight

Comment [Rev15]: How can we infer which was the pioneer species in the current case? Which species is it?
All of a sudden pioneer species concept cannot be introduced, please delineate appropriately in introduction, materials and methods

Comment [KK16]: We had revised the sentences.

Formatted: Superscript
Formatted: Font: Italic
Formatted: Font color: Red
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Not Highlight
Formatted: Font color: Red
Formatted: Not Highlight
Formatted Table

No.	Equation	Author	Estimate of AGB (Mg ha^{-1})	Estimate of C stock (Mg ha^{-1})
~~2~~	~~ln(AGB)=2.62×ln(DBH)-2.30~~	~~Yamakura et al. (1986)~~	~~81.62~~	~~40.81~~
~~3~~	~~ln(AGB)=2.53×ln(DBH)-2.13~~	~~Brown (1997)~~	~~72.94~~	~~36.47~~
~~4~~1	ln(AGB)=2.413×ln(DBH)-1.997	Nelson et al. (1999)	57.84	~~28.92~~27.18
~~5~~2	ln(AGB)=2.55×ln(DBH)-2.010	Chambers et al. (2001)	87.55	~~43.78~~41.15
~~6~~3	ln(AGB)=2.59×ln(DBH)-2.75	Kettering et al. (2001)	47.36	~~23.68~~22.26
~~7~~4	ln(AGB)=2.44×ln(DBH)-2.51	Hashimoto et al. (2004)	37.66	~~18.83~~17.70
~~8~~5	ln(AGB)=2.422×ln(DBH)-2.232	Sierra et al. (2007)	47.03	~~23.52~~22.10
~~9~~6	$AGB=0.1008\times DBH^{2.5264}$	Kiyono and Hastaniah (200~~8~~5)	61.18	~~30.59~~28.75
~~10~~	~~ln(AGB)=2.196×ln(DBH)-1.201~~	~~Basuki et al. (2009)~~	~~65.63~~	~~32.82~~
~~11~~7	$AGB=0.0829\times DBH^{2.43}$	Kenzo et al. (2009a)	37.24	~~18.62~~17.50
~~12~~8	$AGB=0.1525\times DBH^{2.34}$	Kenzo et al. (2009b)	51.82	~~25.91~~24.36
~~13~~9	$AGB=0.071\times DBH^{2.667}$	Manuri et al. (2017)	67.02	~~33.51~~31.50
~~14~~10	ln(AGB)=2.3207×ln(DBH)-1.89	Karyati et al. (2019a)	48.36	~~24.18~~22.73
~~15~~11	ln(AGB)=0.808×ln(DBH)+1.277	Karyati et al. (2019b)	14.03	~~7.02~~6.59
		Current~~This~~ study plot		
~~17~~12	ln(AGB)=1.492×ln(DBH)+0.117		29.98	~~14.99~~14.09
~~20~~13	$\ln(AGB)=0.515\times\ln(DBH^2\times Ht)+0.207$		30.30	~~15.15~~14.24

Formatted Table

Formatted Table

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: English (U.S.)

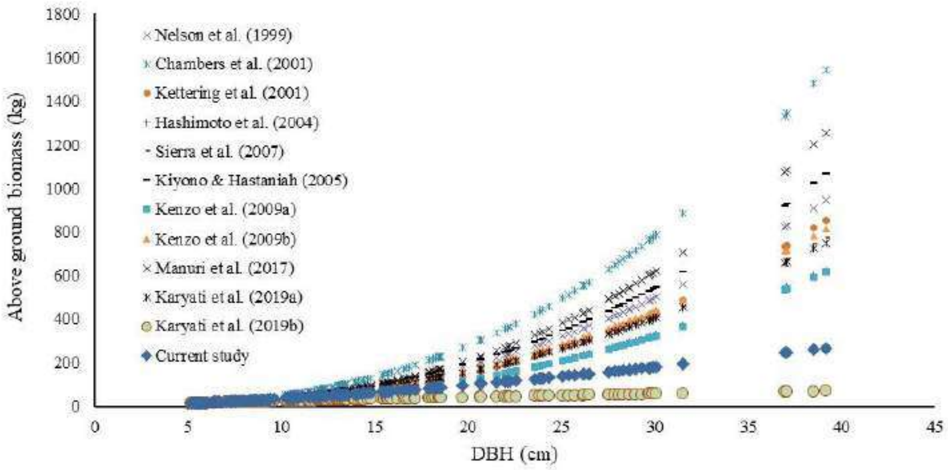
Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: English (U.S.)

