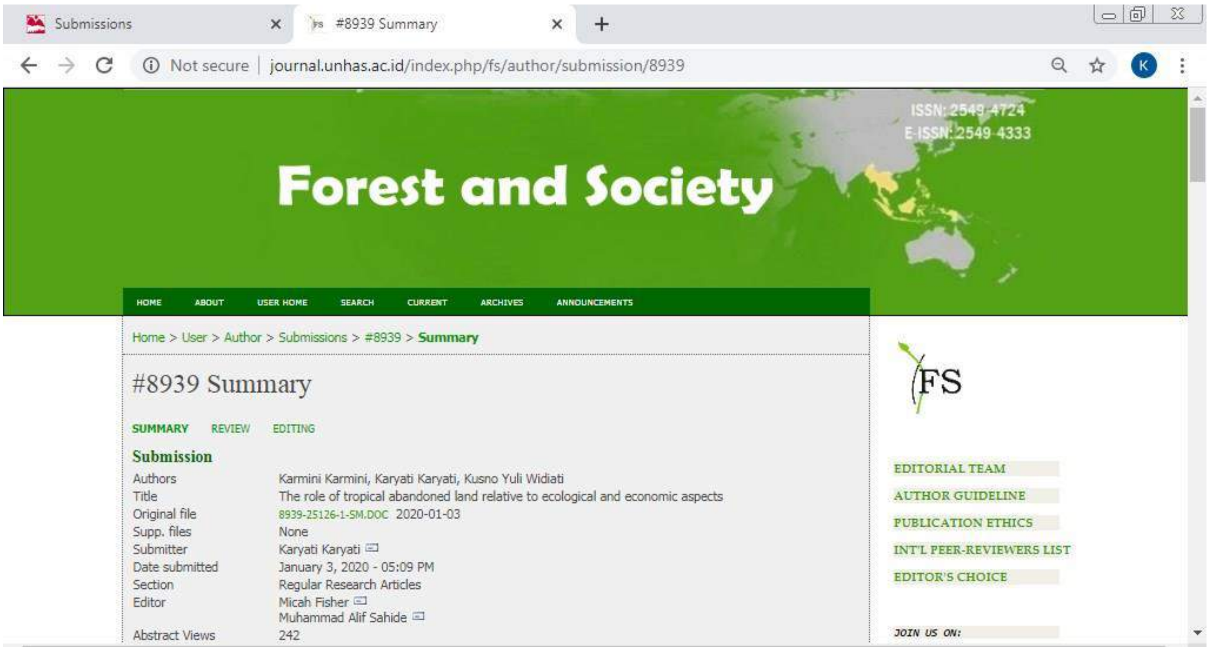
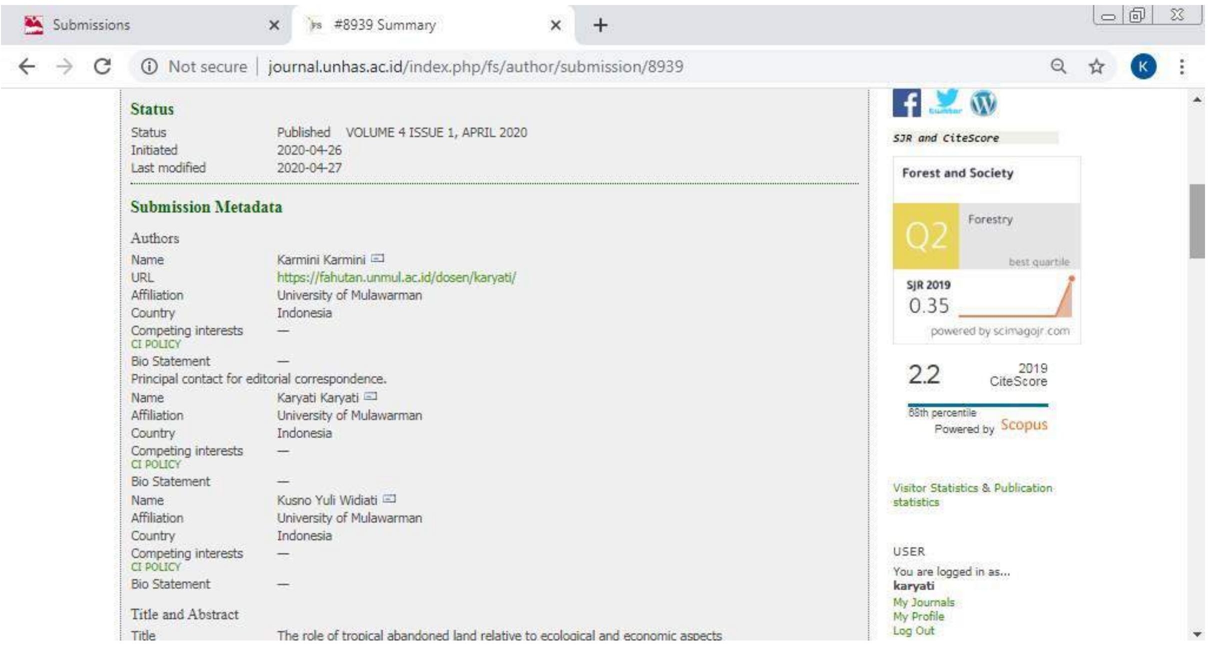
BUKTI-BUKTI PROSES REVIEW (KORESPONDENSI)

Judul	:	The Role of Tropical Abandoned Land Relative to Ecological and Economic Aspects. Forest and Society
Penulis	:	Karmini, Karyati, dan Kusno Yuli Widiati
Nama Jurnal	:	Forest and Society
Volume/Nomor/Tahun/Halaman	:	4, 1, 2020, 181-194
ISSN	:	2549-4724/E-ISSN: 2549-4333
Penerbit	:	Universitas Hasanuddin
DOI	:	10.24259/fs.v4i1.8939





Submissions × | #8939 Summary ×

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Title and Abstract

Title	The role of tropical abandoned land relative to ecological and economic aspects
Abstract	The floristic structure and composition of abandoned lands in the tropic have been observed to be changing dynamically during the succession process. This is mostly because they are not utilized maximally, therefore, there is a need to assess the economic and ecological impacts of this land abandonment in tropical areas. This study was conducted to determine the ecological aspects of standstructure, floristic composition, and species diversity and analyze the economic aspects of standing trees in tropical abandoned land. The vegetation containing woody trees with a diameter at breast height (DBH) of > 5 cm were surveyed at six subplots sized 20 m × 20 m. The economic parameters were evaluated using data of log price, logging cost, profit margin, and stumpage value of standing trees in the study plot and a total of 126 trees including 26 species of 25 genera of 18 families were recorded. The most common species found were *Macaranga tanarius* with 50.60%, *Bridelia glauca* with 49.13%, and *Pterospermum javanicum* with 29.05% based on Importance Value Index (IVi). Moreover, the diversity, dominance, evenness, and richness indices were 1.23, 0.09, 0.87, and 5.17 respectively while the total log price at the abandoned land was 1,462.02 USD m^{-3} with an average value of 56.23USD m^{-3}. The total and mean values of logging costs were 1,212.24USD ha^{-1} and 46.62USD ha^{-1}, respectively while the total profit margin of log selling was USD337.39m^{-3} at maximum with an average of 12.98 USD m^{-3}. Furthermore, the average stumpage value was 83.05 USD ha^{-1} while the total was calculated to be 2,159.36 USD ha^{-1}.These findings showed the utilization of abandoned lands with respect to ecology and economic aspects has the ability to increase community welfare and support the implementation of developmental programs in the country.

Indexing

Keywords	Abandoned land; diversity; economic; floristic structure; stumpage value
Geo-spatial coverage	Southeast Asian; Indonesia
Chronological or historical coverage	—
Research sample characteristics	—
Type, method or approach	Research article
Language	en

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#8939 Review

SUMMARY **REVIEW** EDITING

Submission

Authors	Karmini Karmini, Karyati Karyati, Kusno Yuli Widiati
Title	The role of tropical abandoned land relative to ecological and economic aspects
Section	Regular Research Articles
Editor	Micah Fisher Muhammad Alif Sahide

Peer Review

Round 1

Review Version	8939-25127-1-RV.DOC 2020-01-03
Initiated	2020-01-03
Last modified	2020-01-16
Uploaded file	None
Editor Version	8939-26322-1-ED.DOCX 2020-01-28
Author Version	8939-26321-1-ED.DOCX 2020-01-28 8939-26321-2-ED.DOCX 2020-01-28 8939-26321-3-ED.DOCX 2020-01-28

Round 2

Review Version	8939-25127-2-RV.DOCX 2020-01-28
Initiated	2020-01-28
Last modified	2020-01-28
Uploaded file	None

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Round 2

Review Version	8939-25127-2-RV.DOCX 2020-01-28
Initiated	2020-01-28
Last modified	2020-01-28
Uploaded file	None

Editor Decision

Decision	Accept Submission 2020-02-01
Notify Editor	Editor/Author Email Record 2020-02-01
Editor Version	8939-26322-2-ED.DOCX 2020-01-28
Author Version	8939-26321-4-ED.DOCX 2020-02-01 DELETE 8939-26321-5-ED.DOCX 2020-02-01 DELETE
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SUMMARY REVIEW **EDITING**

Submission

Authors	Karmini Karmini, Karyati Karyati, Kusno Yuli Widiati
Title	The role of tropical abandoned land relative to ecological and economic aspects
Section	Regular Research Articles
Editor	Micah Fisher Muhammad Alif Sahide

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Supplementary Files	FILE	
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2. Proofreader	—	—	—
3. Layout Editor	—	—	—

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[FS] Submission Acknowledgement — Yahoo/Inbox

Muhammad Alif K. Sahide <uhjournal@unhas.ac.id> — Sat, Jan 4 at 9:09 AM
To: Karyati Karyati

The following message is being delivered on behalf of Forest and Society

Karyati Karyati:

Thank you for submitting the manuscript, "The Role of Tropical Abandoned Land on Ecological and Economic Aspects" to Forest and Society. 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:

Manuscript URL: http://journal.unhas.ac.id/index.php/fs/author/submission/8939
Username: karyati

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

Muhammad Alif K. Sahide
Forest and Society

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[FS] Editor Decision Yahoo/Inbox

Muhammad Alif K. Sahide <uhjournal@unhas.ac.id> Fri, Jan 17 at 9:55 AM
To: Karyati Karyati
Cc: Karmini Karmini, Kusno Yuli Widiati

The following message is being delivered on behalf of Forest and Society

---

Dear Dr. Karyati Karyati:

We have received the reviewers' comments on your submission to Forest and Society, "The Role of Tropical Abandoned Land on Ecological and Economic Aspects". Our decision is: Revisions Required

If you can suitably address their comments, below, I invite you to submit a revised version of your manuscript, for consideration. Please carefully address all the issues raised in the comments. We expect to receive your revision within 2 weeks from today.

If you are submitting a revised manuscript please also:
a) highlight any change in the text using the "Track Changes" function, and provide a point by point outline of the revisions, following the reviewers' comments
AND/OR

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If you are submitting a revised manuscript please also:
a) highlight any change in the text using the "Track Changes" function, and provide a point by point outline of the revisions, following the reviewers' comments
AND/OR
b) provide a suitable rebuttal to each reviewer comment not addressed in the text.

I look forward to receiving your revised manuscript.

Yours sincerely,

Muhammad Alif K. Sahide
Universitas Hasanuddin
alif.mksr@gmail.com

Reviewer A:

Subject addressed in this article is worthy of investigation. There is both a cognitive and utilitarian motivation (in case of ecological and economic aspects of tropical abandoned land in East Kalimantan, Indonesia) for the analysis conducted. Please refer to the following issues:

1. The paper is lacking a strong scientific hypothesis. I think in general the article value can be improved. The aim of the paper as well as unclear (add in Introduction). I think the

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Muhammad Alif K. Sahide
Universitas Hasanuddin
alif.mksr@gmail.com

Reviewer A:

Subject addressed in this article is worthy of investigation. There is both a cognitive and utilitarian motivation (in case of ecological and economic aspects of tropical abandoned land in East Kalimantan, Indonesia) for the analysis conducted. Please refer to the following issues:

1. The paper is lacking a strong scientific hypothesis. I think in general, the article value can be improved. The aim of the paper as well as its scientific contribution is unclear (add in Introduction). I think the motivations for this study need to be made clearer in case of sustainability (In Introduction, last paragraph).• The authors should convert IDR to USD (or Euro). This is important for foreign readers.
• Please write "conclusion" - must be clear-cut and normative.
• Grammar and syntax could be improved. Revision with the help of a native English speaker is recommended. Editorial errors ("sp (without dot)", "spesies", "opportunity"; "indigeneous", in references "Journal of Tropical Ecology (dot?)"; Figure 1 (source?); etc).

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Reviewer D:

This manuscript has the potential to be a good article. However, the aim of the paper, as well as its scientific contribution, it is unclear, please add both in abstract and introduction.

I recommend rewriting the abstract following these 7 questions.
Abstract
• Why does your article/research topic matter? [purpose]
• What is the research question? [purpose]
• What is the framework for the research? [methods]
• What data are you [using? [methods]
• How did you do the research? [methods]
• What did you find? [findings/results]
• Again, so what? [relevance]'

Grammar: please proof this article to the native English

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[FS] Editor Decision 5 Yahoo/Inbox

Muhammad Alif K. Sahide <alif.mksr@gmail.com> Mon, Jan 20 at 11:52 PM
To: karyati.hanapi@yahoo.com, karmini.kasiman@yahoo.com, kywidiati@gmail.com

We sent this email (below) in 17 January 2020, Would you please to confirm

---

Dear Dr. Karyati Karyati:

We have received the reviewers` comments on your submission to Forest and Society, "The Role of Tropical Abandoned Land on Ecological and Economic Aspects". Our decision is: Revisions Required

If you can suitably address their comments, below, I invite you to submit a revised version of your manuscript, for consideration. Please carefully
address all the issues raised in the comments. We expect to receive your revision within 2 weeks from today.

If you are submitting a revised manuscript please also:
a) highlight any change in the text using the "Track Changes" function, and provide a point by point outline of the revisions, following the reviewers`
comments
AND/OR
b) provide a suitable rebuttal to each reviewer comment not addressed in the text.

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AND/OR
b) provide a suitable rebuttal to each reviewer comment not addressed in the text.

I look forward to receiving your revised manuscript.

Yours sincerely,

Muhammad Alif K. Sahide
Universitas Hasanuddin
alif.mksr@gmail.com

Reviewer A:

Subject addressed in this article is worthy of investigation. There is both a cognitive and utilitarian motivation (in case of ecological and economic
aspects of tropical abandoned land in East Kalimantan, Indonesia) for the analysis conducted. Please refer to the following issues:

1. The paper is lacking a strong scientific hypothesis. I think in general, the article value can be improved. The aim of the paper as well as
its scientific contribution is unclear (add in Introduction). I think the motivations for this study need to be made clearer in case of sustainability
(In Introduction, last paragraph).• The authors should convert IDR to USD (or Euro). This is important for foreign readers.
• Please write "conclusion" - must be clear-cut and normative.
• Grammar and syntax could be improved. Revision with the help of a native
...nended. Editorial errors ("sp (without dot)",

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• Grammar and syntax could be improved. Revision with the help of a native English speaker is recommended. Editorial errors ("sp (without dot)", "spesies", "opportunity"; "indigeneous", in references "Journal of Tropical Ecology (dot?)"; Figure 1 (source?); etc).

Reviewer D:

This manuscript has the potential to be a good article. However, the aim of the paper, as well as its scientific contribution, it is unclear, please add both in abstract and introduction.

I recommend rewriting the abstract following these 7 questions.
Abstract
• Why does your article/research topic matter? [purpose]
• What is the research question? [purpose]
• What is the framework for the research? [methods]
• What data are you [using? [methods]
• How did you do the research? [methods]
• What did you find? [findings/results]
• Again, so what? [relevance]'

Grammar: please proof this article to the native English

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Karyati Hanapi <karyati.hanapi@yahoo.com> Tue, Jan 21 at 7:19 AM
To: Muhammad Alif K. Sahide

Dear Editor in Chief,

We thank you for receiving the reminder email. We confirm you have received an email in 17 January 2020. We will sent our revised manuscript before 31 January 2020.
Thank you very much.

Your sincerely,

Karyati

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Muhammad Alif K. Sahide <alif.mksr@gmail.com> Tue, Jan 21 at 10:48 AM

To: Karyati Hanapi

Dear Dr. Karyati

Thank you very much for your confirmation

Best regards
Alif Sahide

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Karyati Hanapi <karyati.hanapi@yahoo.com> Tue, Jan 28 at 5:23 PM

To: Muhammad Alif K. Sahide

Cc: Karmini Kasiman, Kusno Widiati, Karyati Kasiman

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Karyati Hanapi <karyati.hanapi@yahoo.com> Tue, Jan 28 at 5:23 PM

To: Muhammad Alif K. Sahide

Cc: Karmini Kasiman, Kusno Widiati, Karyati Kasiman

Dear Editor in Chief,

We attached the proof read of manuscript, the certification of proof read, and feedback for review comments.
Thank you very much.

Regards,

Karyati

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Muhammad Alif K. Sahide <alif.mksr@gmail.com> Tue, Jan 28 at 5:42 PM
To: Karyati Hanapi
Cc: Karmini Kasiman, Kusno Widiati, Karyati Kasiman

Dear Author

Thank you very much for your recent revision, we confirm that we have received the revision, along with the proof-read certificate, track change ms, and response to the reviewers' comments.

We will evaluate it soon, when we have decision, we will inform you

Best regards
Alif Sahide
Editor

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[FS] Editor Decision 3 Yahoo/Sent

Muhammad Alif K. Sahide <uhjournal@unhas.ac.id> Wed, Jan 29 at 12:31 PM
To: Karyati Karyati
Cc: Karmini Karmini, Kusno Yuli Widiati

The following message is being delivered on behalf of Forest and Society

---

Dear Karyati Karyati:

We have received the reviewers' comments on your submission to Forest and Society, "The Role of Tropical Abandoned Land on Ecological and Economic Aspects".

Our decision is: Minor revision

If you can suitably address their comments, below, I invite you to submit a revised version of your manuscript, for consideration. Please carefully address all the issues raised in the comments. We expect to receive your revision within 2 weeks from today.

Please see/use the recent file in the attachment.

If you are submitting a revised manuscript please also:
the text using the "Track Changes" function, and

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If you are submitting a revised manuscript please also:
a) highlight any change in the text using the "Track Changes" function, and provide a point by point outline of the revisions, following the reviewers' comments
AND/OR
b) provide a suitable rebuttal to each reviewer comment not addressed in the text.

I look forward to receiving your revised manuscript.

Yours sincerely,

Muhammad Alif K. Sahide
Universitas Hasanuddin
alif.mksr@gmail.com

Reviewer A:

The author has carefully reviewed all suggestions, and changes have been made and marked to the last manuscript where appropriate. The paper is interesting, but needs some work to be acceptable.
Currency entry is incorrect (order, space). Requires changes (e.g., 1.462.02 USD m-3 and 56.23 USD m-3). Please enter the exchange rate (day, converter). Conclusions must be more clear-cut and normative. The results should be expanded significantly and quantitatively.

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Reviewer B:
The manuscript is improved now

Reviewer A:

The author has carefully reviewed all suggestions, and changes have been made and marked to the last manuscript where appropriate. The paper is interesting, but needs some work to be acceptable.
Currency entry is incorrect (order, space). Requires changes (e.g., 1.462.02 USD m-3 and 56.23 USD m-3). Please enter the exchange rate (day, converter). Conclusions must be more clear-cut and normative. The results should be expanded significantly and quantitatively.

Reviewer B:
The manuscript is improved now

Editorial comment.

- Please make sure only citation in the text is included in the reference, and vice versa
- Please make sure the citation follows APA style
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Reviewer B:
The manuscript is improved now

Reviewer A:

The author has carefully reviewed all suggestions, and changes have been made and marked to the last manuscript where appropriate. The paper is interesting, but needs some work to be acceptable.
Currency entry is incorrect (order, space). Requires changes (e.g., 1.462.02 USD m-3 and 56.23 USD m-3). Please enter the exchange rate (day, converter). Conclusions must be more clear-cut and normative. The results should be expanded significantly and quantitatively.

Reviewer B:
The manuscript is improved now

Editorial comment.

- Please make sure only citation in the text is included in the reference, and vice versa
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Editorial comment.

- Please make sure only citation in the text is included in the reference, and vice versa
- Please make sure the citation follows APA style
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Karyati Hanapi <karyati.hanapi@yahoo.com> Wed, Jan 29 at 2:26 PM
To: Muhammad Alif K. Sahide
Cc: karmini.kasiman@yahoo.com, Kusno Widiati

Dear Editor in Chief

We thank you for the email. We will revise the manuscript as soon as possible.

Regards,

Karyati

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Karyati Hanapi <karyati.hanapi@yahoo.com> Fri, Jan 31 at 9:43 PM
To: Muhammad Alif K. Sahide
Cc: karmini.kasiman@yahoo.com, Kusno Widiati, Karyati Kasiman

Dear Editor in Chief,

As attached below, our revised manuscript and response to the reviewer's comments.
Thank you very much.

Regards,

Karyati

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[FS] Editor Decision 2 — Yahoo/Sent

Muhammad Alif K. Sahide <uhjournal@unhas.ac.id> — Sat, Feb 1 at 8:29 PM
To: Karyati Karyati
Cc: Karmini Karmini, Kusno Yuli Widiati

The following message is being delivered on behalf of Forest and Society

---

Dear Karyati Karyati:

We have reached a decision regarding your submission to Forest and Society, "The Role of Tropical Abandoned Land on Ecological and Economic Aspects".

Our decision is to: Accept Submission

We will send the recent revision for the final editing process, when it is ready we will send it to you for final revision and your approval. Please fill the metadata based on the final edit revision

Regards,
Muhammad Alif K. Sahide
Editor

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Karyati Hanapi <karyati.hanapi@yahoo.com> — Sun, Feb 2 at 9:51 AM
To: Muhammad Alif K. Sahide
Cc: karmini.kasiman@yahoo.com, Kusno Widiati, Karyati Kasiman

Dear Editor in Chief,

We are happy to receive your email. We had fill the metadata based on the final edit revision.
Thank you very much.

Regards,

Karyati

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The role of tropical abandoned land relative to ecological and economic aspects 4 Yahoo/Sent

Muhammad Alif K. Sahide <alif.mksr@gmail.com> Sun, Apr 26 at 10:12 PM
To: Karyati Hanapi
Cc: karmini.kasiman@yahoo.com, Kusno Widiati, Karyati Kasiman

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We have made final proof for your article which is scheduled to be published at the end of this month (April 2020). Our editor has fixed some (minor) grammatical error in the title and abstract. Please find the final proof in the attachment.

How to cite this article: Karyati, K., Karmini, K., & Widiati, K. (2020). The role of tropical abandoned land relative to ecological and economic aspects. *Forest and Society*, 4(1), 181-194. doi:http://dx.doi.org/10.24259/fs.v4i1.8939

Best Regards,
Alif Sahide
Editor, Forest and Society

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Karyati Hanapi <karyati.hanapi@yahoo.com> Tue, Apr 28 at 8:42 AM
To: Muhammad Alif K. Sahide

Dear Editor "Forest and Society"

We are very happy and grateful for the publication of our article in the Forest and Society. We want to inform you that the order of the first author's name is reversed with the second author in the table of contents. We apologize if you are not pleased. Thank you very much.

Regards,

Karyati

Faculty of Forestry, Mulawarman University

East Kalimantan, Indonesia

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Muhammad Alif K. Sahide <alif.mksr@gmail.com> Tue, Apr 28 at 10:24 AM
To: Karyati Hanapi

Dear Karyati

We have fixed the order of the author in metadata system, it is now "Karmini, K., Karyati, K., & Widiati, K. (2020). The role of tropical abandoned land relative to ecological and economic aspects. *Forest and Society, 4*(1), 181-194. doi:http://dx.doi.org/10.24259/fs.v4i1.8939"

Best regards
Alif

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194. doi:http://dx.doi.org/10.24259/fs.v4i1.8939"

Best regards
Alif

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Karyati Hanapi <karyati.hanapi@yahoo.com> Tue, Apr 28 at 11:03 AM
To: Muhammad Alif K. Sahide

Dear Editor,

We really appreciate your help.
Thank you very much.

