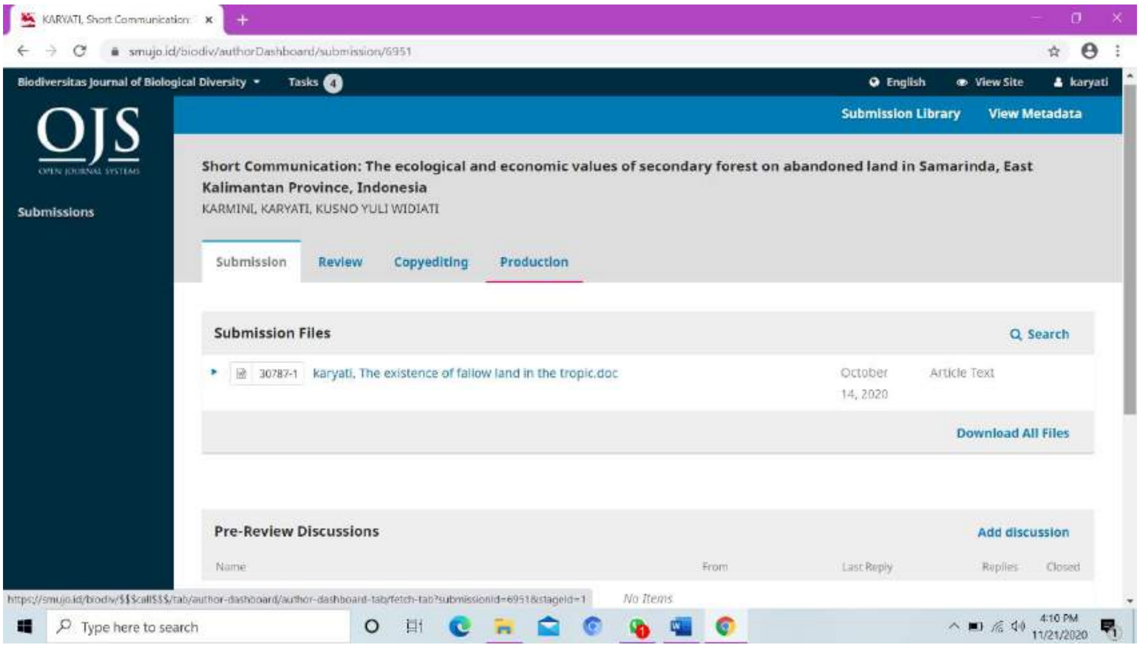
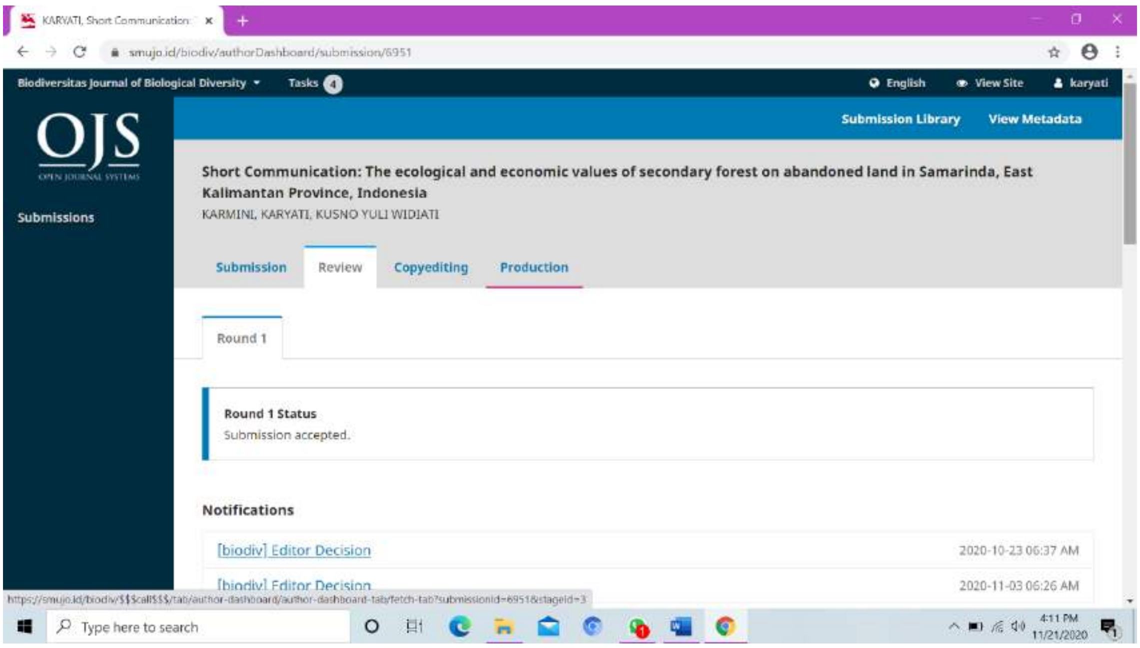