Note: AGB = above-ground biomass~~-~~; C = carbon ; DBH = diameter at breast height (cm) ; Ht = total height (m).



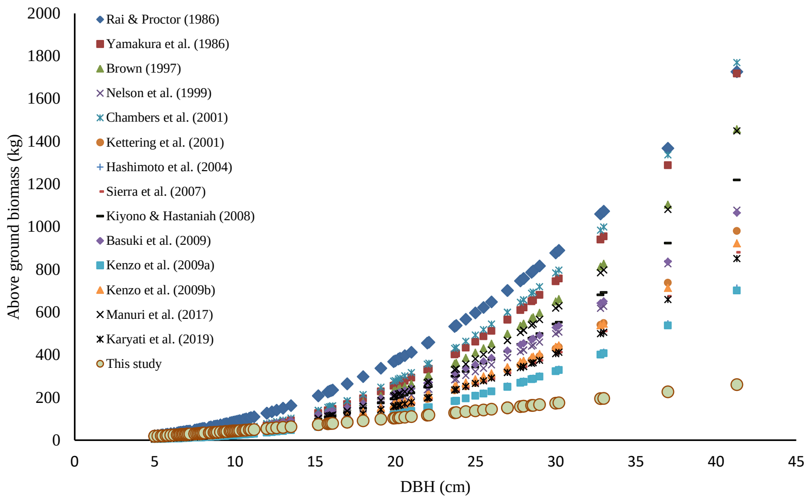


Figure 6. Comparison among various allometric relationships between above-ground biomass (AGB) and diameter at breast height (DBH) in the study site

CONCLUSION

The specific allometric equations to estimate the aboveground biomass in abandoned traditional gardens is need to be developed. The use of these equations is expected to produce a more accurate estimate of aboveground biomass and carbon stock. Besides ecological and economic aspects, the calculation of aboveground biomass and carbon stock on abandoned land is important because its area tends to increase from year to year.

ACKNOWLEDGEMENTS

The authors express their highest appreciation and gratitude to the Ministry of Education and Culture of the Republic of Indonesia for financial support so that this ~~research~~ study was carried out through *Hibah Penelitian Dasar Unggulan Perguruan Tinggi* scheme Contract No.: 183/SP2H/AMD/LT/DRPM/2020.

REFERENCES

Agevi H, Onwonga R, Kuyah S, Tsingalia M. 2017. Carbon stocks and stock changes in agroforestry practices: a review. Tropical and Subtropical Agroecosystems 20: 101–109. Accessed from https://www.revista.ccba.uady.mx/ojs/index.php/TSA/article/view/2291/1057 on 19.12.2020

Basuki TM, v~~V~~an Laake PE, Skidmore AK, Hussin YA. 2009. Allometric equations for estimating the above-ground biomass in tropical lowland Dipterocarp forests. For~~est~~ Ecol~~ogy and~~ Manag~~ement~~ 257: 1684-1694. https://doi.org/10.1016/j.foreco.2009.01.027

BMKG. 2020. Accessed from http://dataonline.bmkg.go.id/home

Bowyer JL, Schmulsky R, Haygreen JG. 2003. Forest Products and Wood Science: An Introduction. 4th Ed. Iowa State Press, Iowa.

~~Brown S, Lugo AE. 1982. The storage and production of organic matter in tropical forests and their role in the global carbon cycle. Biotropica 14:161-187. https://doi.org/10.2307/2388024~~

BPS Kota Samarinda. 2020. Samarinda Municipality in Figures 2020. BPS-Statistics of Samarinda Municipality. Samarinda. [Indonesian]

~~Brown S. 1997. Estimating Biomass and Biomass Change ofin Tropical Forests: A Primer. Rome: Food and Agriculture Organization Forestry paper - 134of the United Nations. Accessed from http://www.fao.org/3/w4095e/w4095e00.htm on 19.12.2020.~~

~~Cannell MGR, Milne R. 1995. Carbon pools and sequestration in forest ecosystems in Britain. Forestry 68: 361-378. https://doi.org/10.1093/forestry/68.4.361~~

Chamber JQ, dos Santos J~~D~~, Ribeiro RJ, Higuchi N. 2001. Tree damage, allometric relationship, and above-ground net primary production in central amazon forest. For~~est~~ Ecol~~ogy and~~ Manag~~ement~~ 152: 73-84. https://doi.org/10.1016/S0378-1127(00)00591-0