Best regards,

Karyati

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Published in Forest and Society 3 Yahoo/Sent

Muhammad Alif K. Sahide <alif.mksr@gmail.com> Tue, Apr 28 at 11:31 PM
To: Karyati Hanapi
Cc: Micah Fisher

Dear Ibu Karyati

I am pleased to inform that we have published publications

Karmini, K., Karyati, K., & Widiati, K. (2020). The role of tropical abandoned land relative to ecological and economic aspects. *Forest and Society, 4*(1), 181-194. doi:http://dx.doi.org/10.24259/fs.v4i1.8939

We would like also to ask you to share some nice photos represent your article, we are planning to build Flickr albums or blogs for each issue of the journal to reach or to attract more type of readership

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Karyati Hanapi Dear Editor, We are very happy for the opportunity to put Thu, Apr 30 at 9:28 AM

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Karyati Hanapi <karyati.hanapi@yahoo.com> Thu, Apr 30 at 9:28 AM
To: Muhammad Alif K. Sahide
Cc: karmini.kasiman@yahoo.com, Kusno Widiati

Dear Editor,

We are very happy for the opportunity to publish our article in Forest and Society. We herewith attach several photographs of fieldwork related to research.
Thank you very much.

Best regards,

Karyati

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Karyati Hanapi <karyati.hanapi@yahoo.com>
To: Muhammad Alif K. Sahide
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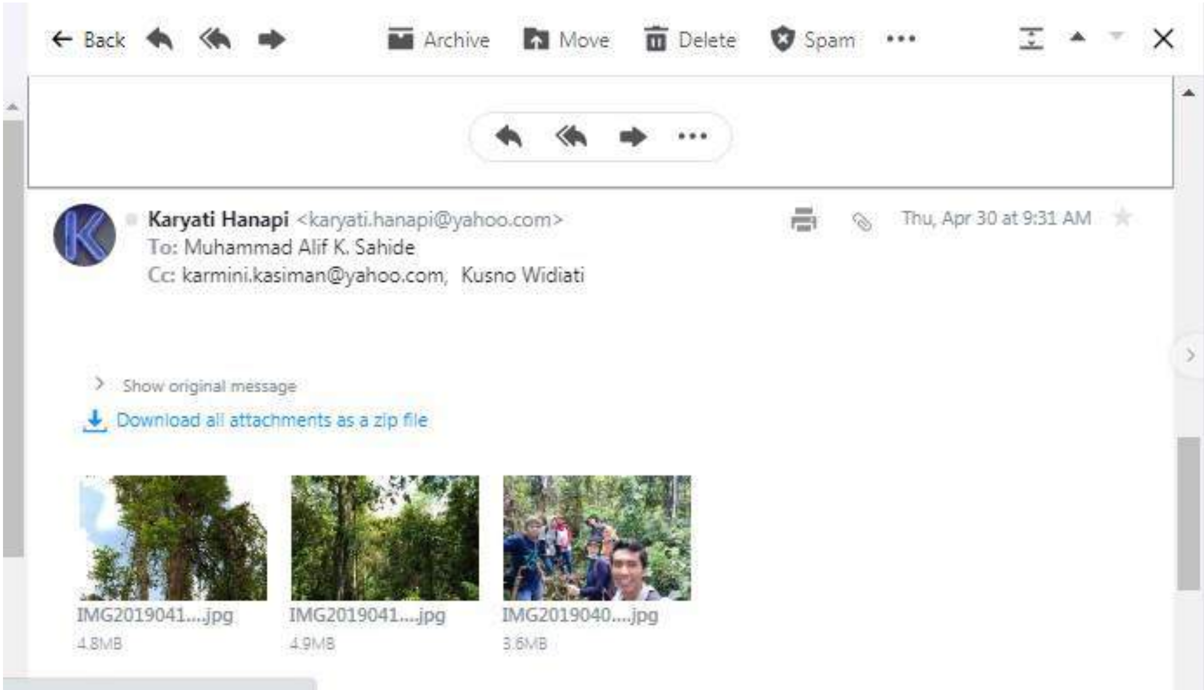
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Regular Research Article

The Role of Tropical Abandoned Land on Ecological and Economic Aspects

Abstract: The floristic structure and composition of abandoned lands changein the tropic have been observed to be changing dynamically during the succession process in the tropic. The existence. This is mostly because they are not utilized maximally, therefore, there is a need to assess the economic and ecological impacts of lands afterthis land abandonment could be assessed economically. The potential of large number of abandoned lands in the tropic has not been used optimally. The information on the ecological and economic aspects of tropical abandoned land is neededareas. This study was conducted to determine the ecological aspects of floristic structure, composition, and diversity and analyze the economic aspects of standing trees in the tropical abandoned land. The vegetation surveys of allcontaining woody trees with diamatera diameter at breast height (DBH) of ≥ 5 cm were conductedsurveyed at six sub plotssubplots sized 20 m × 20 m. The economic parameters were assessed byevaluated using data of log price, logging cost, profit margin, and stumpage value of standing trees in the study plot. A and a total of 126 trees including 26 species of 25 genera of 18 families were recorded. The most common species wasfound were *Macaranga tanarius* (with 50.60%),%, *Bridelia glauca* (with 49.13%),%, and *Pterospermum javanicum* (with 29.05%)% based on Importance Value Index (IVi). TheMoreover, the diversity, dominance, evenness, and richness indices were 1.23, 0.09, 0.87, and 5.17 respectively. Total of while the total log pricesprice at the abandoned land was as much as USD1,462.02 m^{-3} andwith an average value of USD56.23 m^{-3}. TotalThe total and mean values of logging costs in abandoned land were USD1,212.24 ha^{-1} and IDR637,174.40 ha^{-1}, respectively. Total while the total profit margin of log selling was as much as USD337.39m^{-3} at maximum with thean average of IDR177,337.28 m^{-3}. TheFurthermore, the average of stumpage values at abandoned land was as much as value was USD83.05 ha^{-1} withwhile the total ofwas calculated to be USD2,159.36 ha^{-1}. TheThese findings showed the utilization of abandoned lands with respect to ecology and economic aspects canhas the ability to increase the community welfare as well asand support the development programimplementation of developmental programs in the country.

Keywords: Abandoned land, diversity, economic, floristic structure, stumpage value.

1. Introduction

DynamicsThe dynamics at several scales determine the plant diversity within a regenerating fallowfallows (Lawrence 2004). Part of the cause in the increase of secondary forest area is because of exploitation of forest) exploited for agricultural purposes, mainly bythrough shifting cultivation. Shifting cultivation has been practiced all over the world and This is observed to be a global phenomenon because two-thirds of the world's secondary forest were recorded to have been cultivated through the process in 1980 was shifting cultivation fallow, whereas about with 49% of the area deforestedrecorded annually in tropical Asia is attributed to shifting cultivation (Lanly 1982). Secondary forest isThese forests are defined as the type of vegetation that results afterresulting from the clearing of natural high forest vegetation has been disturbed or cleared for shifting cultivation prior tobefore abandonment (Abebrese 2002; Johnson and Miyanishi 2007; Keddy 2007; Misra 1992). The secondary forests are reflected in theirThey are characterized by the structure and extent of vegetative cover, as well as their composition in terms of dominant and secondary species (Mittelman 2001; Van Breugel et al. 2006). However, the principal types include the Swidden fallow secondary forests, along with and some secondary forest other gardens, are the principal types of secondary forests (as reported by Chokkalingam et al. (2001).

According to Van Breugel et al. (2006) stated that to understand), understanding the mechanisms of secondary forest succession~~,~~ requires the consideration of the time ~~since~~of abandonment as ~~to be considered as~~ a compound factor ~~is integrating~~to integrate the variables of plant community ~~structure. Plant community~~ ecology ~~is~~ the ~~sum~~ total ~~of the~~ effective conditions ~~which determine~~determining the existence of the ~~plant or community in a given~~ plants on the land (Tansley 1993). ~~Dynamics at several scales determine plant diversity within a regenerating fallow (Lawrence 2004).~~ Secondary forests are ~~products of~~caused by human activity and fast~~-~~-growing ecosystems whose species life cycles coincide with those of human land uses. In addition, ~~secondary forests~~they are also assets for the conservation of biodiversity in the tropics due to their many ~~other~~ biotic characteristics such as the ability to improve soil and water quality ~~or which~~as well as to conserve genetic material, nutrients, moisture, and/or soil organic ~~matter~~matters (Brown and Lugo 1990).

With the ~~expansion of their area and the~~ continuous depletion of primary forests, ~~the~~ secondary forests have become increasingly important ~~for maintaining~~to maintain the larger habitat for biodiversity conservation (Mittelman 2001). ~~As a result of the increase in the deforestation rate, secondary forests cover~~This is associated with their coverage of more than 600 million ha of the land area in the tropics ~~and its accounting~~which accounts for about 40% of the total forest area ~~with rates of~~as well as the formation ~~are about~~rates estimated at 9 million ha year^{-1} (Brown and Lugo 1990). Moreover, FAO (1996) estimated the area of secondary forest in 1990 in Asia to be 87.5 ~~millions~~million ha~~,~~ while the figures for Latin America and Africa were 165 and 90 ~~millions~~million ha, respectively. These data~~,~~ and the awareness of the accelerated changes in the forest situation in countries like the Philippines, Indonesia, China, and Malaysia~~,~~ strongly suggest ~~that the~~ future goods and services ~~that society obtain~~obtained from the tropical forests ~~will~~would increasingly ~~have to come~~be sourced from secondary ~~forests,~~ or ~~from~~ some other ~~kind~~kinds of anthropogenically-induced ~~forest. These probably include~~forests such as the timber, environmental services, biodiversity conservation, and forest products for the rural poor (De Jong et al. 2001).

The total land area in Indonesia ~~reaches around~~ is estimated to be 190 million hectares~~. From~~ and 2/3 of these~~, 2/3 portion~~ are referred to as forest areas ~~and~~ managed by the Ministry of Forestry~~. Meanwhile~~ while the ~~other~~remaining 1/3 is ~~managed in the form of~~for business ~~use right~~ (HGU) ~~to~~and building ~~rights~~ (HGB). However, the National Land Agency (BPN) indicated ~~that~~ 7.5 million hectares of land ~~in Indonesia have~~ has the potential ~~as~~to be abandoned ~~land. These lands are in the forest area~~, both in and outside the forest ~~area. Many~~areas, and several people ~~assume that abandoned land is not yet ecologically and economically useful. However the existence of abandoned lands can be service conservation and~~ have assumed these lands have no usefulness. However, they have certain ecological and economic benefits~~. Many~~ and several studies ~~had~~have been ~~done~~conducted on the ecological aspect such as the floristic composition and structure of the tropical secondary forest in Borneo Island~~. However,~~ as well as the less information ~~is available~~provided on the ecological and economic aspects of tropical abandoned land in East Kalimantan. This study was, therefore, conducted ~~in order~~ to determine the ecological aspect such as floristic structure, composition, and species diversity as well as ~~analyze~~the economic aspect of standing trees such as log price, logging cost, profit margin, and stumpage value in an abandoned land. The ~~information on the ecological~~findings are expected to be useful in conserving and ~~economic aspects of the abandoned land is important in order to conserve and manage the~~managing tropical forest and ~~environment ecosystem.~~environmental ecosystems.

2. Materials and Methods

2.1. Study Site

The study was conducted in Salo Cella Village, Muara Badak Sub-district, Kutai Kartanegara

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Districts, East Kalimantan Province, Indonesia ~~(Figure 1). The~~ with the geographic location of ~~this site is~~ 0°17'18.7''S 117°18'08.2''E~~.~~ as shown in Figure 1. Salo Cella ~~Village~~ is one of 13 villages in Muara Badak ~~and about~~located 10 km from the capital of Sub-district~~. The~~ with a population of ~~Muara Badak Sub-district is~~ 57.712 ~~persons in coverage~~most of which are farmers and an area of 939.09 km^2 ~~wide. The~~dominated by lowland mixed dipterocarp forest. Moreover, the average monthly ~~rainfall~~ and amount of rainfall ~~are~~were recorded to be 141 mm and 11 raindays in 2017 (Statistics Kutai Kartanegara Regency 2018). ~~Most of the populations are as farmer. Muara Badak~~The subdistrict is administratively bordered ~~with~~by Marang Kayu Sub-district, Anggana Sub-district Samarinda City, Makassar Strait, and Tenggarong Seberang Sub-district ~~at~~on the north, south, east, and west ~~sides,~~ respectively. ~~The potential~~Furthermore, the sectors of Muara Badak with economic potentials are ~~of~~ oil and gas ~~producer~~, fishery, and plantation ~~sectors. The land coverage of area is dominated by lowland mixed dipterocarp forest~~.

2.2. Data Collection

The vegetation and economic surveys of the study site were conducted from March to August 2019~~. Six sub plots~~ through the establishment of six subplots sized 20 m × 20 m ~~were established within study site. The diameter at breast height (DBH) and total height of~~. Moreover, all woody trees with DBH of ≥ 5 cm within the plot were enumerated and their species ~~were~~ identified.

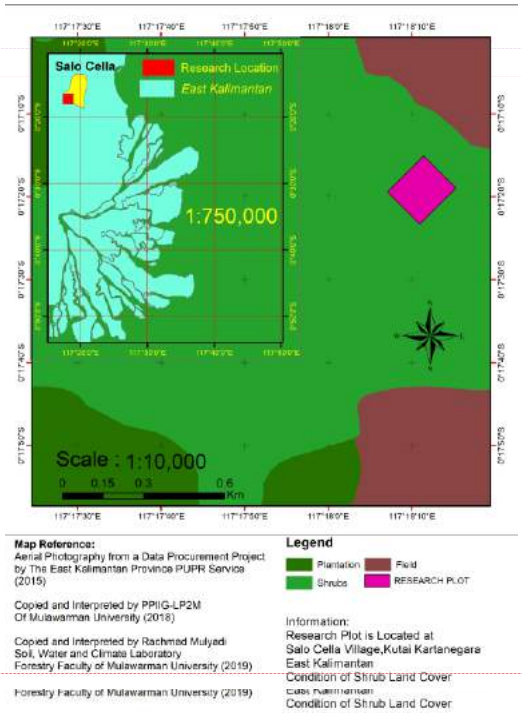

Figure 1. Map of the study site in Muara Badak Sub-district, Kutai Kartanegara District, East Kalimantan Province, Indonesia.

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2.3. Data Analysis

2.3.1. Ecological Aspect

Individual basal area (BA) and volume (V) were determined ~~by~~ using the following formulas (Husch et al. 1982):

Individuals BA = π (DBH/2)^2. 10^{-4} .... (1)

Individuals V = ¼ π × DBH^2. 10^{-4} × H × f .... (2)

where: DBH is the diameter at breast height (cm), 'H' is tree height (m), and '~~f~~'f' is the form factor.

The dominant species ~~of community~~ within the plots were measured ~~by importance value index~~using the Importance Value Index (IVi) (Fachrul 2007):

RF = (Frequency of a species / Total ~~of~~ frequencies of all species) × 100 .... (3)

Rd = (The number of individual ~~of a~~ species / Total number of individuals) × 100 .... (4)

RD = (Total basal area for a species / Total basal area for all species) × 100 .... (5)

IVi = RF + Rd + RD .... (6)

where: RF is relative frequency, Rd is relative density, and RD is relative dominance.

The species diversity ~~of~~for standing trees in the study site ~~were~~was described ~~by~~using four ~~diversity~~ indices ~~of~~including Shannon-Wiener's diversity index (H'), Simpson's dominance index (D_s), Pielou's evenness index (J'), and Margalef's richness index (R) (Odum 2005):

$$H' = -\sum_{i=1}^{s}\left(\frac{n_i}{N}\right)\ln\left(\frac{n_i}{N}\right) \quad (7)$$

$$D_s = \sum_{i=1}^{s}\left(\frac{n_i}{N}\right)^2 \quad (8)$$

$$J' = \frac{H'}{\ln(S)} \quad (9)$$

$$R = \frac{(S-1)}{\ln n} \quad (10)$$

where~~:~~ n_i = number of individuals of the *i*- th species, N = total number of all the individuals in a unit area, and S = number of species in each plot.

2.3.2. Economic Aspect

The equivalent merchantable height~~ and~~, number of logs~~ based on~~, and diameter class ~~and number of logs is~~are presented in Table 1~~. Reduction factor~~ while the reduction factors of log price based on the diameter class ~~can be seen~~are shown in Table 2.

Table 1. Merchantable tree heights.

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
15 – 30	1	5
+30 – 60	2	10
+60 – 75	3	15
75 ke atas	4	20

~~Souce~~Source: Forestry Department of Pinansular Malaysia (FDPM) (1997)

Table 2. Reduction cost of log price.

DBH size class (cm)	Reduction factor

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15 – 29	0,450
30 – 44	0,300
45 – 49	0,150
50 – 54	0,025
55 and above	0,000

Source: Noor et al. (1992) and Hanum et al. (2001)

Logging cost ~~is as much as~~was reported to be IDR480.000,00 (Hikmat, 2005~~). Profit~~) while the profit ratio ~~is determined as many as~~was 30% (Noor and Shahwahid, 1999). ~~Equation for measure~~Therefore, the equation to calculated the profit margin (Noor and Shahwahid, 1999) is presented ~~below~~as follows:

~~$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij} xPR)/(1+PR)$~~

~~where:~~ $$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij} xPR)/(1+PR)$$

Where PM_{ij} = profit margin~~;~~, P_{ij} = log price for each species at sawmill and diameter class~~;~~, PR = profit ratio~~;~~, i = an index for each species (i = 1, 2, 3, 4, …., n~~);~~), and j = an index for diameter class (i = 1, 2, 3, 4, …., n).

~~Stumpage~~ Meanwhile, the stumpage values were calculated ~~by~~ using the following equation:

~~$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij}+C_{ij}+PM)$~~

~~where:~~ $$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij}+C_{ij}+PM)$$

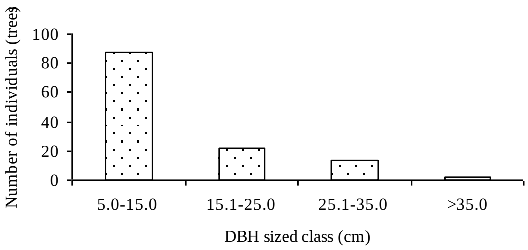
Where S_{ij} = stumpage value for each species and diameter class (USD ha^{-1}~~);~~), V_{ij} = volume of timber for each species and diameter class (m^{3}~~);~~), P_{ij} = log price for each species at sawmill and diameter class (USD m^{-3}~~);~~), C_{ij} = average logging cost (IDR ha^{-1}~~);~~), PM_{ij} = profit margin (USD m^{-3}~~);~~), i = an index for each species (i = 1, 2, 3, 4, …., n~~);~~), and j = an index for diameter class (i = 1, 2, 3, 4, …., n).

3. Results and Discussion

3.1. Ecological Aspect

3.1.1. Diameter at Breast Height (DBH) and Height Distributions

~~The~~ There was a difference in the density of trees in the DBH classes ~~differs in the study site. The DBH distribution forms~~ as observed with the formation of L-~~shaped which is~~shape characterized by the reduction in the total number of trees ~~decreased~~ as the DBH increased as illustrated in Figure 2. The abandoned land ~~in the study site was skewed towards~~was also observed to be dominated by ~~the~~ smaller DBH classes~~,~~ with more than 70% of all trees ~~with the DBH of~~having values > 5 cm in the 5.0-10.0 cm class. ~~The~~ Moreover, the tree diameter distribution ~~of secondary forest forms~~formed a reverse-J-~~shaped tree~~shape (Feldpausch et al. 2007; Álvarez-Yépiz et al. 2008~~). The~~) while the distribution of the classes of the height ~~classes' distribution in the site~~ was skewed slightly positively as shown in Figure 3~~. About~~ with approximately 58% of the trees ~~in the site were~~ included ~~at~~in the 5.1-10.0 m ~~height~~ class.



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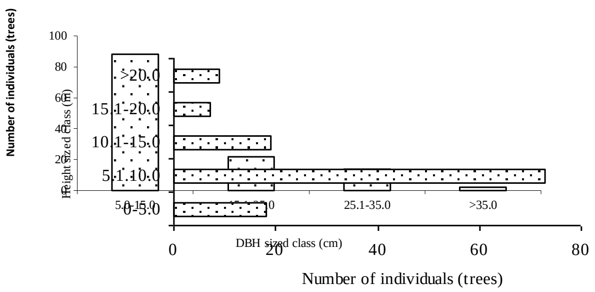

Figure 2. Distributions of diameter at breast height (DBH) in 0.24 ha of abandoned land.

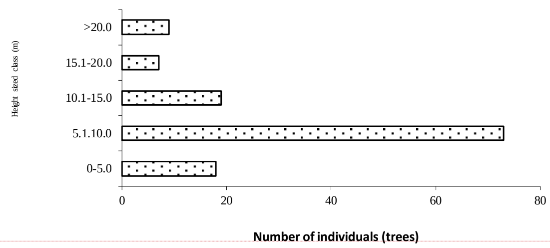

Figure 3. Distributions of height at different ages in 0.24 ha of abandoned land.

3.1.2. Density, Basal Area, and Volume

The density, basal area, and volume of species (at a DBH of > 5 cm) in study site are presented in Table 3. The density of species was found to be 126 trees recorded in 0.24 hectare of this site. Threeand the dominating species of *Macaranga tanarius* (38 trees), *Bridelia* sp. (20 trees), and *Homalanthus* sp. (11 trees) were dominant based on the number of individuals. According to include *Macaranga tanarius* with 38, *Bridelia* sp. with 20, and *Homalanthus* sp. with 11. Regarding the basal area and volume per hectare, three dominant species were also observed and they include *Bridelia glauca* (with 2.10 m^2 ha^{-1} of basal area and 23.24 m^3 ha^{-1} of volume),, *Pterospermum javanicum* (with 1.64 m^2 ha^{-1} of basal area and 18.42 m^3 ha^{-1} of volume),, and *Ficus* sp. (with 1.24 m^2 ha^{-1} of basal area and 11.74 m^3 ha^{-1} of volume). The volume of for basal area and volume respectively. This, therefore, means these three species covered more than 58 percent of the total volume in the study plot. Thewhile other six species ofincluding *Trema orientalisOrientalis*, *Trema orientalisOrientalis*, *Glochidion* sp., *Duabanga moluccana*, *Pometia pinnata*, and *Cananga odorata* had more than volume of 3.70 m^3 ha^{-1}.

3.1.3. Importance value index (IVi)

The common species of study site werewas dominated by light--demanding pioneer and fast--growing species in terms of IVi as presented in Table 4. TheHowever, the same four common species in terms ofspecies observed to be predominant with total basal area and volume were also found for the IVi were and they include *Macaranga tanarius* (IVi ofwith 50.60%),%, *Bridelia glauca* (IVi ofwith 49.13%),%, *Pterospermum javanicum* (IVi ofwith 29.05%),%, and *Ficus septica* (IVi ofwith 22.56%). These four species were also dominant based on total basal area and volume.%. The other three species were also dominant with IVi of more than 10%. These three species of

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discovered to be following the aforementioned were *Homalanthus* sp., *Trema* ~~*orientalis*,~~ *Orientalis*, and *Glochidion* sp. ~~had IVi of~~with 18.89, 16.10, and 11.53% respectively. ~~The~~Furthermore, the seedling and saplings plants of *Ficus aurata* and *Macaranga* sp. were also common based on the Summed Dominance Ratio (SDR) in 3 and 5 years of fallow lands in Sarawak (Karyati et al. 2013). This is in line with the findings of Karyati et al. (2018) ~~reported~~that trees species in lands abandoned for 5 and 10 years ~~lands after abandonment~~ were dominated by *Macaranga* spp.

3.1.4. Species Diversity

The species diversity or ~~species~~ heterogeneity (H' values) of ~~study~~the plot ~~was~~studied were categorized as ~~'intermediate'~~'intermediate' (Odum 2005) ~~as~~according to the results presented in Table 5~~. The~~ while a low ecological dominance (D_s value) ~~of trees species in studied abandoned land was~~ was also observed~~. It~~ which means ~~that~~ there were ~~a~~ few ~~species~~ or almost no species ~~dominant in~~dominating the site. ~~The trees species of this site showed~~This was also supported by the high value of J'~~. The high evenness value means every~~ indicating all the species are evenly distributed ~~evenly~~ in the community. ~~The high J' and R~~These values ~~in study plot~~ may ~~caused by~~, however, be due to the high number of trees per hectare and the number of species. Generally, the increasing diversity (H'), evenness (J'), and richness (R) ~~increased will followed by decreasing~~ caused a reduction in dominance (D_s~~). The~~) in accordance with the findings of a previous study that tree diversity ~~declines~~declined while dominance ~~increases~~increased linearly along a disturbance gradient (Sapkota et al. 2010).