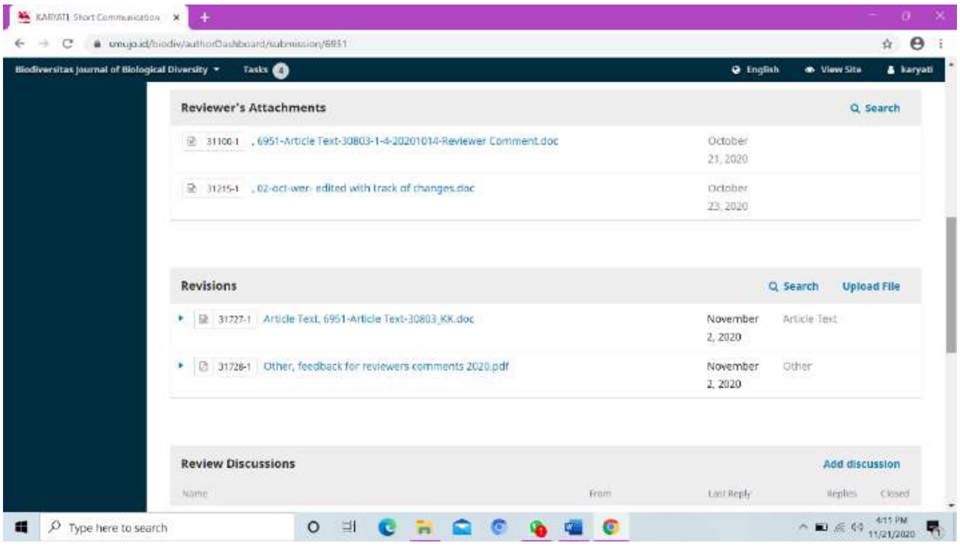
BUKTI-BUKTI PROSES REVIEW (KORESPONDENSI)