Chave J. 2006. Measuring Wood Density for Tropical Forest Trees: A Field Manual. Sixth Framework Programme (2002-2006). Project for the Advancement of Networked Science in Amazonia, France. Accessed from http://www.rainfor.org/upload/ManualsEnglish/wood_density_english%5B1%5D.pdf on 19.12.2020

~~Dixon R, Solomon AM, Brown S, Houghton RA, et alSolomon AM, Trexler MC, Wisniewski J. 1994. Carbon pools and flux of global forest ecosystems. Science 263: 185-190. https://doi.org/10.1126/science.263.5144.185~~

FAO. 2016. State of the World's Forests 2016. Forests and Agriculture: Land-use Challenges and Opportunities. Food and Agriculture Organization of the United Nations. Rome. Accessed from http://www.fao.org/3/a-C0176e.pdf on 19.12.2020.

FAO and UNEP. 2020. The State of the World's Forests 2020 : Forests, Biodiversity and People. Food and Agriculture Organization of the United Nations. Rome. https://doi.org/~~DOI:~~ 10.4060/ca8642en

Formatted: Font: 10 pt, Bold

Formatted: Centered, Space Before: 24 pt, After: 12 pt

Formatted: Indent: First line: 0.19", Space Before: 12 pt, After: 12 pt

Formatted: Font: 10 pt, English (U.S.)

Formatted: Indent: First line: 0.2"

Formatted: Not Highlight

Formatted: English (U.S.)

Field Code Changed

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Field Code Changed

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Field Code Changed

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Field Code Changed

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Gorte RW. 2007. Carbon Sequestration in Forest. CSR Report for Congress. Congressional Research Service. Accessed from https://fas.org/sgp/crs/misc/RL31432.pdf.

Hairiah K, Rahayu S. 2007. Pengukuran "Karbon Tersimpan" di Berbagai Macam Penggunaan Lahan. Bogor, Indonesia: World Agroforestry Centre-ICRAF. [Indonesian]

Hairiah K, Sitompul SM, Van Noordwijk M, Palm C. 2001. Methods for Sampling Carbon Stocks Above and Below Ground. ASB Lecture Note 4B. Bogor, Indonesia: International Centre for Research in Agroforestry. Available at https://www.asb.cgiar.org/

Harmon EH, Ferrell WK, Franklin JF. 1990. Effects on carbon storage of conservation of old growth forets to young forest. Science 297: 699-702. https://doi.org/ 10.1126/science.247.4943.699

Hashimoto T, Tange T~~.~~, Masumori M, Yagi H, Sasaki S, Kojima K. 2004. Allometric equations for pioneer tree species and estimation of the above~~-~~ground biomass of a tropical secondary forest in East Kalimantan. Tropics 14: 123-130. https://doi.org/10.3759/tropics.14.123

IPPC. 2008. 2006 IPPC Guidelines for National Greenhouse Gas Inventories – A Primer. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston HS, Miwa K, Srivastava N, Tanabe K (eds). Japan: IGES.

Karmini, Karyati, Widiati KY. 2020a. The role of tropical abandoned land relative to ecological and economic aspects. Forest and Society 4~~(1)~~: 181-194. https://doi.org/~~DOI:~~ 10.24259/fs.v4i1.8939

Karmini, Karyati, Widiati KY. 2020b. The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province, Indonesia. Biodiversitas J Biol Divers 21~~(11)~~: 5550-5558. https://doi.org/~~DOI:~~ 10.13057/biodiv/d211164

Karyati, Ipor IB, Jusoh I, Wasli ME, Seman IA. 2013. Composition and diversity of plant seedlings and saplings at early secondary succession of fallow lands in Sabal, Sarawak. Acta Biologica Malaysiana 2~~(3)~~: 85-94. ~~DOI: 10.7593/abm/2.3.85~~ ~~e~~ Accessed from https://repository.unmul.ac.id/bitstream/handle/123456789/2098/13%20composition%20and%20diversity_Karyati%20et%20al.pdf?sequence=1&isAllowed=n

Karyati, Ipor IB, Jusoh I, Wasli ME. 2018. Tree stand floristic dynamics in secondary forests of different ages in Sarawak, Malaysia. Biodiversitas J Biol Divers 19~~(3)~~: ~~687~~767-~~693~~773. https://doi.org/~~DOI:~~ 10.13057/biodiv/d190302

Karyati, Ipor IB, Jusoh I, Wasli ME. 2019a. Allometric equations to estimate the above-ground biomass of trees in the tropical secondary forests of different ages. Biodiversitas J Biol Divers 20~~(9)~~: 2427-2436. https://doi.org/~~DOI:~~ 10.13057/biodiv/d200901