Table 3. Density, basal area, and volume of species (DBH of > 5 cm) in the study site.

No.	Species	Family	Number of individuals	Average of DBH (cm)	Average of height (m)	Total of basal area (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
1	*Bridelia glauca*	Phyllanthaceae	20	15.7	11.7	2.10	23.24
2	*Pterospermum javanicum*	Malvaceae	8	24.1	16.6	1.64	18.42
3	*Ficus septica*	Moraceae	5	23.5	11.0	1.24	11.74
4	*Trema* ~~*orientalis*~~*Orientalis*	Cannabaceae	4	21.3	10.8	0.69	5.60
5	*Macaranga tanarius*	Euphorbiaceae	38	8.8	7.7	1.04	5.28
6	*Glochidion obscurum*	Phyllanthaceae	3	22.7	15.3	0.51	5.18
7	*Duabanga moluccana*	Lithraceae	1	29.0	22.0	0.28	3.94
8	*Pometia pinnata*	Sapindaceae	2	19.8	22.0	0.27	3.80
9	*Cananga odorata*	Annonaceae	2	17.5	13.5	0.27	3.72
10	*Nephelium* sp.	Sapindaceae	3	18.6	11.7	0.37	2.99
11	*Nauclea* sp.	Rubiaceae	2	13.4	14.0	0.13	1.39
12	*Artocarpus elasticus*	Moraceae	1	22.0	12.0	0.16	1.24
13	*Homalanthus* sp.	Euphorbiaceae	11	7.6	6.5	0.23	1.07
14	*Archidendron pauciflorum*	Fabaceae	1	16.1	15.0	0.08	0.83
15	Unknown species 1	Anacardiaceae	3	12.1	7.3	0.15	0.74
16	*Dillenia borneensis*	Dilleniaceae	2	11.6	9.5	0.10	0.65
17	*Diospyros* sp.	Ebenaceae	4	9.3	5.8	0.13	0.46
18	*Pternandra* sp.	Melastomataceae	2	11.8	7.0	0.09	0.41
19	*Macaranga gigantea*	Euphorbiaceae	1	11.2	9.0	0.04	0.24
20	*Fordia splendidissima*	Fabaceae	4	7.2	5.3	0.07	0.24
21	Unknown species 2	Anacardiaceae	1	12.3	6.0	0.05	0.19
22	*Eusideroxylon zwageri*	Lauraceae	3	5.7	8.0	0.03	0.16
23	*Vernonia arborea*	Asteraceae	1	9.5	6.0	0.03	0.12
24	*Syzygium* sp.	Myrtaceae	2	6.7	6.0	0.03	0.11
25	*Baccaurea* sp.	Phyllanthaceae	1	8.0	8.0	0.02	0.11
26	Unknown species 3	Unknown family	1	7.6	6.0	0.02	0.07
	Total		126,0	373.0	273.5	9.75	91.97
	Average		4,8	14.3	10.5	0.38	3.54
	Maximum		38.0	29.0	22.0	2.10	23.24
	Minimum		1.0	5.7	5.3	0.02	0.07

Note: DBH = diameter at breast height. ~~Calculation was done~~The values were calculated based on vegetation ~~survei~~surveyed in 0.24 hectare.

Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.24 hectare of the study site.

No.	Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
1	*Macaranga tanarius*	Euphorbiaceae	9.80	30.16	10.64	50.60
2	*Bridelia glauca*	Phyllanthaceae	11.76	15.87	21.50	49.13
3	*Pterospermum javanicum*	Malvaceae	5.88	6.35	16.82	29.05
4	*Ficus septica*	Moraceae	5.88	3.97	12.70	22.56
5	*Homalanthus* sp.	Euphorbiaceae	7.84	8.73	2.32	18.89
6	*Trema orientalis*	Cannabaceae	5.88	3.17	7.04	16.10
7	*Glochidion obscurum*	Phyllanthaceae	3.92	2.38	5.23	11.53
8	*Diospyros* sp.	Ebenaceae	3.92	3.17	1.35	8.45
9	*Cananga odorata*	Annonaceae	3.92	1.59	2.80	8.30
10	*Nephelium* sp.	Sapindaceae	1.96	2.38	3.82	8.17
11	Unknown species 1	Anacardiaceae	3.92	2.38	1.54	7.84
12	*Nauclea* sp.	Rubiaceae	3.92	1.59	1.29	6.80
13	*Eusideroxylon zwageri*	Lauraceae	3.92	2.38	0.34	6.64
14	*Pometia pinnata*	Sapindaceae	1.96	1.59	2.72	6.27
15	*Fordia splendidissima*	Fabaceae	1.96	3.17	0.71	5.85
16	*Syzygium* sp.	Myrtaceae	3.92	1.59	0.30	5.81
17	*Duabanga moluccana*	Lithraceae	1.96	0.79	2.82	5.58
18	*Dillenia borneensis*	Dilleniaceae	1.96	1.59	0.99	4.54
19	*Pternandra* sp.	Melastomataceae	1.96	1.59	0.93	4.48
20	*Artocarpus elasticus*	Moraceae	1.96	0.79	1.62	4.38
21	*Archidendron pauciflorum*	Fabaceae	1.96	0.79	0.87	3.62
22	Unknown species 2	Anacardiaceae	1.96	0.79	0.51	3.26
23	*Macaranga gigantea*	Euphorbiaceae	1.96	0.79	0.42	3.18
24	*Vernonia arborea*	Asteraceae	1.96	0.79	0.30	3.06
25	*Baccaurea* sp.	Phyllanthaceae	1.96	0.79	0.21	2.97
26	Unknown species 3	Unknown family	1.96	0.79	0.19	2.95
	Jumlah		100.00	100.00	100.00	300.00

Note: RF= relative frequency, Rd=relative density, RD=relative dominance; IVi=importance value index.

Table 5. Diversity indices of trees with DBH of ≥ 5 cm in the study site.

No.	Diversity indices	Value
1	Shannon-Wiener diversity index (*H'*)	1.23
2	Simpson dominance index (D_s)	0.09
3	Pielou evenness index (*J'*)	0.87
4	Margalef species richness (*R*)	5.17

Note: ~~Calculation was done~~The values were calculated according to the 6 ~~sub-plots~~subplots sized 20 m × 20 m each.

The study ~~revealed that~~ showed the floristic structure, composition, and diversity were related to the existence and importance of the abandoned land. ~~The common species of study site were~~ dominated by fast-growing species. ~~The~~ Moreover, the species of tree ~~species of this~~on the site had 'intermediate diversity' (*H*'), 'low dominance' (*Ds*), and 'high evenness' (*J*'~~). Similarly, the intermediate diversity, low dominance,~~) and ~~high evenness were also reported~~the same was found for seedling-sapling plants ~~(~~with DBH<5 cm~~)~~ and tree plants ~~(~~with DBH>5cm~~)~~ in 3 ~~years~~, 5 ~~years~~, 10 ~~years~~, and 20 years ~~of fallow~~after the lands ~~after abandonment~~have been fallowed (Karyati et al. 2013; Karyati et al. 2018). ~~The result showed that~~This, therefore, means abandoned land has important ~~role according to~~ ecological ~~aspect. The~~roles. Furthermore, the information ~~about~~on the composition and diversity of plant regeneration at early stages of secondary succession on fallow

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lands is useful for biodiversity conservation~~,~~ and also provide social and economic values for future forest (Karyati et al. 2013). ~~An understanding about~~This shows it is necessary to understand the ecological and economic aspects of abandoned lands ~~is needed~~in order to manage and conserve ~~fallow lands~~them during successional periods in the tropic.

3.2. Economic Aspect

3.2.1. Log price

The results ~~of this research~~ showed ~~that~~the log prices ~~at sawmill~~ for 10 species at the sawmill were different~~. Data in~~ while Table 6 ~~showed~~shows there were 525 stems ha^{-1} ~~at~~on the abandoned land. ~~The~~Moreover, the total and mean ~~of~~ log price ~~at abandoned land was as much as~~were USD1,~~62~~462.02m^{-3} and USD56.23m^{-3}, respectively~~. The~~ with the highest ~~log price owned four species namely~~ values obtained at *Eusideroxylon zwageri* of Lauraceae ~~(~~with 526.85 USD m^{-3}~~),~~, *Diospyros* sp. of Ebenaceae ~~(~~with USD263.3 m^{-3}~~),~~, *Pometia zwageri* of Sapindaceae ~~(~~with USD125.13 m^{-3}~~),~~, and *Artocarpus odoratissimus* of Moraceae ~~(~~with USD69.15 m^{-3}~~). Futhermore,~~ . Furthermore, most of the other 22 species ~~of other trees~~ had ~~log prices~~the same value or were under USD65.86 m^{-3}.

Table 6. Number of stems at abandoned land and log price.

No.	Species	Family	Number (stems ha^{-1})	P_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	13	526.85
2	*Diospyros* sp.	Ebenaceae	17	263.43
3	*Pometia pinnata*	Sapindaceae	8	125.13
4	*Artocarpus odoratissimus*	Moraceae	4	69.15
5	*Archidendron pauciflorum*	Fabaceae	4	65.86
6	*Nephelium* sp.	Sapindaceae	13	59.27
7	*Pternandra* sp.	Melastomataceae	8	44.45
8	*Dillenia borneensis*	Dilleniaceae	8	16.46
9	*Macaranga tanarius*	Euphorbiaceae	158	16.46
10	*Trema orientalis*	Cannabaceae	17	16.46
11	*Syzygium* sp.	Myrtaceae	8	16.46
12	*Homalanthus* sp.	Euphorbiaceae	46	16.46
13	*Nauclea* sp.	Rubiaceae	8	16.46
14	*Glochidion obscurum*	Phyllanthaceae	13	16.46
15	*Fordia splendidissima*	Fabaceae	17	16.46
16	*Vernonia arborea*	Asteraceae	4	16.46
17	*Macaranga gigantea*	Euphorbiaceae	4	16.46
18	*Cananga odorata*	Annonaceae	8	16.46
19	*Duabanga moluccana*	Lithraceae	4	16.46
20	*Baccaurea* sp.	Phyllanthaceae	4	16.46
21	Unknown species 1	Anacardiaceae	13	16.46
22	Unknown species 2	Anacardiaceae	4	16.46
23	Unknown species 3	Unknown family	4	16.46
24	*Bridelia glauca*	Phyllanthaceae	83	16.19
25	*Pterospermum javanicum*	Malvaceae	33	15.09
26	*Ficus septica*	Moraceae	21	13.17
	Total		525	1,462.02
	Mean		20	56.23

Note: P_{ij} = log price for each species at sawmill and diameter class.

~~Log~~The log price ~~depend~~depends on the species and diameter class of log~~. Species of~~ such that trees ~~which own~~with high timber quality and ~~sell well~~many sales in the market ~~will~~ have

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~~high~~higher log prices. ~~The~~However, a bigger diameter at breast ~~hight~~height (DBH) ~~of log, the~~led to a lower reduction factor ~~of~~and higher log price~~, and the higher log price. Log owns big DBH more~~. This means it is easier ~~become many~~ to produce different kinds of products ~~material~~ from the logs with big DBH and ~~also it has big~~ timber volume. ~~The~~Moreover, high community demand for logs of particular species ~~will lead the higher log~~ usually increases their prices in the market~~. This is~~ in accordance with the laws of demand ~~law that stated the higher demand for a commodity will lead the higher price of that commodity~~.

Trees ~~own the~~with high log prices ~~only~~are in a small number ~~at~~on the abandoned land~~. There was the~~ with an average of 20 stems ha^{-1} for each species. ~~The number of trees which including~~ The *Eusideroxylon zwageri* ~~-~~(Lauraceae) ~~was~~had only 13 stems ha^{-1}, ~~meanwhile those including~~ *Diospyros* sp. (Ebenaceae) ~~was~~with 17 stems ha^{-1} ~~at abandoned land. The numbers of~~while *Pometia pinnata* (Sapindaceae) and ~~-~~*Artocarpus odoratissimus* (Moraceae) ~~were~~had 8 stems ha^{-1} and 4 stems ha^{-1}, respectively. ~~Those species that own very high log prices have small population at abandoned land.~~ This is, however, in ~~concordant~~line with the law of supply ~~law~~which states that ~~stated the~~a smaller ~~number~~ supply of the commodity to the market~~, the~~ leads to a higher ~~commodity~~ price.

~~However, that~~A different result was ~~not happen to~~, however, observed with other ~~trees~~ species~~. For example~~ such as *Macaranga tanarius* (Euphorbiaceae) ~~was most met at abandoned land, with the~~with a total number of 158 stems ha^{-1}~~, however its~~ and a log price ~~only~~of USD16.46 m^{-3}~~. The number of some family~~ and other families and species ~~was only four stems ha^{-1} at abandoned land also had~~with low log prices. ~~There are many~~This means several factors determine ~~log~~the price of log in the market ~~such as species,~~and they include tree diameter, timber quality, consumer taste, and ~~other factors~~others. According to Noor et al. (2007a), the market price is the first point of sale where the product is sold freely in the competitive market.

3.2.2. Logging Cost

Logging cost was the same for each species of trees ~~as much as~~ and was found to be USD35.12 m^{-3}~~. The chainsawman used~~ including the costs for the chainsaw man, machine ~~however~~used, fuel, and depreciation ~~costs were not calculate in this research because those costs was including in logging cost. Data in~~. Table 7 ~~showed that~~shows the total and mean ~~of~~ logging costs in the abandoned land were USD1,212.24 ha^{-1} and USD46.62 ha^{-1}~~. The~~ respectively with the lowest ~~logging cost (~~being USD0.72 ha^{-1}~~) was expanded~~ for ~~logging~~ 14 stems ~~including family~~from *Anacardiaceae*~~. The~~ family while the highest ~~logging cost (USD27~~was USD277.17 ha^{-1}~~) was spended~~ for ~~logging~~ 21 stems from ~~-~~*Ficus septica* (Moraceae).

Logging cost ~~did~~is, however, not ~~determine~~determined by the number of trees ~~that will be cut. However, logging cost is determined by estimation of log~~ but by the volume such that ~~resulted in logging process. The~~a higher estimation of log volume~~, the~~ leads to a higher logging cost. ~~The big diameter~~Moreover, trees with high diameters were discovered to have ~~big log~~more volume and ~~the~~ vice versa, and those with small ~~others~~diameters were also found to have ~~small log volume. Small diameter trees need~~needed shorter logging time ~~than big diameter trees.~~. Germain et. al. (2019) found two statistically significant variables ~~which influence and can predict per~~influencing unit logging costs~~:~~ and they include volume per area harvested and the owner/operator experience~~. The increasing both the volume harvested per hectare and operator experience will result in~~ such that an increase in these factors is expected to lower the per~~-~~unit logging costs, with ~~the latter~~experience variable having the least effect ~~on the unit logging costs~~.

Table 7. Logging cost of trees.

No.	Species	Family	Number (stems ha^{-1})	C_{ij} (USD ha^{-1})
1	*Ficus septica*	Moraceae	21	277.17

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No.	Species	Family	Number (stems ha^{-1})	C_{ij} (USD ha^{-1})
2	*Bridelia glauca*	Phyllanthaceae	83	264.77
3	*Pterospermum javanicum*	Malvaceae	33	258.63
4	*Trema orientalis*	Cannabaceae	17	77.30
5	*Glochidion obscurum*	Phyllanthaceae	13	58.19
6	*Macaranga tanarius*	Euphorbiaceae	158	49.69
7	*Nephelium* sp.	Sapindaceae	13	39.72
8	*Duabanga moluccana*	Lithraceae	4	31.42
9	*Pometia pinnata*	Sapindaceae	8	30.31
10	*Cananga odorata*	Annonaceae	8	29.90
11	*Artocarpus odoratissimus*	Moraceae	4	18.08
12	*Nauclea* sp.	Rubiaceae	8	11.99
13	Unknown species 1	Anacardiaceae	13	11.55
14	*Diospyros* sp.	Ebenaceae	17	11.32
15	*Archidendron pauciflorum*	Fabaceae	4	9.68
16	*Dillenia borneensis*	Dilleniaceae	8	9.43
17	*Homalanthus* sp.	Euphorbiaceae	46	8.61
18	*Pternandra* sp.	Melastomataceae	8	3.46
19	*Fordia splendidissima*	Fabaceae	17	2.64
20	Unknown species 2	Anacardiaceae	4	1.80
21	*Macaranga gigantea*	Euphorbiaceae	4	1.57
22	*Eusideroxylon zwageri*	Lauraceae	13	1.26
23	*Vernonia arborea*	Asteraceae	4	1.13
24	*Syzygium* sp.	Myrtaceae	8	1.12
25	*Baccaurea* sp.	Phyllanthaceae	4	0.80
26	Unknown species 3	Unknown family	4	0.72
	Total		525	1,212.24
	Mean		20	46.62

Note: C_{ij} = logging cost of the tree.

3.2.3. Profit Margin

~~Total~~The total profit margin of ~~log~~ selling logs was ~~as much as~~found to be USD337.39 m^{-3} with an average of USD12.98 m^{-3}. The highest ~~profit margin was produced from log marketing~~value of USD121.58 m^{-3} was obtained from *Eusideroxylon zwageri* (Lauraceae) ~~where it~~while the lowest was ~~calculated as much as USD121.58 m^{-3}. Meanwhile, log of~~recorded to be USD3.04 m^{-3} for *Ficus septica* (Moraceae) ~~produced profit margin as much as USD3.04 m^{-3} (~~as shown in Table 8~~)~~.

~~Factors determine~~The factors determining the profit margin ~~are~~include the log price of each species at the sawmill and the class diameter~~. The higher log price, the higher seller~~ such that the opportunity of the seller to ~~own~~make profit~~. Such in~~ increases with a higher price and the ~~case of~~ log diameter.~~ The bigger log diameter of cutting tree, the bigger log volume, and the bigger seller oppportunity to get profit.~~

Table 8. Profit margin.

No.	Species	Family	P_{ij} (USD m^{-3})	PM_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	526.85	121.58
2	*Diospyros* sp.	Ebenaceae	263.43	60.79
3	*Pometia pinnata*	Sapindaceae	125.13	28.88
4	*Artocarpus odoratissimus*	Moraceae	69.15	15.96
5	*Archidendron pauciflorum*	Fabaceae	65.86	15.20
6	*Nephelium* sp.	Sapindaceae	59.27	13.68
7	*Pternandra* sp.	Melastomataceae	44.45	10.26
8	*Dillenia borneensis*	Dilleniaceae	16.46	3.80

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No.	Species	Family	P_{ij} (USD m^{-3})	PM_{ij} (USD m^{-3})
9	*Macaranga tanarius*	Euphorbiaceae	16.46	3.80
10	*Bridelia glauca*	Phyllanthaceae	16.19	3.74
11	*Trema orientalis*	Cannabaceae	16.46	3.80
12	*Syzygium* sp.	Myrtaceae	16.46	3.80
13	*Homalanthus* sp.	Euphorbiaceae	16.46	3.80
14	*Nauclea* sp.	Rubiaceae	16.46	3.80
15	*Glochidion obscurum*	Phyllanthaceae	16.46	3.80
16	*Fordia splendidissima*	Fabaceae	16.46	3.80
17	*Vernonia arborea*	Asteraceae	16.46	3.80
18	*Macaranga gigantea*	Euphorbiaceae	16.46	3.80
19	*Cananga odorata*	Annonaceae	16.46	3.80
20	*Duabanga moluccana*	Lithraceae	16.46	3.80
21	*Baccaurea* sp.	Phyllanthaceae	16.46	3.80
22	Unknown species 1	Anacardiaceae	16.46	3.80
23	Unknown species 2	Anacardiaceae	16.46	3.80
24	Unknown species 3	Unknown family	16.46	3.80
25	*Pterospermum javanicum*	Malvaceae	15.09	3.48
26	*Ficus septica*	Moraceae	13.17	3.04
	Total		1,462.02	337.39
	Mean		56.23	12.98

Note: P_{ij} = log price at sawmill and diameter class; PM_{ij} = profit margin.

3.2.4. Stumpage Value

~~Stumpage~~The stumpage value ~~is~~was determined by the timber volume ~~for each species~~, log diameter, log price ~~for each species~~ at the sawmill, and profit margin~~. The result of this research estimated~~ for each species and the total ~~stumpage values at abandoned land as much as~~valued obtained was USD2,159.36 ha^{-1}. However, Figure 4 shows ~~8~~eight species ~~of trees~~ had economic values above the mean stumpage values ~~of each species at~~on the abandoned land~~. The~~ with the mean contribution ~~mean of each species was as much as~~found to be USD83.05 ha^{-1} ~~for total stumpage values. Meanwhile,~~while 18 species of other trees had ~~economic~~ values under the mean stumpage values ~~of each family/species at abandoned land~~.

The ~~other research~~studies conducted in other location found different stumpage economic values~~. The estimated economic values for~~, for example, in Ayer Hitam Forest Reserve, Puchong, Selangor ~~were~~, it was estimated to be RM34,278,980 for timber, RM67,192 for medical ~~plant's~~plants, RM773,090 for dependence of indigenous people, RM865,770 for potential recreation benefits, and RM2,39 billion for conservation value based on Malaysian adult population (Noor et. al. 2007b). ~~Although total stumpage~~ Even though the values ~~at abandoned land from the result of~~obtained in this ~~research was under~~study are lesser than the ~~result of~~ones in Noor et. al. (2007b~~) research~~), it, however ~~this finding showed that~~, shows abandoned land has many trees ~~own~~with potential economic values.

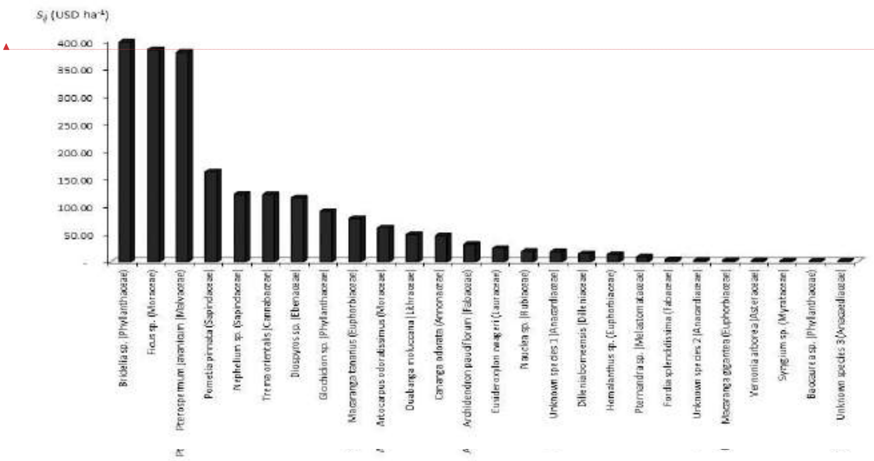

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Figure 4. Stumpage values of trees at abandoned land.

4. Conclusion

The existence of abandoned lands in the tropics has multi functionhave several functions, both from the ecological and economic aspects. Ecologically, the structure and floristic diversity of abandoned land in the early secondary succession is hopedexpected to be ecotone towards the primary succession. The abandoned and this means the lands also play anplan important roleroles in soil, water and environentthe conservation. of soil, water, and the environment. In addition, abandoned lands hae athey also have potential economic value. Thevalues for individuals and the community. Therefore, basic information on ecological and conomiceconomic aspects of the abandoned lands is neededrequired to land management and conservation in the future.