Judul	:	The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province, Indonesia
Penulis	:	Karmini, Karyati, dan Kusno Yuli Widiati
Nama Jurnal	:	Biodiversitas
Volume/Nomor/Tahun/Halaman	:	21, 1, 2020, 5550-5558
ISSN	:	1412-033X/E-ISSN: 2085-4722
Penerbit	:	Society for Indonesian Biodiversity
DOI	:	10.13057/biodiv/d211164



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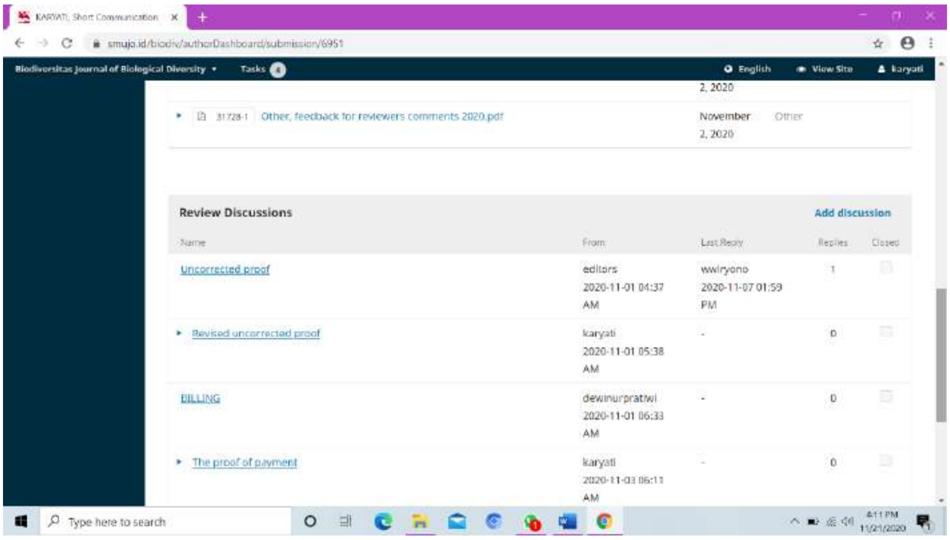