Karyati, Widiati KY, Karmini, Mulyadi R~~M~~. 2019b. Development of allometric relationships for estimate above ground biomass of trees in the tropical abandoned land. Biodiversitas J Biol Divers 20~~(12)~~: 3508-3516. https://doi.org/~~DOI:~~ 10.13057/biodiv/d201207

Kenzo T, Ichie T, Hattori D, et al. ~~Itioka T, Handa C, Ohkubo T, Kendawang JJ, Nakamura M, Sakaguchi M, Takahashi N, Okamoto M, Tanaka-Oda A, Sakurai K, Ninomiya I.~~ 2009a. Development of allometric relationships for accurate estimation of above- and below-ground biomass in tropical secondary forests in Sarawak, Malaysia. ~~–~~J~~ournal of~~ Trop~~ical~~ Ecol~~ogy~~ 25: 371-386. https://doi.org/10.1017/S0266467409006129

Kenzo T, Furutani R, Hattori D, et al. ~~Kendawang JJ, Tanaka S, Sakurai K, Ninomiya I.~~ 2009b. Allometric equations for accurate estimation of above-ground biomass in logged-over tropical rainforests in Sarawak, Malaysia. J~~ournal of~~ For~~est~~ Res~~earch~~ 14~~(6)~~: 365-372. https://doi.org/10.1007/s10310-009-0149-1

Ketterings QM, Coe R, v~~V~~an Noordwijk M, Ambagau Y, Palm CA. 2001. Reducing uncertainty in the use of allometric biomass equations for predicting above-ground tree biomass in mixed secondary forests. For~~est~~ Ecol~~ogy and~~ Manag~~ement~~ 146: 199-209. https://doi.org/10.1016/S0378-1127(00)00460-6

Kiyono Y, Hastaniah. 2005. Pattern of slash-and-burn land use and their effects on forest succession~~.~~: ~~s~~Swidden-land forests in Borneo. Bull For For Prod Res Inst 4: 259-282.

~~Lasco RD, Visco RG, Pulhin JM. 2001. Secondary forests in the Philippines : Formation and transformation in the 20th century. Journal of Tropical Forest Science 13(4): 652-670. Accessed from https://www.jstor.org/stable/43582365 on 17.12.2020~~

Lamlom SH, Savidge RA. 2003. A reassessment of carbon content in wood: Variation within and between 41 North American species. Biomass Bioenergy 25: 381-388. https://doi.org/~~DOI:~~10.1016/S0961-9534(03)00033-3

Lanly JP. 1982. Tropical Forest Resources. FAO Forestry Paper 30. Rome, Italy: FAO.

Manuri S, Brack C, Rusolono T, ~~Noor'an F, Verchot L, Maulana SI, Adinugroho WC, Kurniawan H, Sukisno DW, Kusuma GA, Budiman A, Anggono RS, Siregar CA, Onrizal O, Yuniati D, Soraya E.~~ et al. 2017. Effect of species grouping and site variables on above~~-~~ground biomass models for lowland tropical forests of the Indo-Malay region. Ann For Sci 74 ~~(23)~~: 1-14. https://doi.org/10.1007/s13595-017-0618-1

Marklund LG. 1986. Wood Biomass – A Potential Resource for Energy and Industry. Food and Agriculture Organization of the United Nations, Bangkok.

~~Ministry of Forestry Indonesia~~BSN. ~~-~~2011. SNI 7725: 2011 ~~Development of Allometric Equations for Estimating Forest Carbon Stocks Based on Field Measurement~~ Penyusunan Persamaan Allometrik untuk Penaksiran Cadangan Karbon Hutan Berdasarkan Pengukuran Lapangan (Ground Based Forest Carbon Accounting). Indonesia: ~~Centre for~~

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Comment [Rev17]: DOI not valid, please check

Comment [KK18]: We've provided online link.

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)

Comment [Rev19]: Please provide online link for the document, if any

Comment [KK20]: Online link not available.