Acknowledgments

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Regular Research Article

The Role of Tropical Abandoned Land on Ecological and Economic Aspects

Abstract: The floristic structure and composition of abandoned lands ~~change~~in the tropic have been observed to be changing dynamically during the succession process~~ in the tropic. The existence~~. This is mostly because they are not utilized maximally, therefore, there is a need to assess the economic and ecological impacts of ~~lands after~~this land abandonment ~~could be assessed economically. The potential of large number of abandoned lands~~ in the ~~tropic has not been used optimally. The information on the ecological and economic aspects of~~ tropical ~~abandoned land is needed~~areas. This study was conducted to determine the ecological aspects of floristic structure, composition, and diversity and analyze the economic aspects of standing trees in the tropical abandoned land. The vegetation ~~surveys of all~~containing woody trees with ~~diameter~~a diameter at breast height (DBH) of ≥ 5 cm were ~~conducted~~surveyed at six ~~sub plots~~subplots sized 20 m × 20 m. The economic parameters were ~~assessed by~~evaluated using data of log price, logging cost, profit margin, and stumpage value of standing trees in the study plot~~. A~~ and a total of 126 trees including 26 species of 25 genera of 18 families were recorded. The most common species ~~was~~found were *Macaranga tanarius* ~~(~~with 50.60~~%),~~%, *Bridelia glauca* ~~(~~with 49.13~~%),~~%, and *Pterospermum javanicum* ~~(~~with 29.05~~%)~~% based on Importance Value Index (IVi). ~~The~~Moreover, the diversity, dominance, evenness, and richness indices were 1.23, 0.09, 0.87, and 5.17 respectively~~. Total of~~ while the total log ~~prices~~price at the abandoned land was ~~as much as~~ USD1,462.02 m^{-3} ~~and~~with an average value of USD56.23 m^{-3}. ~~Total~~The total and mean values of logging costs ~~in abandoned land~~ were USD1,212.24 ha^{-1} and USD46.62 ha^{-1}, respectively~~. Total~~ while the total profit margin of log selling was ~~as much as~~ USD337.39 m^{-3} at maximum with ~~the~~an average of USD12.98 m^{-3}. ~~The~~Furthermore, the average ~~of~~ stumpage ~~values at abandoned land was as much as~~ value was USD83.05 ha^{-1} ~~with~~while the total ~~of~~was calculated to be USD2,159.36 ha^{-1}. ~~The~~These findings showed the utilization of abandoned lands with respect to ecology and economic aspects ~~can~~has the ability to increase the community welfare ~~as well as~~and support the ~~development program~~implementation of developmental programs in the country.

Keywords: Abandoned land, diversity, economic, floristic structure, stumpage value.

1. Introduction

~~Dynamics~~The dynamics at several scales determine the plant diversity within ~~a~~ regenerating ~~fallow~~fallows (Lawrence 2004~~). Part of the cause in the increase of secondary forest area is because of exploitation of forest~~) exploited for agricultural purposes, mainly ~~by~~through shifting cultivation. ~~Shifting cultivation has been practiced all over the world and~~ This is observed to be a global phenomenon because two-thirds of the world's secondary forest were recorded to have been cultivated through the process in 1980 ~~was shifting cultivation fallow, whereas about~~ with 49% ~~of the area deforested~~recorded annually in tropical Asia ~~is attributed to shifting cultivation~~ (Lanly 1982). ~~Secondary forest is~~These forests are defined as the ~~type of~~ vegetation ~~that results after~~resulting from the clearing of natural high forest ~~vegetation has been disturbed or cleared~~ for shifting cultivation ~~prior to~~before abandonment (Abebrese 2002; Johnson and Miyanishi 2007; Keddy 2007; Misra 1992). ~~The secondary forests are reflected in their~~They are characterized by the structure and extent of vegetative cover~~,~~ as well as their composition in terms of dominant and secondary species (Mittelman 2001; Van Breugel et al. 2006). However, the principal types include the Swidden fallow secondary forests~~, along with~~ and some ~~secondary forest~~ other gardens~~, are the principal types of secondary forests (~~ as reported by Chokkalingam et al. (2001).

According to Van Breugel et al. (2006~~) stated that to understand~~), understanding the

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mechanisms of secondary forest succession~~, ~~ requires the consideration of the time ~~since~~of abandonment as ~~to be considered as ~~a compound factor ~~is integrating~~to integrate the variables of plant community ~~structure. Plant community ~~ecology ~~is~~ the ~~sum ~~total ~~of the ~~effective conditions ~~which determine~~determining the existence of the ~~plant or community in a given ~~plants on the land (Tansley 1993). ~~Dynamics at several scales determine plant diversity within a regenerating fallow (Lawrence 2004). ~~Secondary forests are ~~products of~~caused by human activity and fast~~-~~-growing ecosystems whose species life cycles coincide with those of human land uses. In addition, ~~secondary forests~~they are also assets for the conservation of biodiversity in the tropics due to their many ~~other ~~biotic characteristics such as the ability to improve soil and water quality ~~or which~~as well as to conserve genetic material, nutrients, moisture, and/or soil organic ~~matter~~matters (Brown and Lugo 1990).

With the ~~expansion of their area and the ~~continuous depletion of primary forests, ~~the~~ secondary forests have become increasingly important ~~for maintaining~~to maintain the larger habitat for biodiversity conservation (Mittelman 2001). ~~As a result of the increase in the deforestation rate, secondary forests cover~~This is associated with their coverage of more than 600 million ha of the land area in the tropics ~~and its accounting~~which accounts for about 40% of the total forest area ~~with rates of~~as well as the formation ~~are about~~rates estimated at 9 million ha year^{-1} (Brown and Lugo 1990). Moreover, FAO (1996) estimated the area of secondary forest in 1990 in Asia to be 87.5 ~~millions~~million ha~~,~~ while the figures for Latin America and Africa were 165 and 90 ~~millions~~million ha, respectively. These data~~,~~ and the awareness of the accelerated changes in the forest situation in countries like the Philippines, Indonesia, China, and Malaysia~~,~~ strongly suggest ~~that the ~~future goods and services ~~that society obtain~~obtained from the tropical forests ~~will~~would increasingly ~~have to come~~be sourced from secondary ~~forests, ~~or ~~from ~~some other ~~kind~~kinds of anthropogenically-induced ~~forest. These probably include~~forests such as the timber, environmental services, biodiversity conservation, and forest products for the rural poor (De Jong et al. 2001).

The total land area in Indonesia ~~reaches around ~~is estimated to be 190 million hectares~~. From~~ and 2/3 of these~~, 2/3 portion~~ are referred to as forest areas ~~and ~~managed by the Ministry of Forestry~~. Meanwhile~~ while the ~~other~~remaining 1/3 is ~~managed in the form of~~for business ~~use right~~ (HGU) ~~to~~and building ~~rights ~~(HGB). However, the National Land Agency (BPN) indicated ~~that ~~7.5 million hectares of land ~~in Indonesia have ~~has the potential ~~as~~to be abandoned~~ land. These lands are in the forest area ~~, both in and outside the forest ~~area. Many~~areas, and several people ~~assume that abandoned land is not yet ecologically and economically useful. However the existence of abandoned lands can be service conservation and ~~have assumed these lands have no usefulness. However, they have certain ecological and economic benefits~~. Many~~ and several studies ~~had~~have been ~~done~~conducted on the ecological aspect such as the floristic composition and structure of the tropical secondary forest in Borneo Island~~. However, ~~ as well as the less information ~~is available~~provided on the ecological and economic aspects of tropical abandoned land in East Kalimantan. This study was, therefore, conducted~~ in order~~ to determine the ecological aspect such as floristic structure, composition, and species diversity as well as ~~analyze~~the economic aspect of standing trees such as log price, logging cost, profit margin, and stumpage value in an abandoned land. The ~~information on the ecological~~findings are expected to be useful in conserving and ~~economic aspects of the abandoned land is important in order to conserve and manage the~~managing tropical forest and ~~environment ecosystem.~~environmental ecosystems.

2. Materials and Methods

2.1. Study Site

The study was conducted in Salo Cella Village, Muara Badak Sub-district, Kutai Kartanegara

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Districts, East Kalimantan Province, Indonesia ~~(Figure 1). The~~ with the geographic location of ~~this site is~~ 0°17'18.7''S 117°18'08.2''E~~.~~ as shown in Figure 1. Salo Cella ~~Village~~ is one of 13 villages in Muara Badak ~~and about~~located 10 km from the capital of Sub-district~~. The~~ with a population of ~~Muara Badak Sub-district is~~ 57.712 ~~persons in coverage~~most of which are farmers and an area of 939.09 km^2 ~~wide. The~~dominated by lowland mixed dipterocarp forest. Moreover, the average monthly ~~rainfall~~ and amount of rainfall ~~are~~were recorded to be 141 mm and 11 raindays in 2017 (Statistics Kutai Kartanegara Regency 2018). ~~Most of the populations are as farmer. Muara Badak~~The subdistrict is administratively bordered ~~with~~by Marang Kayu Sub-district, Anggana Sub-district Samarinda City, Makassar Strait, and Tenggarong Seberang Sub-district ~~at~~on the north, south, east, and west ~~sides,~~ respectively. ~~The potential~~Furthermore, the sectors of Muara Badak with economic potentials are ~~of~~ oil and gas ~~producer~~, fishery, and plantation ~~sectors. The land coverage of area is dominated by lowland mixed dipterocarp forest~~.

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2.2. Data Collection

The vegetation and economic surveys of the study site were conducted from March to August 2019~~. Six sub plots~~ through the establishment of six subplots sized 20 m × 20 m ~~were established within study site. The diameter at breast height (DBH) and total height of~~. Moreover, all woody trees with DBH of ≥ 5 cm within the plot were enumerated and their species ~~were~~ identified.

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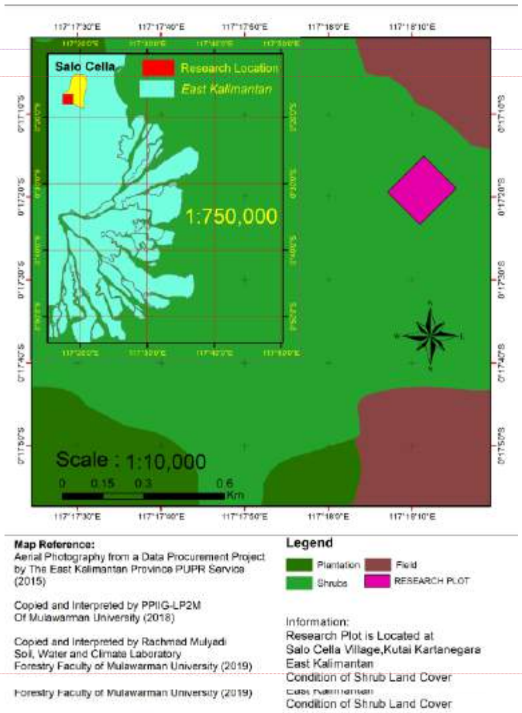

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Figure 1. Map of the study site in Muara Badak Sub-district, Kutai Kartanegara District, East Kalimantan Province, Indonesia.

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2.3. Data Analysis

2.3.1. Ecological Aspect

Individual basal area (BA) and volume (V) were determined by using the following formulas (Husch et al. 1982):

Individuals BA = π (DBH/2)^2. 10^{-4} .... (1)

Individuals V = ¼ π × DBH^2. 10^{-4} × H × f .... (2)

where: DBH is the diameter at breast height (cm), 'H' is tree height (m), and 'f'f' is the form factor.

The dominant species of community within the plots were measured by importance value indexusing the Importance Value Index (IVi) (Fachrul 2007):

RF = (Frequency of a species / Total of frequencies of all species) × 100 .... (3)

Rd = (The number of individual of a species / Total number of individuals) × 100 .... (4)

RD = (Total basal area for a species / Total basal area for all species) × 100 .... (5)

IVi = RF + Rd + RD .... (6)

where: RF is relative frequency, Rd is relative density, and RD is relative dominance.

The species diversity offor standing trees in the study site werewas described byusing four diversity indices ofincluding Shannon-Wiener's diversity index (H'), Simpson's dominance index (D_s), Pielou's evenness index (J'), and Margalef's richness index (R) (Odum 2005):

$$H' = \sum_{i=1}^{s} \left(\frac{n_i}{N}\right) \ln\left(\frac{n_i}{N}\right) \quad \text{.......... (7)}$$

$$H' = -\sum_{i=1}^{s} \left(\frac{n_i}{N}\right) \ln\left(\frac{n_i}{N}\right) \quad \text{.......... (7)}$$

$$D_s = \sum_{i=1}^{s} \left(\frac{n_i}{N}\right)^2 \quad \text{.......... (8)} \quad D_s = \sum_{i=1}^{s} \left(\frac{n_i}{N}\right)^2$$

.... (8)

$$J' = \frac{H'}{\ln(S)} \quad J' = \frac{H'}{\ln(S)} \quad \text{.......... (9)}$$

$$R = \frac{(S-1)}{\ln n} \quad R = \frac{(S-1)}{\ln n} \quad \text{.......... (10)}$$

where: n_i = number of individuals of the i- th species, N = total number of all the individuals in a unit area, and S = number of species in each plot.

2.3.2. Economic Aspect

The equivalent merchantable height and, number of logs based on, and diameter class and number of logs isare presented in Table 1. Reduction factor while the reduction factors of log price based on the diameter class can be seenare shown in Table 2.

Table 1. Merchantable tree heights.

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
15 – 30	1	5
+30 – 60	2	10
+60 – 75	3	15
75 ke atas	4	20

SouceSource: Forestry Department of Pinansular Malaysia (FDPM) (1997)

Table 2. Reduction cost of log price.

DBH size class (cm)	Reduction factor

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15 – 29	0,450
30 – 44	0,300
45 – 49	0,150
50 – 54	0,025
55 and above	0,000

Source: Noor et al. (1992) and Hanum et al. (2001)

Logging cost is as much aswas reported to be IDR480.000,00 (Hikmat, 2005). Profit) while the profit ratio is determined as many aswas 30% (Noor and Shahwahid, 1999). Equation for measureTherefore, the equation to calculated the profit margin (Noor and Shahwahid, 1999) is presented belowas follows:

$$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij} xPR)/(1+PR)$$

where:

$$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij} xPR)/(1+PR)$$

Where PM_{ij} = profit margin;, P_{ij} = log price for each species at sawmill and diameter class;, PR = profit ratio;, i = an index for each species (i = 1, 2, 3, 4, ..., n);), and j = an index for diameter class (i = 1, 2, 3, 4, ..., n).

Stumpage Meanwhile, the stumpage values were calculated by using the following equation:

$$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij}+C_{ij}+PM)$$

where:

$$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij}+C_{ij}+PM)$$

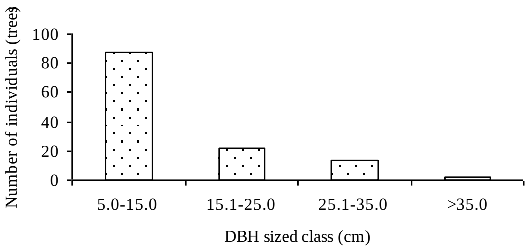
Where S_{ij} = stumpage value for each species and diameter class (USD ha^{-1});), V_{ij} = volume of timber for each species and diameter class (m^{3});), P_{ij} = log price for each species at sawmill and diameter class (USD m^{-3});), C_{ij} = average logging cost (USD ha^{-1});), PM_{ij} = profit margin (USD m^{-3});), i = an index for each species (i = 1, 2, 3, 4, ..., n);), and j = an index for diameter class (i = 1, 2, 3, 4, ..., n).

3. Results and Discussion

3.1. Ecological Aspect

3.1.1. Diameter at Breast Height (DBH) and Height Distributions

The There was a difference in the density of trees in the DBH classes differs in the study site. The DBH distribution forms as observed with the formation of L-shaped which isshape characterized by the reduction in the total number of trees decreased as the DBH increased as illustrated in Figure 2. The abandoned land in the study site was skewed towardswas also observed to be dominated by the smaller DBH classes, with more than 70% of all trees with the DBH ofhaving values > 5 cm in the 5.0-10.0 cm class. The Moreover, the tree diameter distribution of secondary forest formsformed a reverse-J-shaped treeshape (Feldpausch et al. 2007; Álvarez-Yépiz et al. 2008). The) while the distribution of the classes of the height classes' distribution in the site was skewed slightly positively as shown in Figure 3. About with approximately 58% of the trees in the site were included atin the 5.1-10.0 m height class.



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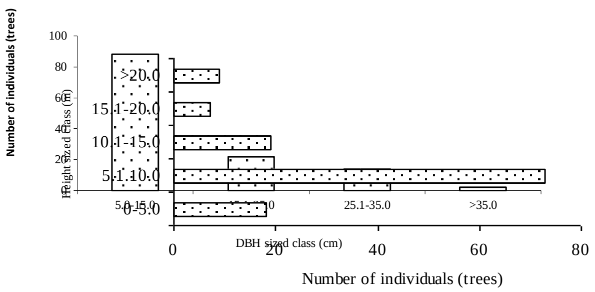

Figure 2. Distributions of diameter at breast height (DBH) in 0.24 ha of abandoned land.

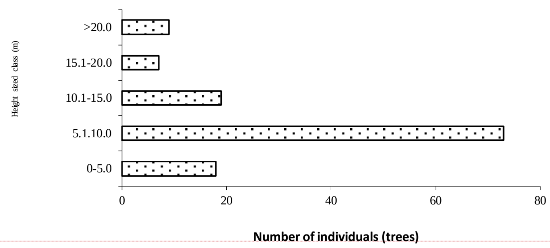

Figure 3. Distributions of height at different ages in 0.24 ha of abandoned land.

3.1.2. Density, Basal Area, and Volume

The density, basal area, and volume of species ~~(~~at a DBH of > 5 cm~~) in study site~~ are presented in Table 3. The density ~~of species~~ was found to be 126 trees ~~recorded~~ in 0.24 hectare ~~of this site. Three~~and the dominating species of ~~*Macaranga tanarius* (38~~ trees~~), *Bridelia* sp. (20 trees), and *Homalanthus* sp. (11 trees) were dominant~~ based on the number of individuals~~. According to include *Macaranga tanarius* with 38, *Bridelia* sp. with 20, and *Homalanthus* sp. with 11. Regarding the~~ basal area and volume per hectare, three dominant species were also observed and they include *Bridelia glauca* ~~(~~with 2.10 m^2 ha^{-1} ~~of basal area~~ and 23.24 m^3 ha^{-1} ~~of volume),~~, *Pterospermum javanicum* ~~(~~with 1.64 m^2 ha^{-1} ~~of basal area~~ and 18.42 m^3 ha^{-1} ~~of volume),~~, and *Ficus* sp. ~~(~~with 1.24 m^2 ha^{-1} ~~of basal area~~ and 11.74 m^3 ha^{-1} ~~of volume). The volume of~~ for basal area and volume respectively. This, therefore, means these three species covered more than 58 percent of the total volume ~~in the study plot. The~~while other six species ~~of~~including *Trema ~~orientalis~~Orientalis*, *Trema ~~orientalis~~Orientalis*, *Glochidion* sp., *Duabanga moluccana*, *Pometia pinnata*, and *Cananga odorata* had more than ~~volume of~~ 3.70 m^3 ha^{-1}.

3.1.3. Importance value index (IVi)

The ~~common species of~~ study site ~~were~~was dominated by light-~~-~~demanding pioneer and fast-~~-~~growing species in terms of IVi as presented in Table 4. ~~The~~However, the same four ~~common species in terms of~~species observed to be predominant with total basal area and volume were also found for the IVi ~~were~~ and they include *Macaranga tanarius* ~~(IVi of~~with 50.60~~%),~~%, *Bridelia glauca* ~~(IVi of~~with 49.13~~%),~~%, *Pterospermum javanicum* ~~(IVi of~~with 29.05~~%),~~%, and *Ficus septica* ~~(IVi of~~with 22.56~~%). These four species were also dominant based on total basal area and volume.~~%. The other three species ~~were also dominant with IVi of more than 10%. These three species of~~

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discovered to be following the aforementioned were *Homalanthus* sp., *Trema* ~~*orientalis*,~~ *Orientalis*, and *Glochidion* sp. ~~had IVi of~~with 18.89, 16.10, and 11.53% respectively. ~~The~~Furthermore, the seedling and saplings plants of *Ficus aurata* and *Macaranga* sp. were also common based on the Summed Dominance Ratio (SDR) in 3 and 5 years of fallow lands in Sarawak (Karyati et al. 2013). This is in line with the findings of Karyati et al. (2018) ~~reported~~that trees species in lands abandoned for 5 and 10 years ~~lands after abandonment~~ were dominated by *Macaranga* spp.

3.1.4. Species Diversity

The species diversity or ~~species~~ heterogeneity (*H'* values) of ~~study~~the plot ~~was~~studied were categorized as ~~'intermediate'~~'intermediate' (Odum 2005) ~~as~~according to the results presented in Table 5~~. The~~ while a low ecological dominance (D_s value) ~~of trees species in studied abandoned land was~~ was also observed~~. It~~ which means ~~that~~ there were ~~a~~ few ~~species~~ or almost no species ~~dominant in~~dominating the site. ~~The trees species of this site showed~~This was also supported by the high value of *J'*~~. The high evenness value means every~~ indicating all the species are evenly distributed ~~evenly~~ in the community. ~~The high J' and R~~These values ~~in study plot~~ may ~~caused by~~, however, be due to the high number of trees per hectare and the number of species. Generally, the increasing diversity (*H'*), evenness (*J'*), and richness (*R*) ~~increased will followed by decreasing~~ caused a reduction in dominance (D_s~~). The~~) in accordance with the findings of a previous study that tree diversity ~~declines~~declined while dominance ~~increases~~increased linearly along a disturbance gradient (Sapkota et al. 2010).

Table 3. Density, basal area, and volume of species (DBH of > 5 cm) in the study site.

No.	Species	Family	Number of individuals	Average of DBH (cm)	Average of height (m)	Total of basal area (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
1	*Bridelia glauca*	Phyllanthaceae	20	15.7	11.7	2.10	23.24
2	*Pterospermum javanicum*	Malvaceae	8	24.1	16.6	1.64	18.42
3	*Ficus septica*	Moraceae	5	23.5	11.0	1.24	11.74
4	*Trema* ~~*orientalis*~~*Orientalis*	Cannabaceae	4	21.3	10.8	0.69	5.60
5	*Macaranga tanarius*	Euphorbiaceae	38	8.8	7.7	1.04	5.28
6	*Glochidion obscurum*	Phyllanthaceae	3	22.7	15.3	0.51	5.18
7	*Duabanga moluccana*	Lithraceae	1	29.0	22.0	0.28	3.94
8	*Pometia pinnata*	Sapindaceae	2	19.8	22.0	0.27	3.80
9	*Cananga odorata*	Annonaceae	2	17.5	13.5	0.27	3.72
10	*Nephelium* sp.	Sapindaceae	3	18.6	11.7	0.37	2.99
11	*Nauclea* sp.	Rubiaceae	2	13.4	14.0	0.13	1.39
12	*Artocarpus elasticus*	Moraceae	1	22.0	12.0	0.16	1.24
13	*Homalanthus* sp.	Euphorbiaceae	11	7.6	6.5	0.23	1.07
14	*Archidendron pauciflorum*	Fabaceae	1	16.1	15.0	0.08	0.83
15	Unknown species 1	Anacardiaceae	3	12.1	7.3	0.15	0.74
16	*Dillenia borneensis*	Dilleniaceae	2	11.6	9.5	0.10	0.65
17	*Diospyros* sp.	Ebenaceae	4	9.3	5.8	0.13	0.46
18	*Pternandra* sp.	Melastomataceae	2	11.8	7.0	0.09	0.41
19	*Macaranga gigantea*	Euphorbiaceae	1	11.2	9.0	0.04	0.24
20	*Fordia splendidissima*	Fabaceae	4	7.2	5.3	0.07	0.24
21	Unknown species 2	Anacardiaceae	1	12.3	6.0	0.05	0.19
22	*Eusideroxylon zwageri*	Lauraceae	3	5.7	8.0	0.03	0.16
23	*Vernonia arborea*	Asteraceae	1	9.5	6.0	0.03	0.12
24	*Syzygium* sp.	Myrtaceae	2	6.7	6.0	0.03	0.11
25	*Baccaurea* sp.	Phyllanthaceae	1	8.0	8.0	0.02	0.11
26	Unknown species 3	Unknown family	1	7.6	6.0	0.02	0.07
	Total		126,0	373.0	273.5	9.75	91.97
	Average		4,8	14.3	10.5	0.38	3.54
	Maximum		38.0	29.0	22.0	2.10	23.24
	Minimum		1.0	5.7	5.3	0.02	0.07

Note: DBH = diameter at breast height. ~~Calculation was done~~The values were calculated based on vegetation ~~survei~~surveyed in 0.24 hectare.

Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.24 hectare of the study site.