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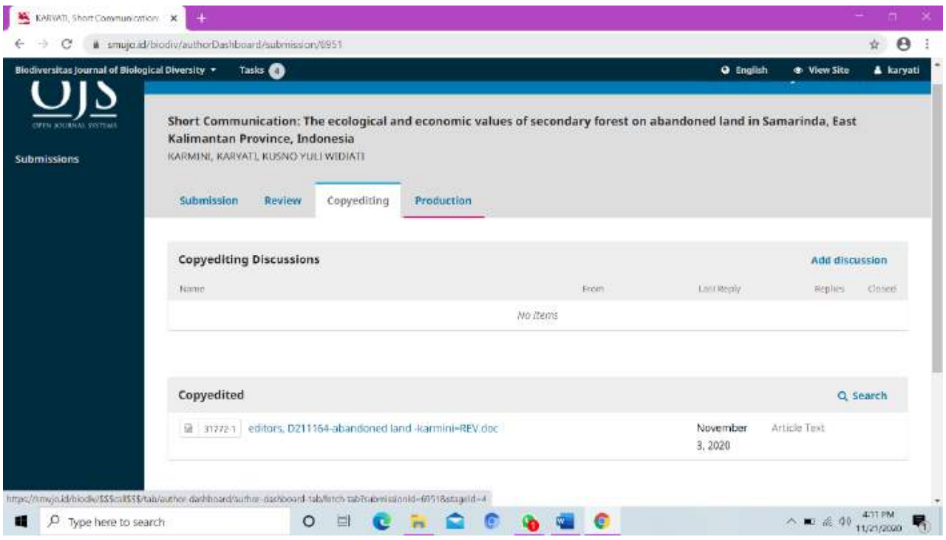
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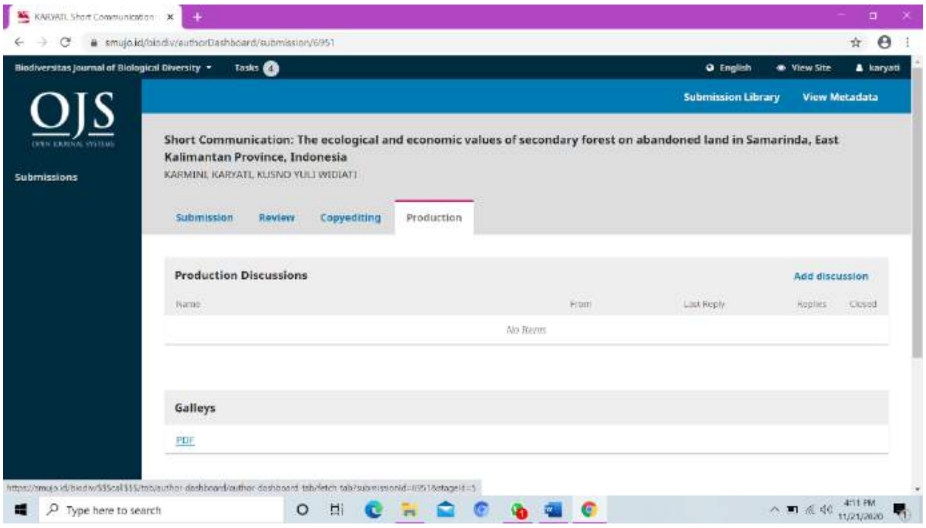
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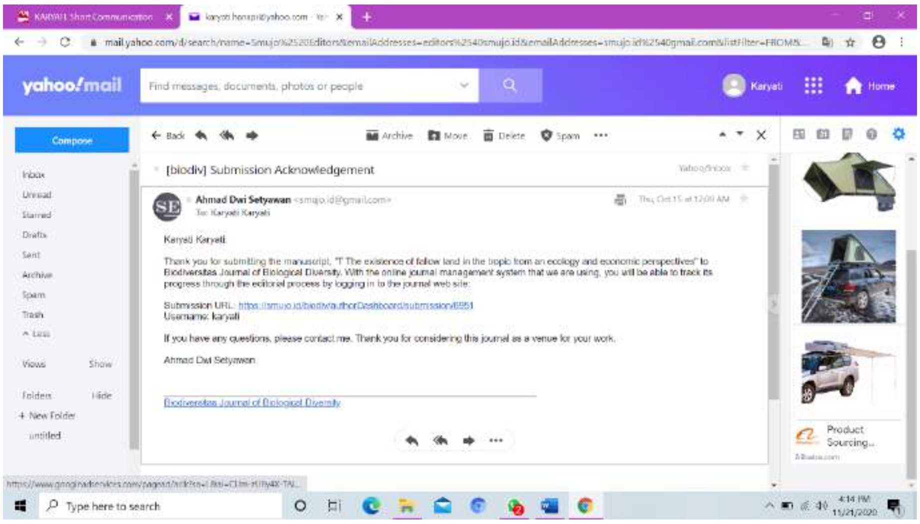
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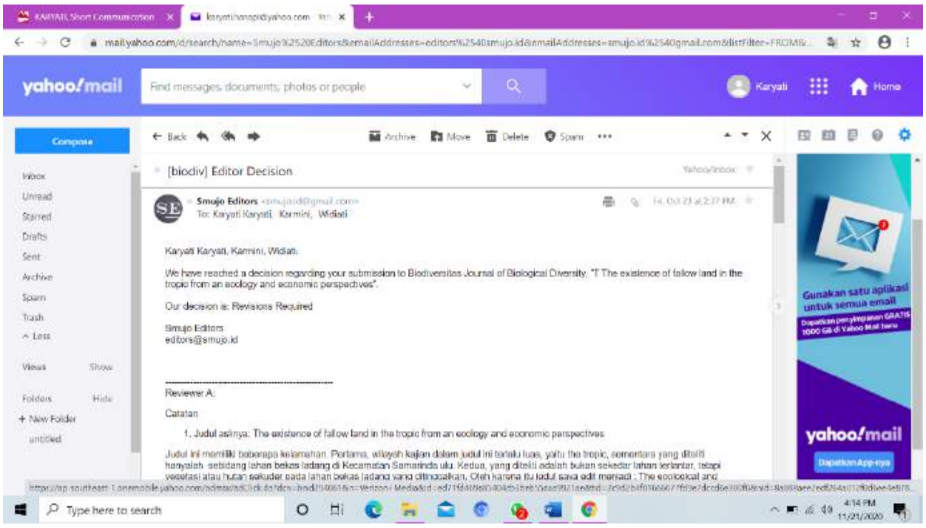
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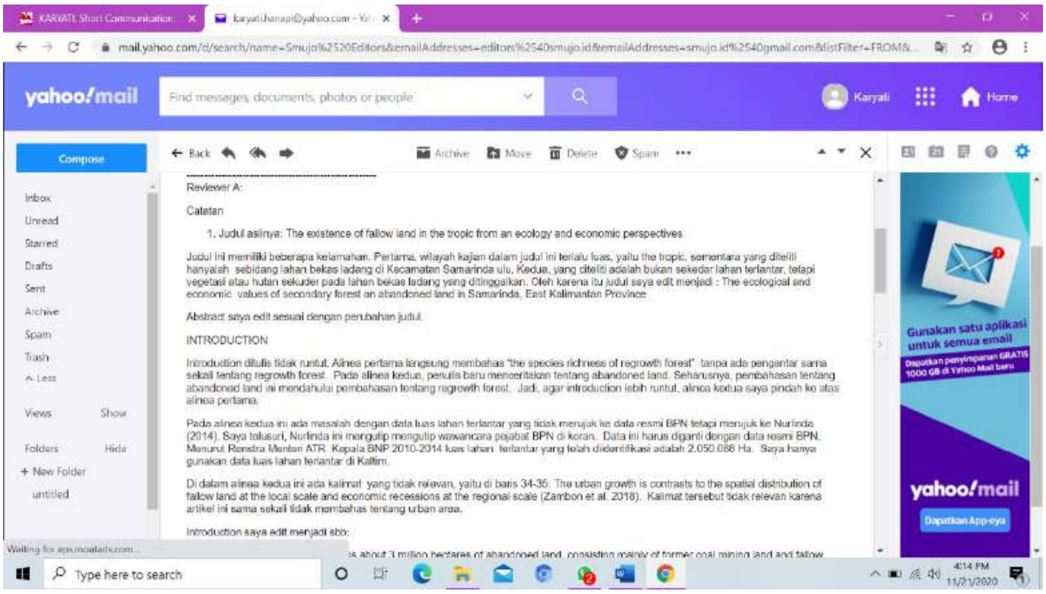