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Field Code Changed

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

~~Standardization and Environment, Ministry of Forestry.~~ BSN. Accessed from https://www.ekowisata.org/uploads/files/SNI_7725_penyusunan-persamaan-alometrik-untuk-penaksiran-ca.pdf

Mokria MG, Mekuria W, Gebrekirstos A, Aynekulu E, Belay B, Gashaw T, Brauning A. 2018. Mixed-species allometric equationsand estimation of aboveground biomass and carbon stocks in restoring degraded landscape in northern Ethiopia. Environ Res Lett 13: 1-14. https://doi.org/10.1088/1748-9326/aaa495

~~Morikawa Y, Inoue H, Yamada M, Hadriyanto D, Diana R, Marjenah, et al. Fatawi M, JIFPRO, JOPP. 2001. Carbon Accumulation of Man-Made Forest. In Monsoon Asia in Relation to CDM. Proc. Inter. Workshop BIO-REFOR Tokyo, pp. 43-51.~~

Nelson BW, Mesquita R, Pereira JLG, et al. ~~De Souza SGA, Batista T, Couto LB.~~ 1999. Allometric regressions for improved estimate of secondary forest biomass in the Central Amazon. For~~est~~ Ecol~~ogy and~~ Manag~~ement~~ 117: 149-167. https://doi.org/10.1016/S0378-1127(98)00475-7

Parlucha J, Barbadillo N, Sedenio P. 2017. Species-site matching based on growth performance evaluation of mixed native and exotic secondary forest in Musuan Bukidnon. J Biodiv Environ Sci 10 ~~(3)~~: 62-70.

~~Rai SN, Proctor J. 1986. Ecological studies on four rainforest in Karnataka, India: II. Litterfall. Journal of Ecology 764: 455-463938-958. https://doi.org/10.2307/2260267~~

Selaya NG, Anten NPR, OOmen RJ, Matthies M, Werger MJA. 2007. Above-ground biomass investments and light interception of tropical forest trees and lianas early in succession. Annals of Botany 99: 141-151. https://doi.org/10.1093/aob/mcl235

Sierra CA, d~~D~~el Valle JI, Orrego SA, et al. ~~Moreno FH, Harmon MA, Zapata M, Colorado GJ, Herrera MA, Lara W, Restrepo DE, Berrouet LM, Loaiza LM, Benjumea JF.~~ 2007. Total carbon stocks in a tropical forest landscape of the Porce Region, Colombia. For~~est~~ Ecol~~ogy and~~ Manag~~ement~~ 243: 299-309. https://doi.org/10.1016/j.foreco.2007.03.026

Stas S. 2011. Above-ground ~~B~~biomass and ~~C~~carbon ~~S~~stocks in ~~A~~a ~~S~~secondary ~~F~~forest in ~~C~~comparison with ~~A~~adjacent ~~P~~primary ~~F~~forest on Limestone in Seram, the Moluccas, Indonesia. Collaborative Land Use Planning and Sustainable Institutional Arrangements for Strengthening Land Tenure, Forest and Community Rights in Indonesia (CoLUPSIA). Accessed from https://www.cifor.org/knowledge/publication/5258/ on 17.12.2020

Tetemke BA, Birhane E, Rannestad MM, Eid T. 2019. Allometric models for predicting aboveground biomass of trees in the dry afromontane forests of Northern Ethiopia. Forests 10(12): 1-15. https://doi.org/10.3390/f10121114

Vieira SA, Alves LF, Aidar M, et al. ~~Araujo LS, Baker T, Batista JLF, Campos MC, Camargo PB, Chave J, Delitti WBC, Higuchi N, Honorio E, Joly CA, Keller M, Martinelli LA, de Mattos EA, Metzker T, Phillips O, dos Santos FAM, Shimabukuro MT, Silveira M, Trumbore SE.~~ 2008. Estimation of biomass and carbon stocks: the case of the Atlantic Forest. Biota Neotrop 8~~(2)~~: 21-29. https://doi.org/10.1590/S1676-06032008000200001

Vieilledent G, Fischer FJ, Chave J, et al. ~~Guibal D, Langbour P, Gérard J.~~ 2018. New formula and conversion factor to compute basic wood density of tree species using a global wood technology database. Am~~erican~~ J~~ournal of~~ Bot~~any~~ 105~~(10)~~: 1~~653~~–9~~1661~~. https://doi.org/10.1002/ajb2.1175

~~Yamakura T, Hagihara A, Sukardjo S, Ogawa H. 1986b. Above ground biomass of tropical rain forest stands in Indonesian Borneo. Vegetatio 68: 71-82. https://doi.org/10.1007/BF00045057~~

Comment [Rev21]: Please provide online link for the document, if any

Comment [KK22]: We've provided online link.

Formatted: English (U.S.)

Formatted: Not Highlight

Comment [Rev23]: Please provide online link for the document, if any

Comment [KK24]: This reference is not used.

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Font color: Red

Formatted: English (U.S.)

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: English (U.S.)

Field Code Changed

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)

Formatted: Not Highlight

Formatted: English (U.S.)