No.	Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
1	*Macaranga tanarius*	Euphorbiaceae	9.80	30.16	10.64	50.60
2	*Bridelia glauca*	Phyllanthaceae	11.76	15.87	21.50	49.13
3	*Pterospermum javanicum*	Malvaceae	5.88	6.35	16.82	29.05
4	*Ficus septica*	Moraceae	5.88	3.97	12.70	22.56
5	*Homalanthus* sp.	Euphorbiaceae	7.84	8.73	2.32	18.89
6	*Trema orientalis*	Cannabaceae	5.88	3.17	7.04	16.10
7	*Glochidion obscurum*	Phyllanthaceae	3.92	2.38	5.23	11.53
8	*Diospyros* sp.	Ebenaceae	3.92	3.17	1.35	8.45
9	*Cananga odorata*	Annonaceae	3.92	1.59	2.80	8.30
10	*Nephelium* sp.	Sapindaceae	1.96	2.38	3.82	8.17
11	Unknown species 1	Anacardiaceae	3.92	2.38	1.54	7.84
12	*Nauclea* sp.	Rubiaceae	3.92	1.59	1.29	6.80
13	*Eusideroxylon zwageri*	Lauraceae	3.92	2.38	0.34	6.64
14	*Pometia pinnata*	Sapindaceae	1.96	1.59	2.72	6.27
15	*Fordia splendidissima*	Fabaceae	1.96	3.17	0.71	5.85
16	*Syzygium* sp.	Myrtaceae	3.92	1.59	0.30	5.81
17	*Duabanga moluccana*	Lithraceae	1.96	0.79	2.82	5.58
18	*Dillenia borneensis*	Dilleniaceae	1.96	1.59	0.99	4.54
19	*Pternandra* sp.	Melastomataceae	1.96	1.59	0.93	4.48
20	*Artocarpus elasticus*	Moraceae	1.96	0.79	1.62	4.38
21	*Archidendron pauciflorum*	Fabaceae	1.96	0.79	0.87	3.62
22	Unknown species 2	Anacardiaceae	1.96	0.79	0.51	3.26
23	*Macaranga gigantea*	Euphorbiaceae	1.96	0.79	0.42	3.18
24	*Vernonia arborea*	Asteraceae	1.96	0.79	0.30	3.06
25	*Baccaurea* sp.	Phyllanthaceae	1.96	0.79	0.21	2.97
26	Unknown species 3	Unknown family	1.96	0.79	0.19	2.95
	Jumlah		100.00	100.00	100.00	300.00

Note: RF= relative frequency, Rd=relative density, RD=relative dominance; IVi=importance value index.

Table 5. Diversity indices of trees with DBH of > 5 cm in the study site.

No.	Diversity indices	Value
1	Shannon-Wiener diversity index (*H*′)	1.23
2	Simpson dominance index (D_s)	0.09
3	Pielou evenness index (*J*′)	0.87
4	Margalef species richness (*R*)	5.17

Note: ~~Calculation was done~~The values were calculated according to the 6 ~~sub plots~~subplots sized 20 m × 20 m each.

The study ~~revealed that~~ showed the floristic structure, composition, and diversity were related to the existence and importance of the abandoned land~~. The common species of study site were~~ dominated by fast-growing species. ~~The~~Moreover, the species of tree ~~species of this~~on the site had ‘intermediate diversity’ (*H*'), ‘low dominance’ (*Ds*), and ‘high evenness’ (*J*'~~). Similarly, the intermediate diversity, low dominance,~~) and ~~high evenness were also reported~~the same was found for seedling-sapling plants ~~(~~with DBH<5 cm~~)~~ and tree plants ~~(~~with DBH>5cm~~)~~ in 3 ~~years~~, 5 ~~years~~, 10 ~~years~~, and 20 years ~~of fallow~~after the lands ~~after abandonment~~have been fallowed (Karyati et al. 2013; Karyati et al. 2018). ~~The result showed that~~This, therefore, means abandoned land has important ~~role according to~~ ecological ~~aspect. The~~roles. Furthermore, the information ~~about~~on the composition and diversity of plant regeneration at early stages of secondary succession on fallow

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lands is useful for biodiversity conservation~~,~~ and also provide social and economic values for future forest (Karyati et al. 2013). ~~An understanding about~~This shows it is necessary to understand the ecological and economic aspects of abandoned lands ~~is needed~~in order to manage and conserve ~~fallow lands~~them during successional periods in the tropic.

3.2. Economic Aspect

3.2.1. Log price

The results ~~of this research~~ showed ~~that~~the log prices ~~at sawmill~~ for 10 species at the sawmill were different~~. Data in~~ while Table 6 ~~showed~~shows there were 525 stems ha^{-1} ~~at~~on the abandoned land. ~~The~~Moreover, the total and mean ~~of~~ log price ~~at abandoned land was as much as~~were USD1,~~62~~462.02m^{-3} and USD56.23m^{-3}, respectively~~. The~~ with the highest ~~log price owned four species namely~~ values obtained at *Eusideroxylon zwageri* of Lauraceae ~~(~~with 526.85 USD m^{-3}~~),~~, *Diospyros* sp. of Ebenaceae ~~(~~with USD263.3 m^{-3}~~),~~, *Pometia zwageri* of Sapindaceae ~~(~~with USD125.13 m^{-3}~~),~~, and *Artocarpus odoratissimus* of Moraceae ~~(~~with USD69.15 m^{-3}~~). Futhermore,~~. Furthermore, most of the other 22 species ~~of other trees~~ had ~~log prices~~the same value or were under USD65.86 m^{-3}.

Table 6. Number of stems at abandoned land and log price.

No.	Species	Family	Number (stems ha^{-1})	P_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	13	526.85
2	*Diospyros* sp.	Ebenaceae	17	263.43
3	*Pometia pinnata*	Sapindaceae	8	125.13
4	*Artocarpus odoratissimus*	Moraceae	4	69.15
5	*Archidendron pauciflorum*	Fabaceae	4	65.86
6	*Nephelium* sp.	Sapindaceae	13	59.27
7	*Pternandra* sp.	Melastomataceae	8	44.45
8	*Dillenia borneensis*	Dilleniaceae	8	16.46
9	*Macaranga tanarius*	Euphorbiaceae	158	16.46
10	*Trema orientalis*	Cannabaceae	17	16.46
11	*Syzygium* sp.	Myrtaceae	8	16.46
12	*Homalanthus* sp.	Euphorbiaceae	46	16.46
13	*Nauclea* sp.	Rubiaceae	8	16.46
14	*Glochidion obscurum*	Phyllanthaceae	13	16.46
15	*Fordia splendidissima*	Fabaceae	17	16.46
16	*Vernonia arborea*	Asteraceae	4	16.46
17	*Macaranga gigantea*	Euphorbiaceae	4	16.46
18	*Cananga odorata*	Annonaceae	8	16.46
19	*Duabanga moluccana*	Lithraceae	4	16.46
20	*Baccaurea* sp.	Phyllanthaceae	4	16.46
21	Unknown species 1	Anacardiaceae	13	16.46
22	Unknown species 2	Anacardiaceae	4	16.46
23	Unknown species 3	Unknown family	4	16.46
24	*Bridelia glauca*	Phyllanthaceae	83	16.19
25	*Pterospermum javanicum*	Malvaceae	33	15.09
26	*Ficus septica*	Moraceae	21	13.17
	Total		525	1,462.02
	Mean		20	56.23

Note: P_{ij} = log price for each species at sawmill and diameter class.

~~Log~~The log price ~~depend~~depends on the species and diameter class of log~~. Species of~~ such that trees ~~which own~~with high timber quality and ~~sell well~~many sales in the market ~~will~~ have

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~~high~~higher log prices. ~~The~~However, a bigger diameter at breast ~~hight~~height (DBH) ~~of log, the~~led to a lower reduction factor ~~of~~and higher log price~~, and the higher log price. Log owns big DBH more~~. This means it is easier ~~become many~~ to produce different kinds of products ~~material~~ from the logs with big DBH and ~~also it has big~~ timber volume. ~~The~~Moreover, high community demand for logs of particular species ~~will lead the higher log~~ usually increases their prices in the market~~. This is~~ in accordance with the laws of demand ~~law that stated the higher demand for a commodity will lead the higher price of that commodity~~.

Trees ~~own the~~with high log prices ~~only~~are in a small number ~~at~~on the abandoned land~~. There was the~~ with an average of 20 stems ha^{-1} for each species. ~~The number of trees which including~~ The *Eusideroxylon zwageri* ~~-~~(Lauraceae) ~~was~~had only 13 stems ha^{-1}, ~~meanwhile those including~~ *Diospyros* sp. (Ebenaceae) ~~was~~with 17 stems ha^{-1} ~~at abandoned land. The numbers of~~while *Pometia pinnata* (Sapindaceae) and ~~-~~*Artocarpus odoratissimus* (Moraceae) ~~were~~had 8 stems ha^{-1} and 4 stems ha^{-1}, respectively. ~~Those species that own very high log prices have small population at abandoned land.~~ This is, however, in ~~concordant~~line with the law of supply ~~law~~which states that ~~stated the~~a smaller ~~number~~ supply of the commodity to the market~~, the~~ leads to a higher ~~commodity~~ price.

~~However, that~~A different result was ~~not happen to~~, however, observed with other ~~trees~~ species~~. For example~~ such as *Macaranga tanarius* (Euphorbiaceae) ~~was most met at abandoned land, with the~~with a total number of 158 stems ha^{-1}~~, however its~~ and a log price ~~only~~of USD16.46 m^{-3}~~. The number of some family~~ and other families and species ~~was only four stems ha^{-1} at abandoned land also had~~with low log prices. ~~There are many~~This means several factors determine ~~log~~the price of log in the market ~~such as species,~~and they include tree diameter, timber quality, consumer taste, and ~~other factors~~others. According to Noor et al. (2007a), the market price is the first point of sale where the product is sold freely in the competitive market.

3.2.2. Logging Cost

Logging cost was the same for each species of trees ~~as much as~~ and was found to be USD35.12 m^{-3}~~. The chainsawman used~~ including the costs for the chainsaw man, machine ~~however~~used, fuel, and depreciation ~~costs were not calculate in this research because those costs was including in logging cost. Data in~~. Table 7 ~~showed that~~shows the total and mean ~~of~~ logging costs in the abandoned land were USD1,212.24 ha^{-1} and USD46.62 ha^{-1}~~. The~~ respectively with the lowest ~~logging cost (~~being USD0.72 ha^{-1}~~) was expanded~~ for ~~logging~~ 14 stems ~~including family~~from *Anacardiaceae*~~. The~~ family while the highest ~~logging cost (USD27~~was USD277.17 ha^{-1}~~) was spended~~ for ~~logging~~ 21 stems from ~~-~~*Ficus septica* (Moraceae).

Logging cost ~~did~~is, however, not ~~determine~~determined by the number of trees ~~that will be cut. However, logging cost is determined by estimation of log~~ but by the volume such that ~~resulted in logging process. The~~a higher estimation of log volume~~, the~~ leads to a higher logging cost. ~~The big diameter~~Moreover, trees with high diameters were discovered to have ~~big log~~more volume and ~~the~~ vice versa, and those with small ~~others~~diameters were also found to have ~~small log volume. Small diameter trees need~~needed shorter logging time ~~than big diameter trees.~~. Germain et. al. (2019) found two statistically significant variables ~~which influence and can predict per~~influencing unit logging costs~~:~~ and they include volume per area harvested and the owner/operator experience~~. The increasing both the volume harvested per hectare and operator experience will result in~~ such that an increase in these factors is expected to lower the per~~-~~unit logging costs, with ~~the latter~~experience variable having the least effect ~~on the unit logging costs~~.

Table 7. Logging cost of trees.

No.	Species	Family	Number (stems ha^{-1})	C_{ij} (USD ha^{-1})
1	*Ficus septica*	Moraceae	21	277.17

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No.	Species	Family	Number (stems ha^{-1})	C_{ij} (USD ha^{-1})
2	*Bridelia glauca*	Phyllanthaceae	83	264.77
3	*Pterospermum javanicum*	Malvaceae	33	258.63
4	*Trema orientalis*	Cannabaceae	17	77.30
5	*Glochidion obscurum*	Phyllanthaceae	13	58.19
6	*Macaranga tanarius*	Euphorbiaceae	158	49.69
7	*Nephelium* sp.	Sapindaceae	13	39.72
8	*Duabanga moluccana*	Lithraceae	4	31.42
9	*Pometia pinnata*	Sapindaceae	8	30.31
10	*Cananga odorata*	Annonaceae	8	29.90
11	*Artocarpus odoratissimus*	Moraceae	4	18.08
12	*Nauclea* sp.	Rubiaceae	8	11.99
13	Unknown species 1	Anacardiaceae	13	11.55
14	*Diospyros* sp.	Ebenaceae	17	11.32
15	*Archidendron pauciflorum*	Fabaceae	4	9.68
16	*Dillenia borneensis*	Dilleniaceae	8	9.43
17	*Homalanthus* sp.	Euphorbiaceae	46	8.61
18	*Pternandra* sp.	Melastomataceae	8	3.46
19	*Fordia splendidissima*	Fabaceae	17	2.64
20	Unknown species 2	Anacardiaceae	4	1.80
21	*Macaranga gigantea*	Euphorbiaceae	4	1.57
22	*Eusideroxylon zwageri*	Lauraceae	13	1.26
23	*Vernonia arborea*	Asteraceae	4	1.13
24	*Syzygium* sp.	Myrtaceae	8	1.12
25	*Baccaurea* sp.	Phyllanthaceae	4	0.80
26	Unknown species 3	Unknown family	4	0.72
	Total		525	1,212.24
	Mean		20	46.62

Note: C_{ij} = logging cost of the tree.

3.2.3. Profit Margin

~~Total~~The total profit margin of ~~log~~ selling logs was ~~as much as~~found to be USD337.39 m^{-3} with an average of USD12.98 m^{-3}. The highest ~~profit margin was produced from log marketing~~value of USD121.58 m^{-3} was obtained from *Eusideroxylon zwageri* (Lauraceae) ~~where it~~while the lowest was ~~calculated as much as USD121.58 m^{-3}. Meanwhile, log of~~recorded to be USD3.04 m^{-3} for *Ficus septica* (Moraceae) ~~produced profit margin as much as USD3.04 m^{-3} (~~as shown in Table 8~~).~~.

~~Factors determine~~The factors determining the profit margin ~~are~~include the log price of each species at the sawmill and the class diameter~~. The higher log price, the higher seller~~ such that the opportunity of the seller to ~~own~~make profit~~. Such in~~ increases with a higher price and the ~~case of~~ log diameter~~. The bigger log diameter of cutting tree, the bigger log volume, and the bigger seller oppportunity to get profit.~~

Table 8. Profit margin.

No.	Species	Family	P_{ij} (USD m^{-3})	PM_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	526.85	121.58
2	*Diospyros* sp.	Ebenaceae	263.43	60.79
3	*Pometia pinnata*	Sapindaceae	125.13	28.88
4	*Artocarpus odoratissimus*	Moraceae	69.15	15.96
5	*Archidendron pauciflorum*	Fabaceae	65.86	15.20
6	*Nephelium* sp.	Sapindaceae	59.27	13.68
7	*Pternandra* sp.	Melastomataceae	44.45	10.26
8	*Dillenia borneensis*	Dilleniaceae	16.46	3.80

No.	Species	Family	P_{ij} (USD m^{-3})	PM_{ij} (USD m^{-3})
9	*Macaranga tanarius*	Euphorbiaceae	16.46	3.80
10	*Bridelia glauca*	Phyllanthaceae	16.19	3.74
11	*Trema orientalis*	Cannabaceae	16.46	3.80
12	*Syzygium* sp.	Myrtaceae	16.46	3.80
13	*Homalanthus* sp.	Euphorbiaceae	16.46	3.80
14	*Nauclea* sp.	Rubiaceae	16.46	3.80
15	*Glochidion obscurum*	Phyllanthaceae	16.46	3.80
16	*Fordia splendidissima*	Fabaceae	16.46	3.80
17	*Vernonia arborea*	Asteraceae	16.46	3.80
18	*Macaranga gigantea*	Euphorbiaceae	16.46	3.80
19	*Cananga odorata*	Annonaceae	16.46	3.80
20	*Duabanga moluccana*	Lithraceae	16.46	3.80
21	*Baccaurea* sp.	Phyllanthaceae	16.46	3.80
22	Unknown species 1	Anacardiaceae	16.46	3.80
23	Unknown species 2	Anacardiaceae	16.46	3.80
24	Unknown species 3	Unknown family	16.46	3.80
25	*Pterospermum javanicum*	Malvaceae	15.09	3.48
26	*Ficus septica*	Moraceae	13.17	3.04
	Total		1,462.02	337.39
	Mean		56.23	12.98

Note: P_{ij} = log price at sawmill and diameter class; PM_{ij} = profit margin.

3.2.4. Stumpage Value

~~Stumpage~~The stumpage value ~~is~~was determined by the timber volume ~~for each species~~, log diameter, log price ~~for each species~~ at the sawmill, and profit margin. ~~The result of this research estimated~~ for each species and the total ~~stumpage values at abandoned land as much as~~valued obtained was USD2,159.36 ha^{-1}. However, Figure 4 shows ~~8~~eight species ~~of trees~~ had economic values above the mean stumpage values ~~of each species at~~on the abandoned land. ~~The~~ with the mean contribution ~~mean of each species was as much as~~found to be USD83.05 ha^{-1} ~~for total stumpage values. Meanwhile,~~while 18 species of other trees had ~~economic~~ values under the mean stumpage values ~~of each family/species at abandoned land~~.

The ~~other research~~studies conducted in other location found different stumpage economic values. ~~The estimated economic values for~~, for example, in Ayer Hitam Forest Reserve, Puchong, Selangor ~~were~~, it was estimated to be RM34,278,980 for timber, RM67,192 for medical ~~plant's~~plants, RM773,090 for dependence of indigenous people, RM865,770 for potential recreation benefits, and RM2,39 billion for conservation value based on Malaysian adult population (Noor et. al. 2007b). ~~Although total stumpage~~ Even though the values ~~at abandoned land from the result of~~obtained in this ~~research was under~~study are lesser than the ~~result of~~ones in Noor et. al. (2007b~~) research~~), it, however ~~this finding showed that~~, shows abandoned land has many trees ~~own~~with potential economic values.

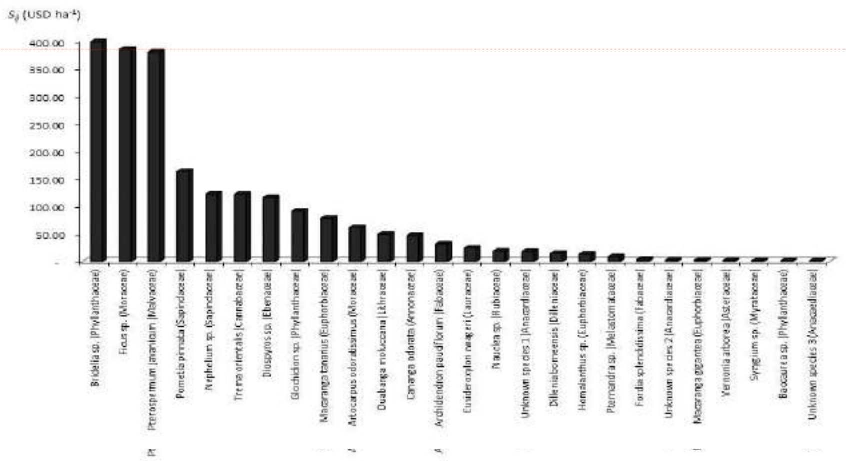

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Figure 4. Stumpage values of trees at abandoned land.

4. Conclusion

The ~~existence of~~ abandoned lands in the tropics ~~has multi function~~have several functions, both from the ecological and economic aspects. Ecologically, the structure and floristic diversity ~~of abandoned land~~ in the early secondary succession is ~~hoped~~expected to be ecotone towards the primary succession~~. The abandoned~~ and this means the lands ~~also play an~~plan important ~~role~~roles in ~~soil, water and environent~~the conservation~~.~~ of soil, water, and the environment. In addition, ~~abandoned lands hae a~~they also have potential economic ~~value. The~~values for individuals and the community. Therefore, basic information on ecological and ~~conomic~~economic aspects of the abandoned lands is ~~needed~~required to land management and conservation in the future.

Acknowledgments

~~We acknowledge to~~The authors appreciate the Ministry of Research, Technology, and Higher Education, the Republic of Indonesia ~~for supporting~~through the support provided by *Hibah Penelitian Dasar Unggulan Perguruan Tinggi* Contract No.: 183/SP2H/LT/DRPM/2019 ~~of~~for this research~~ project~~.

~~cology~~ecology.

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Dear Editor in Chief,

We would like to say thanks and appreciate for constructive suggestion from reviewer.

As attached below, our feedback for the reviewer's comments on our manuscript entitled "The Role of Tropical Abandoned Land on Ecological and Economic Aspects".

No.	Page/ Line	Review	Feedback and revision
Reviewer A			
1	Introduction, last paragraph, Page 2	The paper is lacking a strong scientific hypothesis. I think in general, the article value can be improved. The aim of the paper as well as its scientific contribution is unclear (add in Introduction). I think the motivations for this study need to be made clearer in case of sustainability (In Introduction, last paragraph).	We had revised the last paragraph of Introduction (Page 2).
2		• The authors should convert IDR to USD (or Euro). This is important for foreign readers.	We had converted IDR to USD
3		• Please write "conclusion" - must be clear-cut and normative.	We had added "Conclusion"
4	Page 12, Conclusion	• Grammar and syntax could be improved. Revision with the help of a native English speaker is recommended. Editorial errors ("sp (without dot)", "spesies", "opportunity"; "indigeneous", in references "Journal of Tropical Ecology (dot?)"; Figure 1 (source?); etc).	• "sp (without dot)"➔ abbreviation for "sp." or "spec." is used if the species name cannot or does not need to be explained. Example: *Homalanthus* sp. means one type of the genus Homalanthus. • "Spesies" had revised to "species" • "indigeneous" had revised to "indigenous • "Journal of Tropical Ecology (dot?) ➔ had revised with dot (.) • Figure 1 had added source ➔ Map Reference: Aerial photograph from a Data Procurement Project by the East Kalimantan Province PUPR Service (2015)
Reviewer D			
1	Abstract and Introduction	This manuscript has the potential to be a good article. However, the aim of the paper, as well as its scientific contribution, it is unclear, please add both in abstract and	The aim of the study had revised.

No.	Page/ Line	Review	Feedback and revision
		introduction.	
2	Abstract	I recommend rewriting the abstract following these 7 questions. Abstract • Why does your article/research topic matter? [purpose] • What is the research question? [purpose] • What is the framework for the research? [methods] • What data are you [using? [methods] • How did you do the research? [methods] • What did you find? [findings/results] • Again, so what? [relevance]´	The abstract had been rewriting. • The potential of a large number of abandoned lands in the tropics has not been used optimally. • This study was conducted to determine the ecological aspects of floristic structure, composition, and diversity and analyze economic aspects of standing trees in the tropical abandoned land in East Kalimantan, Indonesia. • The vegetation surveys of all woody trees with diamater at breast height (DBH) of $\geq$ 5 cm were conducted at six sub plots sized 20 m × 20 m. The economic parameters were assessed by using data of log price, logging cost, profit margin, and stumpage value of standing trees in the study plot. • A total of 126 trees including 26 species of 25 genera of 18 families were recorded. The most common species was *Macaranga tanarius* (50.60%), *Bridelia glauca* (49.13%), and *Pterospermum javanicum* (29.05%) based on Importance Value Index (IVi). The diversity, dominance, evenness, and richness indices were 1.23, 0.09, 0.87, and 5.17 respectively. Total of log prices at abandoned land was as much as USD1,462.02 m^{-3} and an average value of USD56.23 m^{-3}. Total and mean of logging costs in abandoned land were USD1,212.24 ha^{-1} and IDR637,174.40 ha^{-1}, respectively. Total profit margin of log selling was as much as USD337.39m^{-3} with the average of IDR177,337.28 m^{-3}. The average of stumpage values at abandoned land was as much as USD83.05 ha^{-1} with the total of USD2,159.36 ha^{-1}. • The utilization of abandoned lands with respect to ecology and economic aspects can increase the community welfare as well as support the development program in the country.
3		Grammar: please proof this article to the native English	The article had checked by proof reader.

Samarinda, 22 January 2020

Karyati

Dear Editor in Chief,

We thanks to reviewer's comments for our manuscript entitled "The Role of Tropical Abandoned Land on Ecological and Economic Aspects".