Reviewer A:

Catatan

1. Judul aslinya: The existence of fallow land in the tropic from an ecology and economic perspectives

Judul ini memiliki beberapa kelamahan. Pertama, wilayah kajian dalam judul ini terlalu luas, yaitu the tropic, sementara yang diteliti hanyalah sebidang lahan bekas ladang di Kecamatan Samarinda ulu. Kedua, yang diteliti adalah bukan sekedar lahan terlantar, tetapi vegetasi atau hutan sekuder pada lahan bekas ladang yang ditinggalkan. Oleh karena itu judul saya edit menjadi : The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province

Abstract saya edit sesuai dengan perubahan judul.

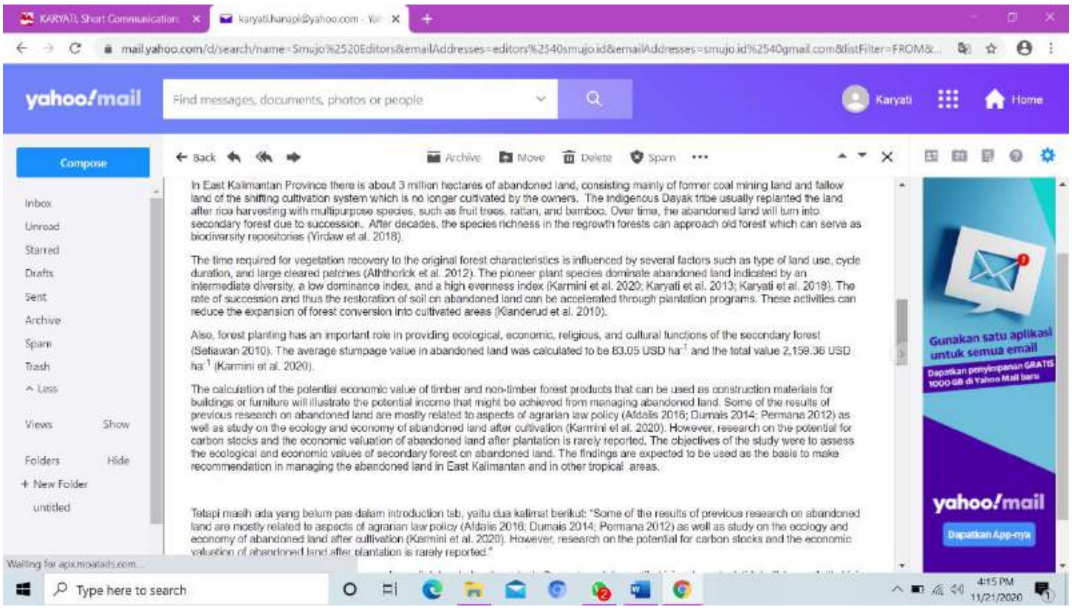
INTRODUCTION

Introduction ditulis tidak runtut. Alinea pertama langsung membahas "the species richness of regrowth forest" tanpa ada pengantar sama sekali tentang regrowth forest. Pada alinea kedua, penulis baru menceritakan tentang abandoned land. Seharusnya, pembahasan tentang abandoned land ini mendahului pembahasan tentang regrowth forest. Jadi, agar introduction lebih runtut, alinea kedua saya pindah ke atas alinea pertama.

Pada alinea kedua ini ada masalah dengan data luas lahan terlantar yang tidak merujuk ke data resmi BPN tetapi merujuk ke Nurlinda (2014). Saya telusuri, Nurlinda ini mengutip mengutip wawancara pejabat BPN di koran. Data ini harus diganti dengan data resmi BPN. Menurut Renstra Menteri ATR. Kepala BNP 2010-2014 luas lahan terlantar yang telah diidentifikasi adalah 2.050.088 Ha. Saya hanya gunakan data luas lahan terlantar di Kaltim.

Di dalam alinea kedua ini ada kalimat yang tidak relevan, yaitu di baris 34-36. The urban growth is contrasts to the spatial distribution of fallow land at the local scale and economic recessions at the regional scale (Zambon et al. 2018). Kalimat tersebut tidak relevan karena artikel ini sama sekali tidak membahas tentang urban area.

Introduction saya edit menjadi sbb:

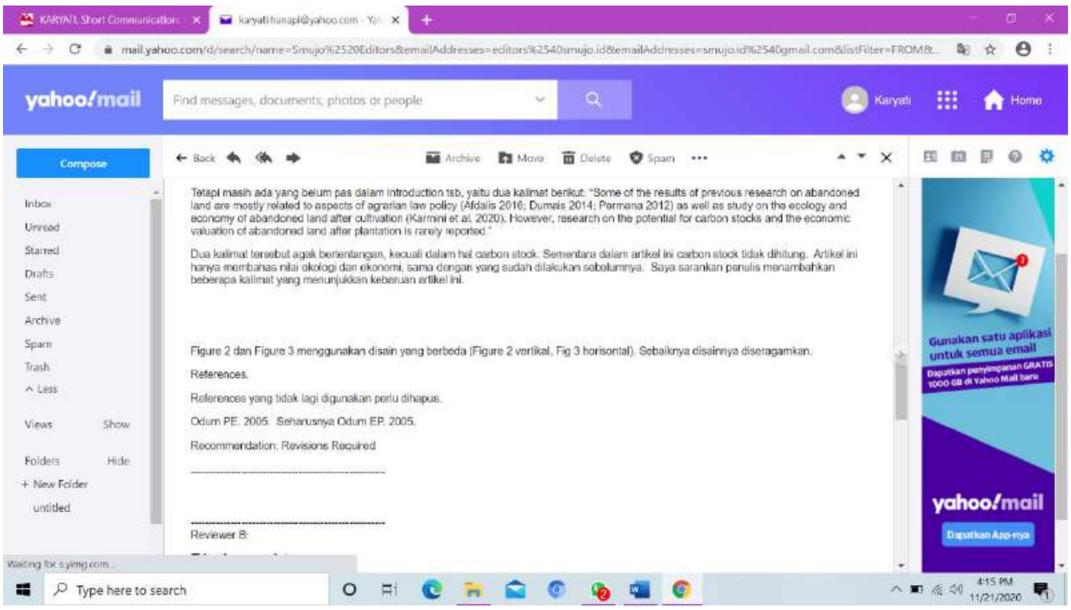


In East Kalimantan Province there is about 3 million hectares of abandoned land, consisting mainly of former coal mining land and fallow land of the shifting cultivation system which is no longer cultivated by the owners. The indigenous Dayak tribe usually replanted the land after rice harvesting with multipurpose species, such as fruit trees, rattan, and bamboo. Over time, the abandoned land will turn into secondary forest due to succession. After decades, the species richness in the regrowth forests can approach old forest which can serve as biodiversity repositories (Yirdaw et al. 2018).

The time required for vegetation recovery to the original forest characteristics is influenced by several factors such as type of land use, cycle duration, and large cleared patches (Althhorick et al. 2012). The pioneer plant species dominate abandoned land indicated by an intermediate diversity, a low dominance index, and a high evenness index (Karmini et al. 2020; Karyati et al. 2013; Karyati et al. 2018). The rate of succession and thus the restoration of soil on abandoned land can be accelerated through plantation programs. These activities can reduce the expansion of forest conversion into cultivated areas (Klanderud et al. 2010).

Also, forest planting has an important role in providing ecological, economic, religious, and cultural functions of the secondary forest (Setiawan 2010). The average stumpage value in abandoned land was calculated to be 83.05 USD ha^{-1} and the total value 2,159.36 USD ha^{-1} (Karmini et al. 2020).

The calculation of the potential economic value of timber and non-timber forest products that can be used as construction materials for buildings or furniture will illustrate the potential income that might be achieved from managing abandoned land. Some of the results of previous research on abandoned land are mostly related to aspects of agrarian law policy (Afdalis 2016; Dumais 2014; Permana 2012) as well as study on the ecology and economy of abandoned land after cultivation (Karmini et al. 2020). However, research on the potential for carbon stocks and the economic valuation of abandoned land after plantation is rarely reported. The objectives of the study were to assess the ecological and economic values of secondary forest on abandoned land. The findings are expected to be used as the basis to make recommendation in managing the abandoned land in East Kalimantan and in other tropical areas.



Tetapi masih ada yang belum pas dalam introduction tsb, yaitu dua kalimat berikut: "Some of the results of previous research on abandoned land are mostly related to aspects of agrarian law policy (Afdalis 2016; Dumais 2014; Permana 2012) as well as study on the ecology and economy of abandoned land after cultivation (Karmini et al. 2020). However, research on the potential for carbon stocks and the economic valuation of abandoned land after plantation is rarely reported."

Dua kalimat tersebut agak bertentangan, kecuali dalam hal carbon stock. Sementara dalam artikel ini carbon stock tidak dihitung. Artikel ini hanya membahas nilai okologi dan ekonomi, sama dengan yang sudah dilakukan sebelumnya. Saya sarankan penulis menambahkan beberapa kalimat yang menunjukkan kebaruan artikel ini.

Figure 2 dan Figure 3 menggunakan disain yang berbeda (Figure 2 vertikal, Fig 3 horisontal). Sebaiknya disainnya diseragamkan.