No.	**Page/ Line**	**Review**	**Feedback and revision**
Reviewer A			
1	Results and Discussion	Currency entry is incorrect (order, space). Requires changes (e.g., 1.462.02 USD m-3 and 56.23 USD m-3). Please enter the exchange rate (day, converter).	We have corrected the currency entri. We have added the exchange rate.
2	Conclusion	Conclusions must be more clear-cut and normative.	We have revised the conclusions.
3	Results	The results should be expanded significantly and quantitatively.	We have revised the results.
Reviewer B			
1		The manuscript is improved now	The manuscript was edited by Native Proofreading Service (NPS).
Editorial comment.			
1	References	Please make sure only citation in the text is included in the reference, and vice versa	We have checked the reference.
2	References	Please make sure the citation follows APA style	We have revised the citation based on APA style.
3	References	Please provide DOI for each reference (if available)	We have completed DOI for each reference (if available) .

Samarinda, 31 January 2020

Karyati

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Manuscript Title

The Role of Tropical Abandoned Land on Ecological and Economic Aspects

Authors

Karmini, Karyati , and Kusno Yuli Widiati

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Regular Research Article

The role of tropical abandoned land on ecological and economic aspects

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Abstract: The floristic structure and composition of abandoned lands in the tropic have been observed to be changing dynamically during the succession process. This is mostly because they are not utilized maximally, therefore, there is a need to assess the economic and ecological impacts of this land abandonment in the tropical areas. This study was conducted to determine the ecological aspects of ~~floristic~~ stand structure, floristic composition, and species diversity and analyze the economic aspects of standing trees in the tropical abandoned land. The vegetation containing woody trees with a diameter at breast height (DBH) of $\geq$ 5 cm were surveyed at six subplots sized 20 m × 20 m. The economic parameters were evaluated using data of log price, logging cost, profit margin, and stumpage value of standing trees in the study plot and a total of 126 trees including 26 species of 25 genera of 18 families were recorded. The most common species found were *Macaranga tanarius* with 50.60%, *Bridelia glauca* with 49.13%, and *Pterospermum javanicum* with 29.05% based on Importance Value Index (IVi). Moreover, the diversity, dominance, evenness, and richness indices were 1.23, 0.09, 0.87, and 5.17 respectively while the total log price at the abandoned land was ~~USD~~ 1,462.02 USD m^{-3} with an average value of ~~USD~~56.23 USD m^{-3}. The total and mean values of logging costs were ~~USD~~ 1,212.24 USD ha^{-1} and ~~USD~~46.62 USD ha^{-1}, respectively while the total profit margin of log selling was USD337.39 m^{-3} at maximum with an average of ~~USD~~ 12.9~~7~~8 USD m^{-3}. Furthermore, the average stumpage value was ~~USD~~83.05 USD ha^{-1} while the total was calculated to be ~~USD~~ 2,159.36 USD ha^{-1}. These findings showed the utilization of abandoned lands with respect to ecology and economic aspects has the ability to increase the community welfare and support the implementation of developmental programs in the country.

Keywords: Abandoned land; diversity; economic; floristic structure; stumpage value

1. Introduction

The dynamics at several scales determine the plant diversity within regenerating fallows (Lawrence, 2004) exploited for agricultural purposes, mainly through shifting cultivation. This is observed to be a global phenomenon because two-thirds of the world's secondary forests were recorded to have been cultivated through the process in 1980 with 49% recorded annually in tropical Asia (Lanly, 1982). These forests are defined as the vegetation resulting from the clearing of natural high forest for shifting cultivation before abandonment (Abebrese, 2002; Johnson and Miyanishi, 2007; Keddy, 2007; Misra, 1992). They are characterized by the structure and extent of vegetative cover as well as their composition in terms of dominant and secondary species (Mittelman, 2001; Van Breugel et al. 2006). However, the principal types include the Swidden fallow secondary forests and some other gardens as reported by Chokkalingam et al. (2001).

According to Van Breugel et al. (2006), understanding the mechanisms of secondary forest succession requires the consideration of the time of abandonment as a compound factor to integrate the variables of plant community ecology - the total effective conditions determining the existence of the plants on the land (Tansley, 1993). Secondary forests are caused by human activity and fast-growing ecosystems whose species life cycles coincide with those of human land

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uses. In addition, they are also assets for the conservation of biodiversity in the tropics due to their many biotic characteristics such as the ability to improve soil and water quality as well as to conserve genetic material, nutrients, moisture, and/or soil organic matters (Brown and Lugo, 1990).

With the continuous depletion of primary forests, secondary forests have become increasingly important to maintain the larger habitat for biodiversity conservation (Mittelman, 2001). This is associated with their coverage of more than 600 million ha of the land area in the tropics which accounts for about 40% of the total forest area as well as the formation rates estimated at 9 million ha year^{-1} (Brown and Lugo, 1990). Moreover, FAO (1996) estimated the area of secondary forest in 1990 in Asia to be 87.5 million ha while the figures for Latin America and Africa were 165 and 90 million ha, respectively. These data and the awareness of the accelerated changes in the forest situation in countries like the Philippines, Indonesia, China, and Malaysia strongly suggest future goods and services obtained from the tropical forests would increasingly be sourced from secondary or some other kinds of anthropogenically-induced forests such as the timber, environmental services, biodiversity conservation, and forest products for the rural poor (De Jong et al., 2001).

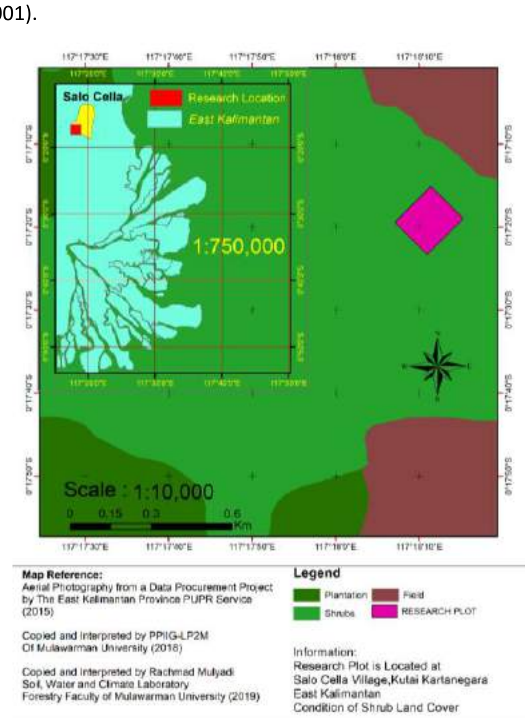

Figure 1. Map of the study site in Muara Badak Sub-district, Kutai Kartanegara District, East Kalimantan Province, Indonesia.

The total land area in Indonesia is estimated to be 190 million hectares and -2/3 of these are referred to as forest areas managed by the Ministry of Forestry while the remaining 1/3 is for business (HGU) and building (HGB). However, the National Land Agency (BPN) indicated 7.5 million hectares of land has the potential to be abandoned, both in and outside the forest areas, and several people have assumed these lands have no usefulness. However, they have certain ecological and economic benefits and several studies have been conducted on the ecological aspect such as the floristic composition and structure of the tropical secondary forest in Borneo Island as well as the less information provided on the ecological and economic aspects of tropical abandoned land in East Kalimantan. This study was, therefore, conducted to determine the ecological aspect such as ~~floristic~~ stand structure, floristic composition, and species diversity as well as the economic aspect of standing trees such as log price, logging cost, profit margin, and stumpage value in an abandoned land. The findings are expected to be useful in conserving and managing tropical forest and environmental ecosystems.

2. Materials and methods

2.1. Study site

The study was conducted in Salo Cella Village, Muara Badak Sub-district, Kutai Kartanegara Districts, East Kalimantan Province, Indonesia with the geographic location of 0°17'18.7''S 117°18'08.2''E as shown in Figure 1. Salo Cella is one of 13 villages in Muara Badak located 10 km from the capital of Sub-district with a population of ~~57.712~~49,361,000 most of which are farmers and an area of 939.09 km^2 dominated by lowland mixed dipterocarp forest. Moreover, the average monthly and amount of rainfall were recorded to be ~~141~~92 mm^3 and ~~11~~9 raindays in 201~~7~~8 (Statistics Kutai Kartanegara Regency 201~~8~~9). The subdistrict is administratively bordered by Marang Kayu Sub-district, Anggana Sub-district Samarinda City, Makassar Strait, and Tenggarong Seberang Sub-district on the north, south, east, and west respectively. Furthermore, the sectors of Muara Badak with economic potentials are oil and gas, fishery, and plantation.

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2.2 Data collection

The vegetation and economic surveys of the study site were conducted from March to August 2019 through the establishment of six subplots sized 20 m × 20 m. Moreover, all woody trees with DBH of $\geq$ 5 cm within the plot were enumerated and their species identified.

2.3 Data analysis

2.3.1 Ecological aspect

Individual basal area (BA) and volume (V) were determined using the following formulas (Husch et al. 1982):

$$\text{Individuals BA} = \pi\,(DBH/2)^2 .\ 10^{-4} \quad \ldots\ldots (1)$$

$$\text{Individuals V} = \tfrac{1}{4}\,\pi \times DBH^2 .\ 10^{-4} \times H \times f \quad \ldots\ldots (2)$$

where: DBH is the diameter at breast height (cm), 'H' is tree height (m), and '*f*' is the form factor.

The dominant species within the plots were measured using the Importance Value Index (IVi) (Fachrul 2007):

RF = (Frequency of a species / Total frequencies of all species) × 100 .... (3)

Rd = (The number of individual species / Total number of individuals) × 100 .... (4)

RD = (Total basal area for a species / Total basal area for all species) × 100 .... (5)

IVi = RF + Rd + RD .... (6)

where: RF is relative frequency, Rd is relative density, and RD is relative dominance.

The species diversity for standing trees in the study site was described using four indices including Shannon-Wiener's diversity index (H'), Simpson's dominance index (D_s), Pielou's evenness index (J'), and Margalef's richness index (R) (Odum 2005):

$$H' = -\sum_{i=1}^{s}\left(\frac{n_i}{N}\right)\ln\left(\frac{n_i}{N}\right) \quad (7)$$

$$D_s = \sum_{i=1}^{s}\left(\frac{n_i}{N}\right)^2 \quad (8)$$

$$J' = \frac{H'}{\ln(S)} \quad (9)$$

$$R = \frac{(S-1)}{\ln n} \quad (10)$$

where n_i = number of individuals of the *i*- th species, N = total number of all the individuals in a unit area, and S = number of species in each plot.

2.3.2 Economic aspect

The equivalent merchantable height, number of logs, and diameter class are presented in Table 1 while the reduction factors of log price based on the diameter class are shown in Table 2.

Table 1. Merchantable tree heights.

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
15 – 30	1	5
+30 – 60	2	10
+60 – 75	3	15
75 ke atas	4	20

Source: Forestry Department of Pinansular Malaysia (FDPM) (1997)

Table 2. Reduction cost of log price.

DBH size class (cm)	Reduction factor
15 – 29	0,450
30 – 44	0,300
45 – 49	0,150
50 – 54	0,025
55 and above	0,000

Source: Noor et al. (1992) and Hanum et al. (2001)

Logging cost was reported to be ~~IDR~~480,.000.,00 IDR (Hikmat, 2005) while the profit ratio was 30% (Noor and Shahwahid, 1999). Therefore, the equation to calculate~~d~~ the profit margin (Noor and Shahwahid, 1999) is presented as follows:

$$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij} x PR)/(1+PR)$$

Where PM_{ij} = profit margin, P_{ij} = log price for each species at sawmill and diameter class, *PR* = profit ratio, *i* = an index for each species (i = 1, 2, 3, 4, ..., n), and *j* = an index for diameter class (i = 1, 2, 3, 4, ..., n).

Meanwhile, the stumpage values were calculated using the following equation:

$$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij} + C_{ij} + PM)$$

Where S_{ij} = stumpage value for each species and diameter class (USD ha^{-1}), V_{ij} = volume of timber for each species and diameter class (m^3), P_{ij} = log price for each species at sawmill and diameter class (USD m^{-3}), C_{ij} = average logging cost (USD ha^{-1}), PM_{ij} = profit margin (USD m^{-3}), *i* = an index for each species (i = 1, 2, 3, 4, ..., n), and *j* = an index for diameter class (i = 1, 2, 3, 4, ..., n). The exchange rate was 1 USD equal with 13,666 IDR at 21st January 2020.

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3. Results and discussion

3.1. Ecological aspect

3.1.1 Diameter at Breast Height (DBH) and Height Distributions

There was a difference in the density of trees in the DBH classes as observed with the formation of L-shape characterized by the reduction in the total number of trees as the DBH increased as illustrated in Figure 2. There were 88 trees with the DBH size of 5.0-15.0 cm, followed by 22 trees (17%) with the DBH size of 15.1-25.0 cm, 14 trees (11%) with the DBH size of 25.1-35.0 cm, and 2 trees (2%) with the DBH size of more 35 cm. The abandoned land was also observed to be dominated by ~~smaller DBH classes with more than~~ 70% of all trees having ~~values~~ DBH > 5 cm in the 5.0-1~~0~~5.0 cm class. Moreover, the tree diameter distribution formed a reverse-J-shape (Feldpausch et al., 2007; Álvarez-Yépiz et al., 2008) while the distribution of the classes of the height was skewed slightly positively (Ohtsuka, 1999) as shown in Figure 3 with approximately 58% of the trees included in the 5.1-10.0 m class. The overall composition was 18 trees (14%) of 0-5.0 m height, 73 trees (58%) of 5.1-10.0 m height, 19 trees (15%) of 10.1-15.0 height, 7 trees (6%) of 15.1-20.0 height, and 9 trees (7%) of more than 20.0 cm height.

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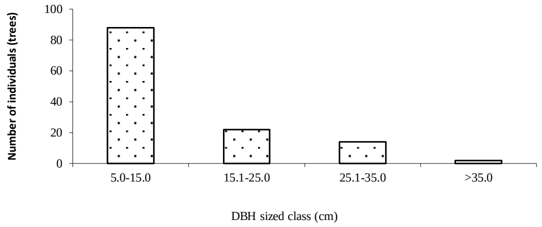

Figure 2. Distributions of diameter at breast height (DBH) in 0.24 ha of abandoned land.

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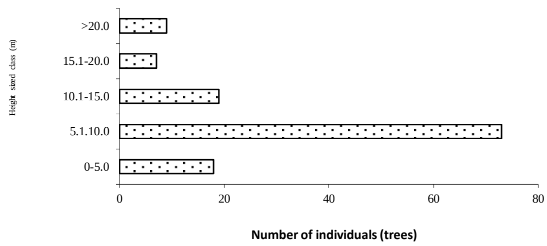

Figure 3. Distributions of height at different ages in 0.24 ha of abandoned land.

3.1.2 Density, basal area, and volume

The density, basal area, and volume of species at a DBH of > 5 cm are presented in Table 3. Twenty six species of 18 families were recorded in the study site. Three species such as *Bridelia glauca*, *Glochidion obscurum*, and *Baccaurea* sp. were included to Phyllanthaceae. Similarly, *Macaranga tanarius*, *Homalanthus* sp., and *Macaranga gigantea* were from Euphorbiaceae. The other 16 families had one species each. The density was found to be 126 trees in 0.24 hectare and the dominating species of trees based on the number of individuals include *Macaranga tanarius* with 38, *Bridelia* sp. with 20, ~~and~~ *Homalanthus* sp. with 11, *Pterospermum javanicum* with 8, and *Ficus septica* with 5. The other species had number of individuals of < 4 trees. The average of DBH and height of trees were 14.3 cm and 10.5 m, respectively. Regarding the basal area and volume per hectare, three dominant species were also observed and they include *Bridelia glauca* with 2.10 m^2 ha^{-1} and 23.24 m^3 ha^{-1}, *Pterospermum javanicum* with 1.64 m^2 ha^{-1} and 18.42 m^3 ha^{-1}, and *Ficus* sp. with 1.24 m^2 ha^{-1} and 11.74 m^3 ha^{-1} for basal area and volume respectively. This, therefore, means these three species covered more than 58 percent of the total volume while other six species including *Trema Orientalis*, *Trema Orientalis*, *Glochidion* sp., *Duabanga moluccana*, *Pometia pinnata*, and *Cananga odorata* had more than 3.70 m^3 ha^{-1}. The four species of *Nephelium* sp., *Nauclea* sp., *Artocarpus elasticus*, and *Homalanthus* sp. had relative high volume (> 1.07 m^3 ha^{-1}). While 13 other species had few basal area (0.02 to 0.15 m^2 ha^{-1}) and volume (0.07 to 0.83 m^3 ha^{-1}). *Macaranga gigantea*, *Vitex pubescens*, and *Dillenia suffruticosa* were three dominant species in terms of density, basal area and volume per hectare in the 5 and 10 year old after abandoned lands. In addition, *Macaranga hypoleuca* and *Macaranga caladifolia* were also common in the 10 year old of abandoned land, while *Macaranga trichocarpa* in the 5 year old of abandoned land (Karyati et al., 2018).

3.1.3 Importance value index (IVi)

The study site was dominated by light-demanding pioneer and fast-growing species in terms of IVi as presented in Table 4. However, the same four species observed to be predominant with total basal area and volume were also found for the IVi and they include *Macaranga tanarius* with 50.60%, *Bridelia glauca* with 49.13%, *Pterospermum javanicum* with 29.05%, and *Ficus septica* with 22.56%. The other three species discovered to be following the aforementioned were *Homalanthus* sp., *Trema* o~~O~~*rientalis*, and *Glochidion* sp. with 18.89, 16.10, and 11.53%, respectively. Three species of Euphorbiaceae were dominant in terms of the IVi. These three species such as *Macaranga tanarius*, *Homalanthus* sp., and *Macaranga gigantea* reached more than 72%. Similarly, Euphorbiaceae was include the ten most important family in the tropic as reported by Danquah et al. (2011) and Nizam et al. (2006). From 18 species recorded, there were 10 species with IVi of more than 5. The other 9 species reached IVi between 2 to 5. Furthermore, the seedling and saplings plants of *Ficus aurata* and *Macaranga* sp. were also common based on the Summed Dominance Ratio (SDR) in 3 and 5 years of fallow lands in Sarawak (Karyati et al., 2013). This is in line with the findings of Karyati et al. (2018) that trees species in lands abandoned for 5 and 10 years were dominated by *Macaranga* spp.

3.1.4 Species Diversity

The species diversity or heterogeneity (*H'* value~~s~~) of the plot studied was~~ere~~ categorized as 'intermediate' (Odum, 2005) according to the results presented in Table 5 while a low ecological dominance (D_s value) was also observed which means there were few or almost no species dominating the site. The high species diversity indicates a highly complex community (Brower et al., 1990). This was also supported by the high value of *J'* indicating all the species are evenly distributed in the community. These values may, however, be due to the high number of trees ~~per~~

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hectare and the number of species. The species richness can be measured most simply by counting the number of species in an area (Krebs, 2001). Generally, the increasing diversity (*H'*), evenness (*J'*), and richness (*R*) caused a reduction in dominance (D_s) in accordance with the findings of a previous study that tree diversity declined while dominance increased linearly along a disturbance gradient (Sapkota et al., 2010). The typical of most tropical lowland forests are no single tree species with high frequency and dominance (Kartawinata et al., 1981).

Table 3. Density, basal area, and volume of species (DBH of > 5 cm) in the study site.

No.	Species	Family	Number of individuals	Average of DBH (cm)	Average of height (m)	Total of basal area (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
1	*Bridelia glauca*	Phyllanthaceae	20	15.7	11.7	2.10	23.24
2	*Pterospermum javanicum*	Malvaceae	8	24.1	16.6	1.64	18.42
3	*Ficus septica*	Moraceae	5	23.5	11.0	1.24	11.74
4	*Trema Orientalis*	Cannabaceae	4	21.3	10.8	0.69	5.60
5	*Macaranga tanarius*	Euphorbiaceae	38	8.8	7.7	1.04	5.28
6	*Glochidion obscurum*	Phyllanthaceae	3	22.7	15.3	0.51	5.18
7	*Duabanga moluccana*	Lithraceae	1	29.0	22.0	0.28	3.94
8	*Pometia pinnata*	Sapindaceae	2	19.8	22.0	0.27	3.80
9	*Cananga odorata*	Annonaceae	2	17.5	13.5	0.27	3.72
10	*Nephelium* sp.	Sapindaceae	3	18.6	11.7	0.37	2.99
11	*Nauclea* sp.	Rubiaceae	2	13.4	14.0	0.13	1.39
12	*Artocarpus elasticus*	Moraceae	1	22.0	12.0	0.16	1.24
13	*Homalanthus* sp.	Euphorbiaceae	11	7.6	6.5	0.23	1.07
14	*Archidendron pauciflorum*	Fabaceae	1	16.1	15.0	0.08	0.83
15	Unknown species 1	Anacardiaceae	3	12.1	7.3	0.15	0.74
16	*Dillenia borneensis*	Dilleniaceae	2	11.6	9.5	0.10	0.65
17	*Diospyros* sp.	Ebenaceae	4	9.3	5.8	0.13	0.46
18	*Pternandra* sp.	Melastomataceae	2	11.8	7.0	0.09	0.41
19	*Macaranga gigantea*	Euphorbiaceae	1	11.2	9.0	0.04	0.24
20	*Fordia splendidissima*	Fabaceae	4	7.2	5.3	0.07	0.24
21	Unknown species 2	Anacardiaceae	1	12.3	6.0	0.05	0.19
22	*Eusideroxylon zwageri*	Lauraceae	3	5.7	8.0	0.03	0.16
23	*Vernonia arborea*	Asteraceae	1	9.5	6.0	0.03	0.12
24	*Syzygium* sp.	Myrtaceae	2	6.7	6.0	0.03	0.11
25	*Baccaurea* sp.	Phyllanthaceae	1	8.0	8.0	0.02	0.11
26	Unknown species 3	Unknown family	1	7.6	6.0	0.02	0.07
	Total		126,0	373.0	273.5	9.75	91.97
	Average		4,8	14.3	10.5	0.38	3.54
	Maximum		38.0	29.0	22.0	2.10	23.24
	Minimum		1.0	5.7	5.3	0.02	0.07

Note: DBH = diameter at breast height. The values were calculated based on vegetation surveyed in 0.24 hectare.

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Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.24 hectare of the study site.

No.	Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
1	*Macaranga tanarius*	Euphorbiaceae	9.80	30.16	10.64	50.60
2	*Bridelia glauca*	Phyllanthaceae	11.76	15.87	21.50	49.13
3	*Pterospermum javanicum*	Malvaceae	5.88	6.35	16.82	29.05
4	*Ficus septica*	Moraceae	5.88	3.97	12.70	22.56
5	*Homalanthus* sp.	Euphorbiaceae	7.84	8.73	2.32	18.89
6	*Trema orientalis*	Cannabaceae	5.88	3.17	7.04	16.10
7	*Glochidion obscurum*	Phyllanthaceae	3.92	2.38	5.23	11.53
8	*Diospyros* sp.	Ebenaceae	3.92	3.17	1.35	8.45
9	*Cananga odorata*	Annonaceae	3.92	1.59	2.80	8.30
10	*Nephelium* sp.	Sapindaceae	1.96	2.38	3.82	8.17
11	Unknown species 1	Anacardiaceae	3.92	2.38	1.54	7.84
12	*Nauclea* sp.	Rubiaceae	3.92	1.59	1.29	6.80
13	*Eusideroxylon zwageri*	Lauraceae	3.92	2.38	0.34	6.64

No.	Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
14	*Pometia pinnata*	Sapindaceae	1.96	1.59	2.72	6.27
15	*Fordia splendidissima*	Fabaceae	1.96	3.17	0.71	5.85
16	*Syzygium* sp.	Myrtaceae	3.92	1.59	0.30	5.81
17	*Duabanga moluccana*	Lithraceae	1.96	0.79	2.82	5.58
18	*Dillenia borneensis*	Dilleniaceae	1.96	1.59	0.99	4.54
19	*Pternandra* sp.	Melastomataceae	1.96	1.59	0.93	4.48
20	*Artocarpus elasticus*	Moraceae	1.96	0.79	1.62	4.38
21	*Archidendron pauciflorum*	Fabaceae	1.96	0.79	0.87	3.62
22	Unknown species 2	Anacardiaceae	1.96	0.79	0.51	3.26
23	*Macaranga gigantea*	Euphorbiaceae	1.96	0.79	0.42	3.18
24	*Vernonia arborea*	Asteraceae	1.96	0.79	0.30	3.06
25	*Baccaurea* sp.	Phyllanthaceae	1.96	0.79	0.21	2.97
26	Unknown species 3	Unknown family	1.96	0.79	0.19	2.95
	Jumlah		100.00	100.00	100.00	300.00

Note: RF= relative frequency, Rd=relative density, RD=relative dominance; IVi=importance value index.

Table 5. Diversity indices of trees with DBH of ≥ 5 cm in the study site.

No.	Diversity indices	Value
1	Shannon-Wiener diversity index (*H'*)	1.23
2	Simpson dominance index (D_s)	0.09
3	Pielou evenness index (*J'*)	0.87
4	Margalef species richness (*R*)	5.17

Note: The values were calculated according to the 6 subplots sized 20 m × 20 m each.

The study showed the floristic structure, composition, and diversity were related to the existence and importance of the abandoned land dominated by fast-growing species. Moreover, the species of tree on the site had 'intermediate diversity' (*H'*), 'low dominance' (*Ds*), and 'high evenness' (*J'*) and the same was found for seedling-sapling plants with DBH< 5 cm and tree plants with DBH>5 cm in 3, 5, 10, and 20 years after the lands have been fallowed (Karyati et al., 2013; Karyati et al., 2018). This, therefore, means abandoned land has important ecological roles. Furthermore, the information on the composition and diversity of plant regeneration at early stages of secondary succession on fallow lands is useful for biodiversity conservation and also provide social and economic values for future forest (Karyati et al., 2013). This shows it is necessary to understand the ecological and economic aspects of abandoned lands in order to manage and conserve them during successional periods in the tropic.

3.2 Economic aspect

3.2.1 Log price

The results showed the log prices for 10 species at the sawmill were different while Table 6 shows there were 525 stems ha^{-1} on the abandoned land. Moreover, the total and mean log price were USD1,462.02 USD m^{-3} and USD56.23 USD m^{-3}, respectively with the highest values obtained at *Eusideroxylon zwageri* of Lauraceae with 526.85 USD m^{-3}, *Diospyros* sp. of Ebenaceae with USD263.43 USD m^{-3}, *Pometia zwageri* of Sapindaceae with USD125.13 USD m^{-3}, and *Artocarpus odoratissimus* of Moraceae with USD69.15 USD m^{-3}. Furthermore, most of the other 22 species had the same value or were under USD65.86 USD m^{-3}.

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Table 6. Number of stems at abandoned land and log price.

No.	Species	Family	Number (stems ha^{-1})	P_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	13	526.85
2	*Diospyros* sp.	Ebenaceae	17	263.43
3	*Pometia pinnata*	Sapindaceae	8	125.13
4	*Artocarpus odoratissimus*	Moraceae	4	69.15
5	*Archidendron pauciflorum*	Fabaceae	4	65.86
6	*Nephelium* sp.	Sapindaceae	13	59.27
7	*Pternandra* sp.	Melastomataceae	8	44.45
8	*Dillenia borneensis*	Dilleniaceae	8	16.46
9	*Macaranga tanarius*	Euphorbiaceae	158	16.46
10	*Trema orientalis*	Cannabaceae	17	16.46
11	*Syzygium* sp.	Myrtaceae	8	16.46
12	*Homalanthus* sp.	Euphorbiaceae	46	16.46
13	*Nauclea* sp.	Rubiaceae	8	16.46
14	*Glochidion obscurum*	Phyllanthaceae	13	16.46
15	*Fordia splendidissima*	Fabaceae	17	16.46
16	*Vernonia arborea*	Asteraceae	4	16.46
17	*Macaranga gigantea*	Euphorbiaceae	4	16.46
18	*Cananga odorata*	Annonaceae	8	16.46
19	*Duabanga moluccana*	Lithraceae	4	16.46
20	*Baccaurea* sp.	Phyllanthaceae	4	16.46
21	Unknown species 1	Anacardiaceae	13	16.46
22	Unknown species 2	Anacardiaceae	4	16.46
23	Unknown species 3	Unknown family	4	16.46
24	*Bridelia glauca*	Phyllanthaceae	83	16.19
25	*Pterospermum javanicum*	Malvaceae	33	15.09
26	*Ficus septica*	Moraceae	21	13.17
	Total		525	1,462.02
	Mean		20	56.23

Note: P_{ij} = log price for each species at sawmill and diameter class.

The log price depends on the species and diameter class of log such that trees with high timber quality and many sales in the market have higher log prices. However, a bigger diameter at breast height (DBH) led to a lower reduction factor and higher log price. This means it is easier to produce different kinds of products from the logs with big DBH and timber volume. Moreover, high community demand for logs of particular species usually increases their prices in the market in accordance with the laws of demand.

Trees with high log prices are in a small number on the abandoned land with an average of 20 stems ha^{-1} for each species. The *Eusideroxylon zwageri* (Lauraceae) had only 13 stems ha^{-1}, *Diospyros* sp. (Ebenaceae) with 17 stems ha^{-1} while *Pometia pinnata* (Sapindaceae) and *Artocarpus odoratissimus* (Moraceae) had 8 stems ha^{-1} and 4 stems ha^{-1}, respectively. This is, however, in line with the law of supply which states that a smaller supply of the commodity to the market leads to a higher price.

A different result was, however, observed with other species such as *Macaranga tanarius* (Euphorbiaceae) with a total number of 158 stems ha^{-1} and a log price of ~~USD~~16.46 USD m^{-3} and other families and species with low log prices. This means several factors determine the price of log in the market and they include tree diameter, timber quality, consumer taste, and others. According to Noor et al. (2007a), the market price is the first point of sale where the product is sold freely in the competitive market.

3.2.2 Logging cost

Logging cost was the same for each species of trees and was found to be USD35.12 m^{-3} including the costs for the chainsaw man, machine used, fuel, and depreciation. Table 7 shows the total and mean logging costs in the abandoned land were USD1,212.24 USD ha^{-1} and USD46.62 USD ha^{-1} respectively with the lowest being USD0.72 USD ha^{-1} for 4 stems from *Anacardiaceae* family while the highest was USD277.17 USD ha^{-1} for 21 stems from *Ficus septica* (Moraceae).

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Table 7. Logging cost of trees.

No.	Species	Family	Number (stems ha^{-1})	C_{ij} (USD ha^{-1})
1	*Ficus septica*	Moraceae	21	277.17
2	*Bridelia glauca*	Phyllanthaceae	83	264.77
3	*Pterospermum javanicum*	Malvaceae	33	258.63
4	*Trema orientalis*	Cannabaceae	17	77.30
5	*Glochidion obscurum*	Phyllanthaceae	13	58.19
6	*Macaranga tanarius*	Euphorbiaceae	158	49.69
7	*Nephelium* sp.	Sapindaceae	13	39.72
8	*Duabanga moluccana*	Lithraceae	4	31.42
9	*Pometia pinnata*	Sapindaceae	8	30.31
10	*Cananga odorata*	Annonaceae	8	29.90
11	*Artocarpus odoratissimus*	Moraceae	4	18.08
12	*Nauclea* sp.	Rubiaceae	8	11.99
13	Unknown species 1	Anacardiaceae	13	11.55
14	*Diospyros* sp.	Ebenaceae	17	11.32
15	*Archidendron pauciflorum*	Fabaceae	4	9.68
16	*Dillenia borneensis*	Dilleniaceae	8	9.43
17	*Homalanthus* sp.	Euphorbiaceae	46	8.61
18	*Pternandra* sp.	Melastomataceae	8	3.46
19	*Fordia splendidissima*	Fabaceae	17	2.64
20	Unknown species 2	Anacardiaceae	4	1.80
21	*Macaranga gigantea*	Euphorbiaceae	4	1.57
22	*Eusideroxylon zwageri*	Lauraceae	13	1.26
23	*Vernonia arborea*	Asteraceae	4	1.13
24	*Syzygium* sp.	Myrtaceae	8	1.12
25	*Baccaurea* sp.	Phyllanthaceae	4	0.80
26	Unknown species 3	Unknown family	4	0.72
	Total		525	1,212.24
	Mean		20	46.62

Note: C_{ij} = logging cost of the tree.

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Logging cost is, however, not determined by the number of trees cut but by the volume such that a higher estimation of log volume leads to a higher logging cost. Moreover, trees with high diameters were discovered to have more volume and vice versa, and those with small diameters were also found to have needed shorter logging time. -Germain et. al. (2019) found two statistically significant variables influencing unit logging costs and they include volume per area harvested and the owner/operator experience such that an increase in these factors is expected to lower the per-unit logging costs, with experience variable having the least effect.

3.2.3 Profit margin

The total profit margin of selling logs was found to be USD337.39 USD m^{-3} with an average of USD12.98 m^{-3}. The highest value of USD121.58 USD m^{-3} was obtained from *Eusideroxylon zwageri* (Lauraceae) while the lowest was recorded to be USD3.04 USD m^{-3} for *Ficus septica* (Moraceae) as shown in Table 8.

The factors determining the profit margin include the log price of each species at the sawmill and the class diameter such that the opportunity of the seller to make profit increases with a higher price and the log diameter.

Table 8. Profit margin.

No.	Species	Family	P_{ij} (USD m^{-3})	PM_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	526.85	121.58
2	*Diospyros* sp.	Ebenaceae	263.43	60.79
3	*Pometia pinnata*	Sapindaceae	125.13	28.88
4	*Artocarpus odoratissimus*	Moraceae	69.15	15.96
5	*Archidendron pauciflorum*	Fabaceae	65.86	15.20
6	*Nephelium* sp.	Sapindaceae	59.27	13.68
7	*Pternandra* sp.	Melastomataceae	44.45	10.26
8	*Dillenia borneensis*	Dilleniaceae	16.46	3.80
9	*Macaranga tanarius*	Euphorbiaceae	16.46	3.80
10	*Bridelia glauca*	Phyllanthaceae	16.19	3.74
11	*Trema orientalis*	Cannabaceae	16.46	3.80
12	*Syzygium* sp.	Myrtaceae	16.46	3.80
13	*Homalanthus* sp.	Euphorbiaceae	16.46	3.80
14	*Nauclea* sp.	Rubiaceae	16.46	3.80
15	*Glochidion obscurum*	Phyllanthaceae	16.46	3.80
16	*Fordia splendidissima*	Fabaceae	16.46	3.80
17	*Vernonia arborea*	Asteraceae	16.46	3.80
18	*Macaranga gigantea*	Euphorbiaceae	16.46	3.80
19	*Cananga odorata*	Annonaceae	16.46	3.80
20	*Duabanga moluccana*	Lithraceae	16.46	3.80
21	*Baccaurea* sp.	Phyllanthaceae	16.46	3.80
22	Unknown species 1	Anacardiaceae	16.46	3.80
23	Unknown species 2	Anacardiaceae	16.46	3.80
24	Unknown species 3	Unknown family	16.46	3.80
25	*Pterospermum javanicum*	Malvaceae	15.09	3.48
26	*Ficus septica*	Moraceae	13.17	3.04
	Total		1,462.02	337.39
	Mean		56.23	12.98

Note: P_{ij} = log price at sawmill and diameter class; PM_{ij} = profit margin.

3.2.4 Stumpage Value

The stumpage value was determined by the timber volume, log diameter, log price at the sawmill, and profit margin for each species and the total valued obtained was USD 2,159.36 USD ha^{-1}. However, Figure 4 shows eight species had economic values above the mean stumpage values on the abandoned land with the mean contribution found to be USD83.05 USD ha^{-1} while 18 species of other trees had values under the mean stumpage values.

The studies conducted in other location found different stumpage economic values, for example, in Ayer Hitam Forest Reserve, Puchong, Selangor, it was estimated to be RM 34,278,980 for timber, RM 67,192 for medical plants, RM 773,090 for dependence of indigenous people, RM 865,770 for potential recreation benefits, and RM 2.,39 billion for conservation value based on Malaysian adult population (Noor et. al. 2007b). Even though the values obtained in this study are lesser than the ones in Noor et. al. (2007b), it, however, shows abandoned land has many trees with potential economic values.

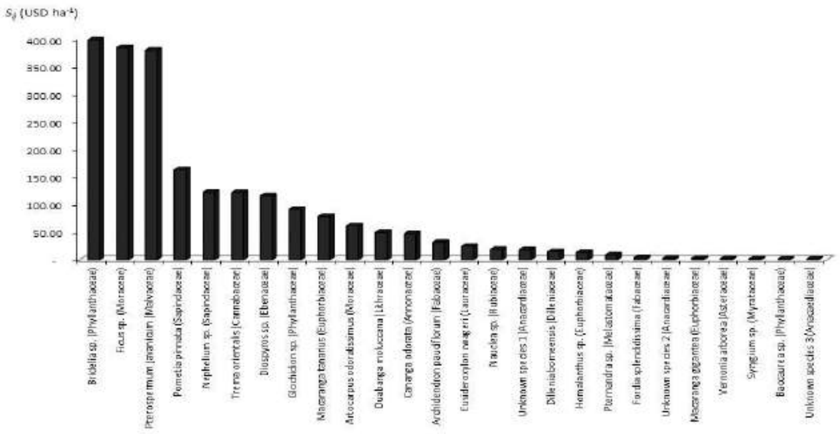

Figure 4. Stumpage values of trees at abandoned land.

4. Conclusions

This paper determined the abandoned lands in the tropic play important roles based on ecological and economic aspects. The ecological aspect was indicated by stand structure, floristic composition, and species diversity. The stand structure was dominated by trees with 5-10 cm DBH class and 5-10 m height class. The average basal area and volume of the trees with DBH of > 5 cm were recorded 0.38 m^2 ha^{-1} and 3.54 m^3 ha^{-1}. The presence of fast growing species indicated the early secondary successional process is still ongoing in the study site. The four most common species consisted mostly of light demanding pioneer, such as *Macaranga tanarius*, *Bridelia glauca*, *Pterospermum javanicum*, and *Ficus septica* in terms of IVi. The diversity indices of this abandoned land were categorized into intermediate diversity (*H*'), low dominance (*Ds*), and high evenness (*J*'). In addition, the tropical abandoned lands also have potential economic values for individuals and the community. The total of log price, logging cost, and profit margin at abandoned land were as much as 1,462.02 USD m^{-3}; 1,212.24 USD ha^{-1}, and 337.39 USD m^{-3}, respectively. Total stumpage value of this land was estimated as much as 2,159.36 USD ha^{-1}. The government cooperates with the community need to formulate an appropriate method for sustainable land use. ~~The abandoned lands in the tropics have several functions, both from the ecological and economic aspects. Ecologically, the structure and floristic diversity in the early secondary succession is expected to be ecotone towards the primary succession and this means the lands plan important roles in the conservation of soil, water, and the environment. In addition, they also have potential economic values for individuals and the community.~~ Therefore, basic information on ecological and economic aspects of the abandoned lands is required to land management and conservation in the future.

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Regular Research Article

The Role of Tropical Abandoned Land on Ecological and Economic Aspects

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Abstract: The floristic structure and composition of abandoned lands in the tropic have been observed to be changing dynamically during the succession process. This is mostly because they are not utilized maximally, therefore, there is a need to assess the economic and ecological impacts of this land abandonment in the tropical areas. This study was conducted to determine the ecological aspects of floristic structure, composition, and diversity and analyze the economic aspects of standing trees in the tropical abandoned land. The vegetation containing woody trees with a diameter at breast height (DBH) of $\geq$ 5 cm were surveyed at six subplots sized 20 m × 20 m. The economic parameters were evaluated using data of log price, logging cost, profit margin, and stumpage value of standing trees in the study plot and a total of 126 trees including 26 species of 25 genera of 18 families were recorded. The most common species found were *Macaranga tanarius* with 50.60%, *Bridelia glauca* with 49.13%, and *Pterospermum javanicum* with 29.05% based on Importance Value Index (IVi). Moreover, the diversity, dominance, evenness, and richness indices were 1.23, 0.09, 0.87, and 5.17 respectively while the total log price at the abandoned land was USD1,462.02 m^{-3} with an average value of USD56.23 m^{-3}. The total and mean values of logging costs were USD1,212.24 ha^{-1} and USD46.62 ha^{-1}, respectively while the total profit margin of log selling was USD337.39 m^{-3} at maximum with an average of USD12.97 m^{-3}. Furthermore, the average stumpage value was USD83.05 ha^{-1} while the total was calculated to be USD2,159.36 ha^{-1}. These findings showed the utilization of abandoned lands with respect to ecology and economic aspects has the ability to increase the community welfare and support the implementation of developmental programs in the country.

Keywords: Abandoned land, diversity, economic, floristic structure, stumpage value.

1. Introduction

The dynamics at several scales determine the plant diversity within regenerating fallows (Lawrence 2004) exploited for agricultural purposes, mainly through shifting cultivation. This is observed to be a global phenomenon because two-thirds of the world's secondary forests were recorded to have been cultivated through the process in 1980 with 49% recorded annually in tropical Asia (Lanly 1982). These forests are defined as the vegetation resulting from the clearing of natural high forest for shifting cultivation before abandonment (Abebrese 2002; Johnson and Miyanishi 2007; Keddy 2007; Misra 1992). They are characterized by the structure and extent of vegetative cover as well as their composition in terms of dominant and secondary species (Mittelman 2001; Van Breugel et al. 2006). However, the principal types include the Swidden fallow secondary forests and some other gardens as reported by Chokkalingam et al. (2001).

According to Van Breugel et al. (2006), understanding the mechanisms of secondary forest succession requires the consideration of the time of abandonment as a compound factor to integrate the variables of plant community ecology - the total effective conditions determining the existence of the plants on the land (Tansley 1993). Secondary forests are caused by human activity and fast-growing ecosystems whose species life cycles coincide with those of human land uses. In addition, they are also assets for the conservation of biodiversity in the tropics due to their many biotic characteristics such as the ability to improve soil and water quality as well as to conserve genetic material, nutrients, moisture, and/or soil organic matters (Brown and Lugo 1990).

With the continuous depletion of primary forests, secondary forests have become increasingly important to maintain the larger habitat for biodiversity conservation (Mittelman 2001). This is associated with their coverage of more than 600 million ha of the land area in the tropics which accounts for about 40% of the total forest area as well as the formation rates estimated at 9 million ha year^{-1} (Brown and Lugo 1990). Moreover, FAO (1996) estimated the area of secondary forest in 1990 in Asia to be 87.5 million ha while the figures for Latin America and Africa were 165 and 90 million ha, respectively. These data and the awareness of the accelerated changes in the forest situation in countries like the Philippines, Indonesia, China, and Malaysia strongly suggest future goods and services obtained from the tropical forests would increasingly be sourced from secondary or some other kinds of anthropogenically-induced forests such as the timber, environmental services, biodiversity conservation, and forest products for the rural poor (De Jong et al. 2001).

The total land area in Indonesia is estimated to be 190 million hectares and 2/3 of these are referred to as forest areas managed by the Ministry of Forestry while the remaining 1/3 is for business (HGU) and building (HGB). However, the National Land Agency (BPN) indicated 7.5 million hectares of land has the potential to be abandoned, both in and outside the forest areas, and several people have assumed these lands have no usefulness. However, they have certain ecological and economic benefits and several studies have been conducted on the ecological aspect such as the floristic composition and structure of the tropical secondary forest in Borneo Island as well as the less information provided on the ecological and economic aspects of tropical abandoned land in East Kalimantan. This study was, therefore, conducted to determine the ecological aspect such as floristic structure, composition, and species diversity as well as the economic aspect of standing trees such as log price, logging cost, profit margin, and stumpage value in an abandoned land. The findings are expected to be useful in conserving and managing tropical forest and environmental ecosystems.

2. Materials and Methods

2.1. Study Site

The study was conducted in Salo Cella Village, Muara Badak Sub-district, Kutai Kartanegara Districts, East Kalimantan Province, Indonesia with the geographic location of 0°17'18.7''S 117°18'08.2''E as shown in Figure 1. Salo Cella is one of 13 villages in Muara Badak located 10 km from the capital of Sub-district with a population of 57.712 most of which are farmers and an area of 939.09 km^2 dominated by lowland mixed dipterocarp forest. Moreover, the average monthly and amount of rainfall were recorded to be 141 mm and 11 raindays in 2017 (Statistics Kutai Kartanegara Regency 2018). The subdistrict is administratively bordered by Marang Kayu Sub-district, Anggana Sub-district Samarinda City, Makassar Strait, and Tenggarong Seberang Sub-district on the north, south, east, and west respectively. Furthermore, the sectors of Muara Badak with economic potentials are oil and gas, fishery, and plantation.

2.2. Data Collection

The vegetation and economic surveys of the study site were conducted from March to August 2019 through the establishment of six subplots sized 20 m × 20 m. Moreover, all woody trees with DBH of $\geq$ 5 cm within the plot were enumerated and their species identified.

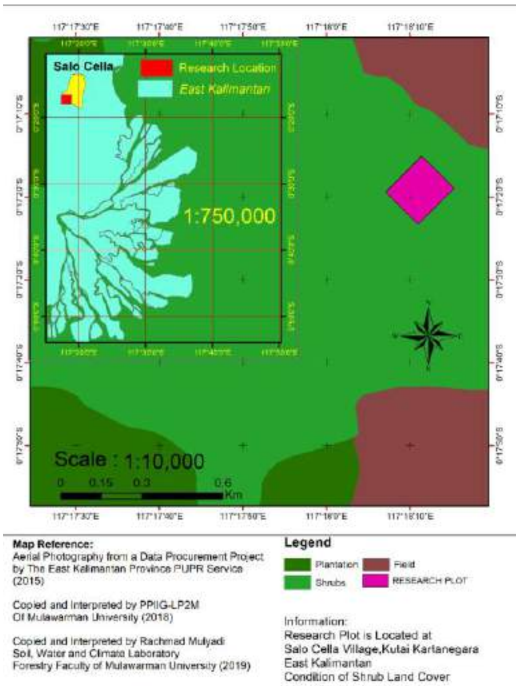

Figure 1. Map of the study site in Muara Badak Sub-district, Kutai Kartanegara District, East Kalimantan Province, Indonesia.

2.3. Data Analysis

2.3.1. Ecological Aspect

Individual basal area (BA) and volume (V) were determined using the following formulas (Husch et al. 1982):

Individuals BA = π (DBH/2)^2. 10^{-4} ………………………………………………………... (1)

Individuals V = ¼ $\pi \times$ DBH^2. $10^{-4} \times H \times f$ ………………………………………………… (2)

where: DBH is the diameter at breast height (cm), 'H' is tree height (m), and 'f'' is the form factor.

The dominant species within the plots were measured using the Importance Value Index (IVi) (Fachrul 2007):

RF = (Frequency of a species / Total frequencies of all species) $\times$ 100 ……………….... (3)

Rd = (The number of individual species / Total number of individuals) $\times$ 100 …..... (4)

RD = (Total basal area for a species / Total basal area for all species) $\times$ 100 ………..... (5)

IVi = RF + Rd + RD ………………………………………………………………………. (6)

where: RF is relative frequency, Rd is relative density, and RD is relative dominance.

The species diversity for standing trees in the study site was described using four indices including Shannon-Wiener's diversity index (*H'*), Simpson's dominance index (D_s), Pielou's evenness index (*J'*), and Margalef's richness index (*R*) (Odum 2005):

$$H' = -\sum_{i=1}^{s}\left(\frac{n_i}{N}\right)\ln\left(\frac{n_i}{N}\right) \quad (7)$$

$$D_s = \sum_{i=1}^{s}\left(\frac{n_i}{N}\right)^2 \quad (8)$$

$$J' = \frac{H'}{\ln(S)} \quad (9)$$

$$R = \frac{(S-1)}{\ln n} \quad (10)$$

where n_i = number of individuals of the *i*- th species, N = total number of all the individuals in a unit area, and S = number of species in each plot.

2.3.2. Economic Aspect

The equivalent merchantable height, number of logs, and diameter class are presented in Table 1 while the reduction factors of log price based on the diameter class are shown in Table 2.

Table 1. Merchantable tree heights.

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
15 – 30	1	5
+30 – 60	2	10
+60 – 75	3	15
75 ke atas	4	20

Source: Forestry Department of Pinansular Malaysia (FDPM) (1997)

Table 2. Reduction cost of log price.

DBH size class (cm)	Reduction factor
15 – 29	0,450
30 – 44	0,300
45 – 49	0,150
50 – 54	0,025
55 and above	0,000

Source: Noor et al. (1992) and Hanum et al. (2001)

Logging cost was reported to be IDR480.000,00 (Hikmat, 2005) while the profit ratio was 30% (Noor and Shahwahid, 1999). Therefore, the equation to calculated the profit margin (Noor and Shahwahid, 1999) is presented as follows:

$$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij} x PR)/(1+PR)$$

Where PM_{ij} = profit margin, P_{ij} = log price for each species at sawmill and diameter class, *PR* = profit ratio, *i* = an index for each species (i = 1, 2, 3, 4, ..., n), and *j* = an index for diameter class (i = 1, 2, 3, 4, ..., n).

Meanwhile, the stumpage values were calculated using the following equation:

$$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij} + C_{ij} + PM)$$

Where S_{ij} = stumpage value for each species and diameter class (USD ha^{-1}), V_{ij} = volume of timber for each species and diameter class (m^3), P_{ij} = log price for each species at sawmill and diameter class (USD m^{-3}), C_{ij} = average logging cost (USD ha^{-1}), PM_{ij} = profit margin (USD m^{-3}), i = an index for each species (i = 1, 2, 3, 4, ..., n), and j = an index for diameter class (i = 1, 2, 3, 4, ..., n).

3. Results and Discussion

3.1. Ecological Aspect

3.1.1. Diameter at Breast Height (DBH) and Height Distributions

There was a difference in the density of trees in the DBH classes as observed with the formation of L-shape characterized by the reduction in the total number of trees as the DBH increased as illustrated in Figure 2. The abandoned land was also observed to be dominated by smaller DBH classes with more than 70% of all trees having values $\geq$ 5 cm in the 5.0-10.0 cm class. Moreover, the tree diameter distribution formed a reverse-J-shape (Feldpausch et al. 2007; Álvarez-Yépiz et al. 2008) while the distribution of the classes of the height was skewed slightly positively as shown in Figure 3 with approximately 58% of the trees included in the 5.1-10.0 m class.

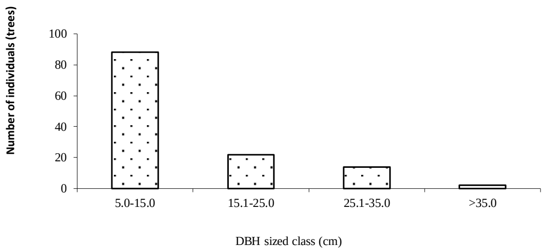

Figure 2. Distributions of diameter at breast height (DBH) in 0.24 ha of abandoned land.

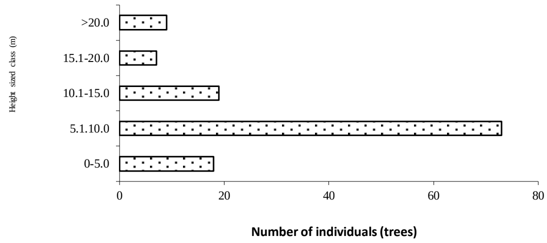

Figure 3. Distributions of height at different ages in 0.24 ha of abandoned land.

3.1.2. Density, Basal Area, and Volume

The density, basal area, and volume of species at a DBH of > 5 cm are presented in Table 3. The density was found to be 126 trees in 0.24 hectare and the dominating species of trees based on the number of individuals include *Macaranga tanarius* with 38, *Bridelia* sp. with 20, and *Homalanthus* sp. with 11. Regarding the basal area and volume per hectare, three dominant species were also observed and they include *Bridelia glauca* with 2.10 m^2 ha^{-1} and 23.24 m^3 ha^{-1}, *Pterospermum javanicum* with 1.64 m^2 ha^{-1} and 18.42 m^3 ha^{-1}, and *Ficus* sp. with 1.24 m^2 ha^{-1} and 11.74 m^3 ha^{-1} for basal area and volume respectively. This, therefore, means these three species covered more than 58 percent of the total volume while other six species including *Trema*

Orientalis, *Trema Orientalis*, *Glochidion* sp., *Duabanga moluccana*, *Pometia pinnata*, and *Cananga odorata* had more than 3.70 m^3 ha^{-1}.

3.1.3. Importance value index (IVi)

The study site was dominated by light-demanding pioneer and fast-growing species in terms of IVi as presented in Table 4. However, the same four species observed to be predominant with total basal area and volume were also found for the IVi and they include *Macaranga tanarius* with 50.60%, *Bridelia glauca* with 49.13%, *Pterospermum javanicum* with 29.05%, and *Ficus septica* with 22.56%. The other three species discovered to be following the aforementioned were *Homalanthus* sp., *Trema Orientalis*, and *Glochidion* sp. with 18.89, 16.10, and 11.53% respectively. Furthermore, the seedling and saplings plants of *Ficus aurata* and *Macaranga* sp. were also common based on the Summed Dominance Ratio (SDR) in 3 and 5 years of fallow lands in Sarawak (Karyati et al. 2013). This is in line with the findings of Karyati et al. (2018) that trees species in lands abandoned for 5 and 10 years were dominated by *Macaranga* spp.

3.1.4. Species Diversity

The species diversity or heterogeneity (H' values) of the plot studied were categorized as 'intermediate' (Odum 2005) according to the results presented in Table 5 while a low ecological dominance (D_s value) was also observed which means there were few or almost no species dominating the site. This was also supported by the high value of J' indicating all the species are evenly distributed in the community. These values may, however, be due to the high number of trees per hectare and the number of species. Generally, the increasing diversity (H'), evenness (J'), and richness *(R)* caused a reduction in dominance (D_s) in accordance with the findings of a previous study that tree diversity declined while dominance increased linearly along a disturbance gradient (Sapkota et al. 2010).

Table 3. Density, basal area, and volume of species (DBH of > 5 cm) in the study site.

No.	Species	Family	Number of individuals	Average of DBH (cm)	Average of height (m)	Total of basal area (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
1	*Bridelia glauca*	Phyllanthaceae	20	15.7	11.7	2.10	23.24
2	*Pterospermum javanicum*	Malvaceae	8	24.1	16.6	1.64	18.42
3	*Ficus septica*	Moraceae	5	23.5	11.0	1.24	11.74
4	*Trema Orientalis*	Cannabaceae	4	21.3	10.8	0.69	5.60
5	*Macaranga tanarius*	Euphorbiaceae	38	8.8	7.7	1.04	5.28
6	*Glochidion obscurum*	Phyllanthaceae	3	22.7	15.3	0.51	5.18
7	*Duabanga moluccana*	Lithraceae	1	29.0	22.0	0.28	3.94
8	*Pometia pinnata*	Sapindaceae	2	19.8	22.0	0.27	3.80
9	*Cananga odorata*	Annonaceae	2	17.5	13.5	0.27	3.72
10	*Nephelium* sp.	Sapindaceae	3	18.6	11.7	0.37	2.99
11	*Nauclea* sp.	Rubiaceae	2	13.4	14.0	0.13	1.39
12	*Artocarpus elasticus*	Moraceae	1	22.0	12.0	0.16	1.24
13	*Homalanthus* sp.	Euphorbiaceae	11	7.6	6.5	0.23	1.07
14	*Archidendron pauciflorum*	Fabaceae	1	16.1	15.0	0.08	0.83
15	Unknown species 1	Anacardiaceae	3	12.1	7.3	0.15	0.74
16	*Dillenia borneensis*	Dilleniaceae	2	11.6	9.5	0.10	0.65
17	*Diospyros* sp.	Ebenaceae	4	9.3	5.8	0.13	0.46
18	*Pternandra* sp.	Melastomataceae	2	11.8	7.0	0.09	0.41
19	*Macaranga gigantea*	Euphorbiaceae	1	11.2	9.0	0.04	0.24
20	*Fordia splendidissima*	Fabaceae	4	7.2	5.3	0.07	0.24
21	Unknown species 2	Anacardiaceae	1	12.3	6.0	0.05	0.19
22	*Eusideroxylon zwageri*	Lauraceae	3	5.7	8.0	0.03	0.16
23	*Vernonia arborea*	Asteraceae	1	9.5	6.0	0.03	0.12
24	*Syzygium* sp.	Myrtaceae	2	6.7	6.0	0.03	0.11
25	*Baccaurea* sp.	Phyllanthaceae	1	8.0	8.0	0.02	0.11
26	Unknown species 3	Unknown family	1	7.6	6.0	0.02	0.07
	Total		126,0	373.0	273.5	9.75	91.97
	Average		4,8	14.3	10.5	0.38	3.54

No.	Species	Family	Number of individuals	Average of DBH (cm)	Average of height (m)	Total of basal area (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
	Maximum		38.0	29.0	22.0	2.10	23.24
	Minimum		1.0	5.7	5.3	0.02	0.07

Note: DBH = diameter at breast height. The values were calculated based on vegetation surveyed in 0.24 hectare.

Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.24 hectare of the study site.

No.	Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
1	*Macaranga tanarius*	Euphorbiaceae	9.80	30.16	10.64	50.60
2	*Bridelia glauca*	Phyllanthaceae	11.76	15.87	21.50	49.13
3	*Pterospermum javanicum*	Malvaceae	5.88	6.35	16.82	29.05
4	*Ficus septica*	Moraceae	5.88	3.97	12.70	22.56
5	*Homalanthus* sp.	Euphorbiaceae	7.84	8.73	2.32	18.89
6	*Trema orientalis*	Cannabaceae	5.88	3.17	7.04	16.10
7	*Glochidion obscurum*	Phyllanthaceae	3.92	2.38	5.23	11.53
8	*Diospyros* sp.	Ebenaceae	3.92	3.17	1.35	8.45
9	*Cananga odorata*	Annonaceae	3.92	1.59	2.80	8.30
10	*Nephelium* sp.	Sapindaceae	1.96	2.38	3.82	8.17
11	Unknown species 1	Anacardiaceae	3.92	2.38	1.54	7.84
12	*Nauclea* sp.	Rubiaceae	3.92	1.59	1.29	6.80
13	*Eusideroxylon zwageri*	Lauraceae	3.92	2.38	0.34	6.64
14	*Pometia pinnata*	Sapindaceae	1.96	1.59	2.72	6.27
15	*Fordia splendidissima*	Fabaceae	1.96	3.17	0.71	5.85
16	*Syzygium* sp.	Myrtaceae	3.92	1.59	0.30	5.81
17	*Duabanga moluccana*	Lithraceae	1.96	0.79	2.82	5.58
18	*Dillenia borneensis*	Dilleniaceae	1.96	1.59	0.99	4.54
19	*Pternandra* sp.	Melastomataceae	1.96	1.59	0.93	4.48
20	*Artocarpus elasticus*	Moraceae	1.96	0.79	1.62	4.38
21	*Archidendron pauciflorum*	Fabaceae	1.96	0.79	0.87	3.62
22	Unknown species 2	Anacardiaceae	1.96	0.79	0.51	3.26
23	*Macaranga gigantea*	Euphorbiaceae	1.96	0.79	0.42	3.18
24	*Vernonia arborea*	Asteraceae	1.96	0.79	0.30	3.06
25	*Baccaurea* sp.	Phyllanthaceae	1.96	0.79	0.21	2.97
26	Unknown species 3	Unknown family	1.96	0.79	0.19	2.95
	Jumlah		100.00	100.00	100.00	300.00

Note: RF= relative frequency, Rd=relative density, RD=relative dominance; IVi=importance value index.

Table 5. Diversity indices of trees with DBH of $\geq$5 cm in the study site.

No.	Diversity indices	Value
1	Shannon-Wiener diversity index (*H'*)	1.23
2	Simpson dominance index (D_s)	0.09
3	Pielou evenness index (*J'*)	0.87
4	Margalef species richness (*R*)	5.17

Note: The values were calculated according to the 6 subplots sized 20 m × 20 m each.

The study showed the floristic structure, composition, and diversity were related to the existence and importance of the abandoned land dominated by fast-growing species. Moreover, the species of tree on the site had 'intermediate diversity' (*H*'), 'low dominance' (*Ds*), and 'high evenness' (*J'*) and the same was found for seedling-sapling plants with DBH<5 cm and tree plants with DBH>5cm in 3, 5, 10, and 20 years after the lands have been fallowed (Karyati et al. 2013; Karyati et al. 2018). This, therefore, means abandoned land has important ecological roles. Furthermore, the information on the composition and diversity of plant regeneration at early stages of secondary succession on fallow lands is useful for biodiversity conservation and also provide social and economic values for future forest (Karyati et al. 2013). This shows it is necessary to understand the ecological and economic aspects of abandoned lands in order to manage and conserve them during successional periods in the tropic.

3.2. Economic Aspect

3.2.1. Log price

The results showed the log prices for 10 species at the sawmill were different while Table 6 shows there were 525 stems ha^{-1} on the abandoned land. Moreover, the total and mean log price were USD1,462.02m^{-3} and USD56.23m^{-3}, respectively with the highest values obtained at *Eusideroxylon zwageri* of Lauraceae with 526.85 USD m^{-3}, *Diospyros* sp. of Ebenaceae with USD263.3 m^{-3}, *Pometia zwageri* of Sapindaceae with USD125.13 m^{-3}, and *Artocarpus odoratissimus* of Moraceae with USD69.15 m^{-3}. Furthermore, most of the other 22 species had the same value or were under USD65.86 m^{-3}.

Table 6. Number of stems at abandoned land and log price.

No.	Species	Family	Number (stems ha^{-1})	P_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	13	526.85
2	*Diospyros* sp.	Ebenaceae	17	263.43
3	*Pometia pinnata*	Sapindaceae	8	125.13
4	*Artocarpus odoratissimus*	Moraceae	4	69.15
5	*Archidendron pauciflorum*	Fabaceae	4	65.86
6	*Nephelium* sp.	Sapindaceae	13	59.27
7	*Pternandra* sp.	Melastomataceae	8	44.45
8	*Dillenia borneensis*	Dilleniaceae	8	16.46
9	*Macaranga tanarius*	Euphorbiaceae	158	16.46
10	*Trema orientalis*	Cannabaceae	17	16.46
11	*Syzygium* sp.	Myrtaceae	8	16.46
12	*Homalanthus* sp.	Euphorbiaceae	46	16.46
13	*Nauclea* sp.	Rubiaceae	8	16.46
14	*Glochidion obscurum*	Phyllanthaceae	13	16.46
15	*Fordia splendidissima*	Fabaceae	17	16.46
16	*Vernonia arborea*	Asteraceae	4	16.46
17	*Macaranga gigantea*	Euphorbiaceae	4	16.46
18	*Cananga odorata*	Annonaceae	8	16.46
19	*Duabanga moluccana*	Lithraceae	4	16.46
20	*Baccaurea* sp.	Phyllanthaceae	4	16.46
21	Unknown species 1	Anacardiaceae	13	16.46
22	Unknown species 2	Anacardiaceae	4	16.46
23	Unknown species 3	Unknown family	4	16.46
24	*Bridelia glauca*	Phyllanthaceae	83	16.19
25	*Pterospermum javanicum*	Malvaceae	33	15.09
26	*Ficus septica*	Moraceae	21	13.17
	Total		525	1,462.02
	Mean		20	56.23

Note: P_{ij} = log price for each species at sawmill and diameter class.

The log price depends on the species and diameter class of log such that trees with high timber quality and many sales in the market have higher log prices. However, a bigger diameter at breast height (DBH) led to a lower reduction factor and higher log price. This means it is easier to produce different kinds of products from the logs with big DBH and timber volume. Moreover, high community demand for logs of particular species usually increases their prices in the market in accordance with the laws of demand.

Trees with high log prices are in a small number on the abandoned land with an average of 20 stems ha^{-1} for each species. The *Eusideroxylon zwageri* (Lauraceae) had only 13 stems ha^{-1}, *Diospyros* sp. (Ebenaceae) with 17 stems ha^{-1} while *Pometia pinnata* (Sapindaceae) and *Artocarpus odoratissimus* (Moraceae) had 8 stems ha^{-1} and 4 stems ha^{-1}, respectively. This is, however, in line with the law of supply which states that a smaller supply of the commodity to the market leads to a higher price.

A different result was, however, observed with other species such as *Macaranga tanarius* (Euphorbiaceae) with a total number of 158 stems ha^{-1} and a log price of USD16.46 m^{-3} and other families and species with low log prices. This means several factors determine the price of log in the market and they include tree diameter, timber quality, consumer taste, and others. According to Noor et al. (2007a), the market price is the first point of sale where the product is sold freely in the competitive market.

3.2.2. Logging Cost

Logging cost was the same for each species of trees and was found to be USD35.12 m^{-3} including the costs for the chainsaw man, machine used, fuel, and depreciation. Table 7 shows the total and mean logging costs in the abandoned land were USD1,212.24 ha^{-1} and USD46.62 ha^{-1} respectively with the lowest being USD0.72 ha^{-1} for 4 stems from *Anacardiaceae* family while the highest was USD277.17 ha^{-1} for 21 stems from *Ficus septica* (Moraceae).

Logging cost is, however, not determined by the number of trees cut but by the volume such that a higher estimation of log volume leads to a higher logging cost. Moreover, trees with high diameters were discovered to have more volume and vice versa, and those with small diameters were also found to have needed shorter logging time. Germain et. al. (2019) found two statistically significant variables influencing unit logging costs and they include volume per area harvested and the owner/operator experience such that an increase in these factors is expected to lower the per-unit logging costs, with experience variable having the least effect.

Table 7. Logging cost of trees.

No.	Species	Family	Number (stems ha^{-1})	C_{ij} (USD ha^{-1})
1	*Ficus septica*	Moraceae	21	277.17
2	*Bridelia glauca*	Phyllanthaceae	83	264.77
3	*Pterospermum javanicum*	Malvaceae	33	258.63
4	*Trema orientalis*	Cannabaceae	17	77.30
5	*Glochidion obscurum*	Phyllanthaceae	13	58.19
6	*Macaranga tanarius*	Euphorbiaceae	158	49.69
7	*Nephelium* sp.	Sapindaceae	13	39.72
8	*Duabanga moluccana*	Lithraceae	4	31.42
9	*Pometia pinnata*	Sapindaceae	8	30.31
10	*Cananga odorata*	Annonaceae	8	29.90
11	*Artocarpus odoratissimus*	Moraceae	4	18.08
12	*Nauclea* sp.	Rubiaceae	8	11.99
13	Unknown species 1	Anacardiaceae	13	11.55
14	*Diospyros* sp.	Ebenaceae	17	11.32

No.	Species	Family	Number (stems ha^{-1})	C_{ij} (USD ha^{-1})
15	*Archidendron pauciflorum*	Fabaceae	4	9.68
16	*Dillenia borneensis*	Dilleniaceae	8	9.43
17	*Homalanthus* sp.	Euphorbiaceae	46	8.61
18	*Pternandra* sp.	Melastomataceae	8	3.46
19	*Fordia splendidissima*	Fabaceae	17	2.64
20	Unknown species 2	Anacardiaceae	4	1.80
21	*Macaranga gigantea*	Euphorbiaceae	4	1.57
22	*Eusideroxylon zwageri*	Lauraceae	13	1.26
23	*Vernonia arborea*	Asteraceae	4	1.13
24	*Syzygium* sp.	Myrtaceae	8	1.12
25	*Baccaurea* sp.	Phyllanthaceae	4	0.80
26	Unknown species 3	Unknown family	4	0.72
	Total		525	1,212.24
	Mean		20	46.62

Note: C_{ij} = logging cost of the tree.

3.2.3. Profit Margin

The total profit margin of selling logs was found to be USD337.39 m^{-3} with an average of USD12.98 m^{-3}. The highest value of USD121.58 m^{-3} was obtained from *Eusideroxylon zwageri* (Lauraceae) while the lowest was recorded to be USD3.04 m^{-3} for *Ficus septica* (Moraceae) as shown in Table 8.

The factors determining the profit margin include the log price of each species at the sawmill and the class diameter such that the opportunity of the seller to make profit increases with a higher price and the log diameter.

Table 8. Profit margin.

No.	Species	Family	P_{ij} (USD m^{-3})	PM_{ij} (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	526.85	121.58
2	*Diospyros* sp.	Ebenaceae	263.43	60.79
3	*Pometia pinnata*	Sapindaceae	125.13	28.88
4	*Artocarpus odoratissimus*	Moraceae	69.15	15.96
5	*Archidendron pauciflorum*	Fabaceae	65.86	15.20
6	*Nephelium* sp.	Sapindaceae	59.27	13.68
7	*Pternandra* sp.	Melastomataceae	44.45	10.26
8	*Dillenia borneensis*	Dilleniaceae	16.46	3.80
9	*Macaranga tanarius*	Euphorbiaceae	16.46	3.80
10	*Bridelia glauca*	Phyllanthaceae	16.19	3.74
11	*Trema orientalis*	Cannabaceae	16.46	3.80
12	*Syzygium* sp.	Myrtaceae	16.46	3.80
13	*Homalanthus* sp.	Euphorbiaceae	16.46	3.80
14	*Nauclea* sp.	Rubiaceae	16.46	3.80
15	*Glochidion obscurum*	Phyllanthaceae	16.46	3.80
16	*Fordia splendidissima*	Fabaceae	16.46	3.80
17	*Vernonia arborea*	Asteraceae	16.46	3.80
18	*Macaranga gigantea*	Euphorbiaceae	16.46	3.80
19	*Cananga odorata*	Annonaceae	16.46	3.80
20	*Duabanga moluccana*	Lithraceae	16.46	3.80
21	*Baccaurea* sp.	Phyllanthaceae	16.46	3.80
22	Unknown species 1	Anacardiaceae	16.46	3.80
23	Unknown species 2	Anacardiaceae	16.46	3.80
24	Unknown species 3	Unknown family	16.46	3.80

No.	Species	Family	P_{ij} (USD m^{-3})	PM_{ij} (USD m^{-3})
25	*Pterospermum javanicum*	Malvaceae	15.09	3.48
26	*Ficus septica*	Moraceae	13.17	3.04
	Total		1,462.02	337.39
	Mean		56.23	12.98

Note: P_{ij} = log price at sawmill and diameter class; PM_{ij} = profit margin.

3.2.4. Stumpage Value

The stumpage value was determined by the timber volume, log diameter, log price at the sawmill, and profit margin for each species and the total valued obtained was USD2,159.36 ha^{-1}. However, Figure 4 shows eight species had economic values above the mean stumpage values on the abandoned land with the mean contribution found to be USD83.05 ha^{-1} while 18 species of other trees had values under the mean stumpage values.

The studies conducted in other location found different stumpage economic values, for example, in Ayer Hitam Forest Reserve, Puchong, Selangor, it was estimated to be RM34,278,980 for timber, RM67,192 for medical plants, RM773,090 for dependence of indigenous people, RM865,770 for potential recreation benefits, and RM2,39 billion for conservation value based on Malaysian adult population (Noor et. al. 2007b). Even though the values obtained in this study are lesser than the ones in Noor et. al. (2007b), it, however, shows abandoned land has many trees with potential economic values.

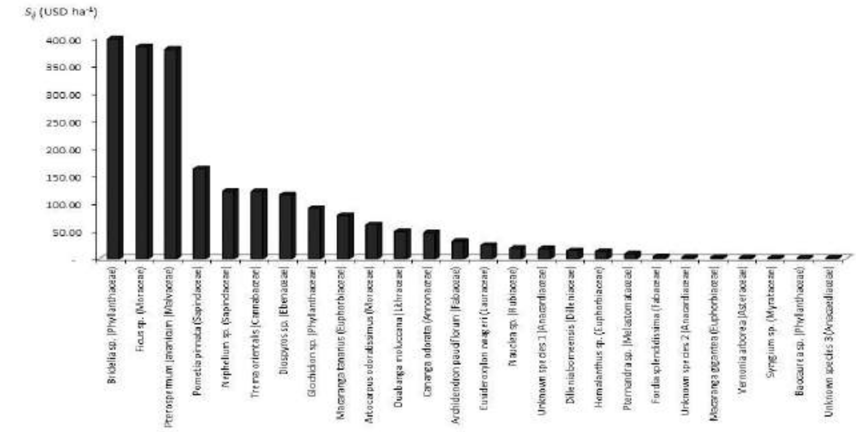

Figure 4. Stumpage values of trees at abandoned land.

4. Conclusion

The abandoned lands in the tropics have several functions, both from the ecological and economic aspects. Ecologically, the structure and floristic diversity in the early secondary succession is expected to be ecotone towards the primary succession and this means the lands plan important roles in the conservation of soil, water, and the environment. In addition, they also have potential economic values for individuals and the community. Therefore, basic information on ecological and economic aspects of the abandoned lands is required to land management and conservation in the future.

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