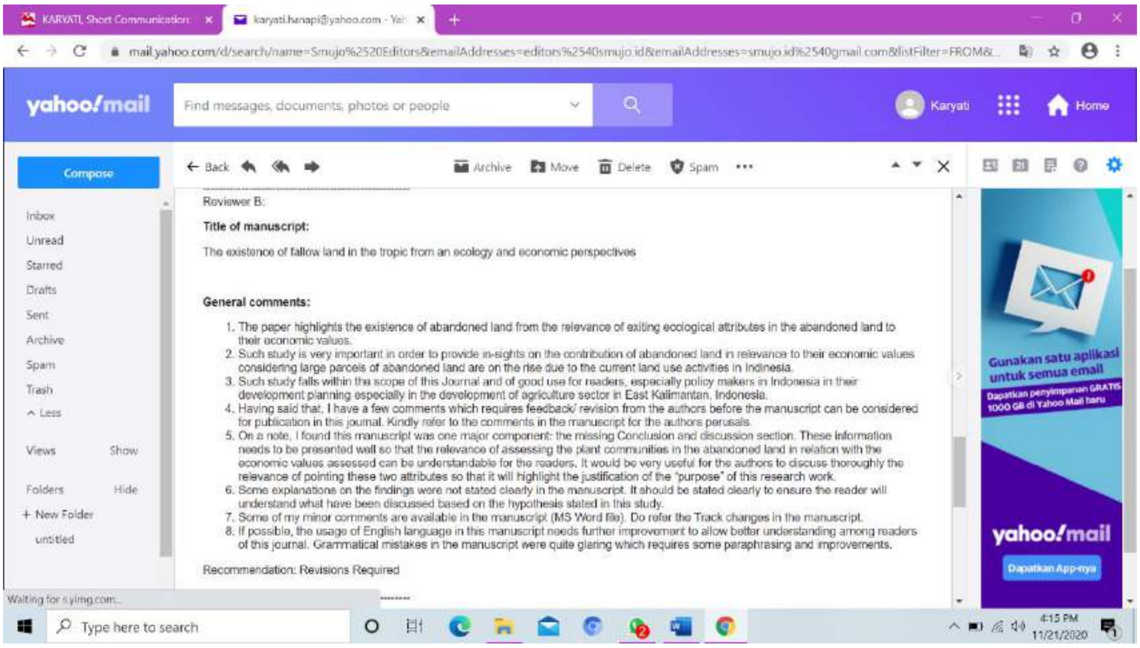
References.

References yang tidak lagi digunakan perlu dihapus.

Odum PE. 2005. Seharusnya Odum EP. 2005.

Recommendation: Revisions Required

Reviewer B:



Reviewer B:

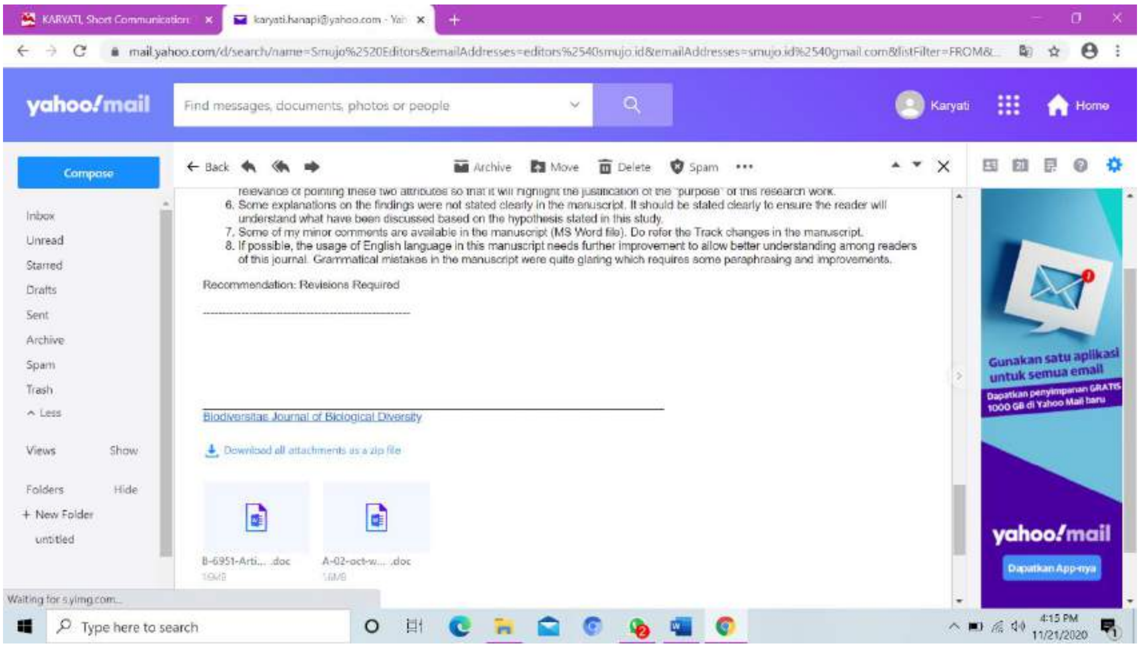
Title of manuscript:

The existence of fallow land in the tropic from an ecology and economic perspectives

General comments:

1. The paper highlights the existence of abandoned land from the relevance of exiting ecological attributes in the abandoned land to their economic values.
2. Such study is very important in order to provide in-sights on the contribution of abandoned land in relevance to their economic values considering large parcels of abandoned land are on the rise due to the current land use activities in Indinesia.
3. Such study falls within the scope of this Journal and of good use for readers, especially policy makers in Indonesia in their development planning especially in the development of agriculture sector in East Kalimantan, Indonesia.
4. Having said that, I have a few comments which requires feedback/ revision from the authors before the manuscript can be considered for publication in this journal. Kindly refer to the comments in the manuscript for the authors perusals.
5. On a note, I found this manuscript was one major component: the missing Conclusion and discussion section. These information needs to be presented well so that the relevance of assessing the plant communities in the abandoned land in relation with the economic values assessed can be understandable for the readers. It would be very useful for the authors to discuss thoroughly the relevance of pointing these two attributes so that it will highlight the justification of the "purpose" of this research work.
6. Some explanations on the findings were not stated clearly in the manuscript. It should be stated clearly to ensure the reader will understand what have been discussed based on the hypothesis stated in this study.
7. Some of my minor comments are available in the manuscript (MS Word file). Do refer the Track changes in the manuscript.
8. If possible, the usage of English language in this manuscript needs further improvement to allow better understanding among readers of this journal. Grammatical mistakes in the manuscript were quite glaring which requires some paraphrasing and improvements.

Recommendation: Revisions Required



relevance of pointing these two attributes so that it will highlight the justification of the "purpose" of this research work.
6. Some explanations on the findings were not stated clearly in the manuscript. It should be stated clearly to ensure the reader will understand what have been discussed based on the hypothesis stated in this study.
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8. If possible, the usage of English language in this manuscript needs further improvement to allow better understanding among readers of this journal. Grammatical mistakes in the manuscript were quite glaring which requires some paraphrasing and improvements.

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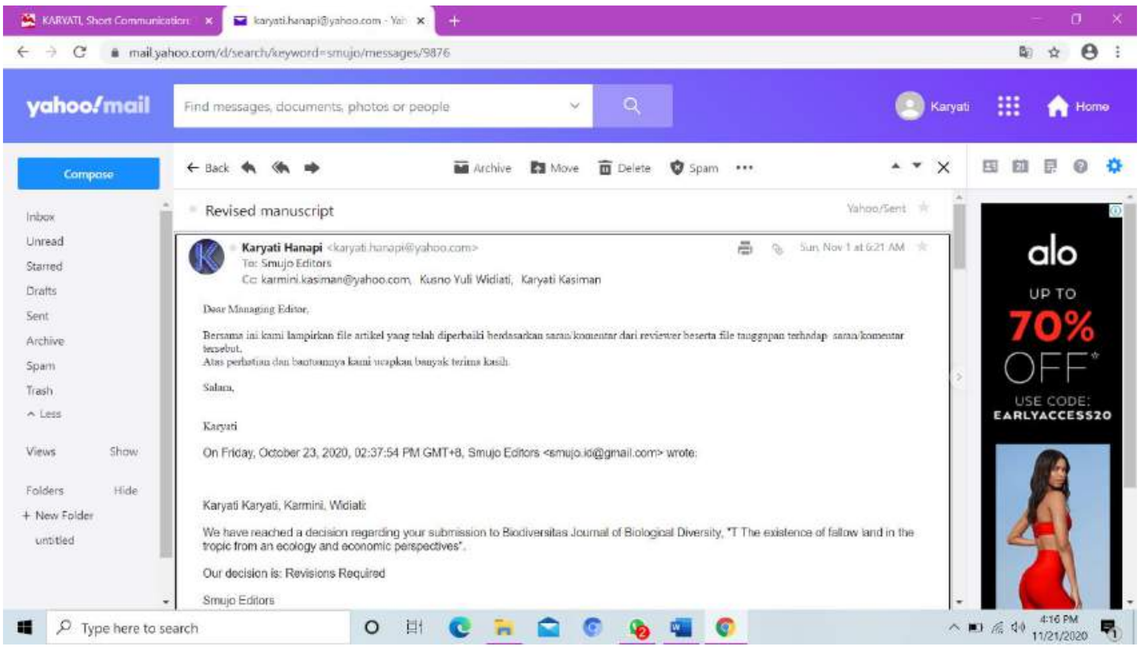

Revised manuscript

Karyati Hanapi <karyati.hanapi@yahoo.com>
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Cc: karmini.kasiman@yahoo.com, Kusno Yuli Widiati, Karyati Kasiman
Sun, Nov 1 at 6:21 AM

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Bersama ini kami lampirkan file artikel yang telah diperbaiki berdasarkan saran/komentar dari reviewer beserta file tanggapan terhadap saran/komentar tersebut.
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Salam,

Karyati

On Friday, October 23, 2020, 02:37:54 PM GMT+8, Smujo Editors <smujo.id@gmail.com> wrote:

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Our decision is: Revisions Required

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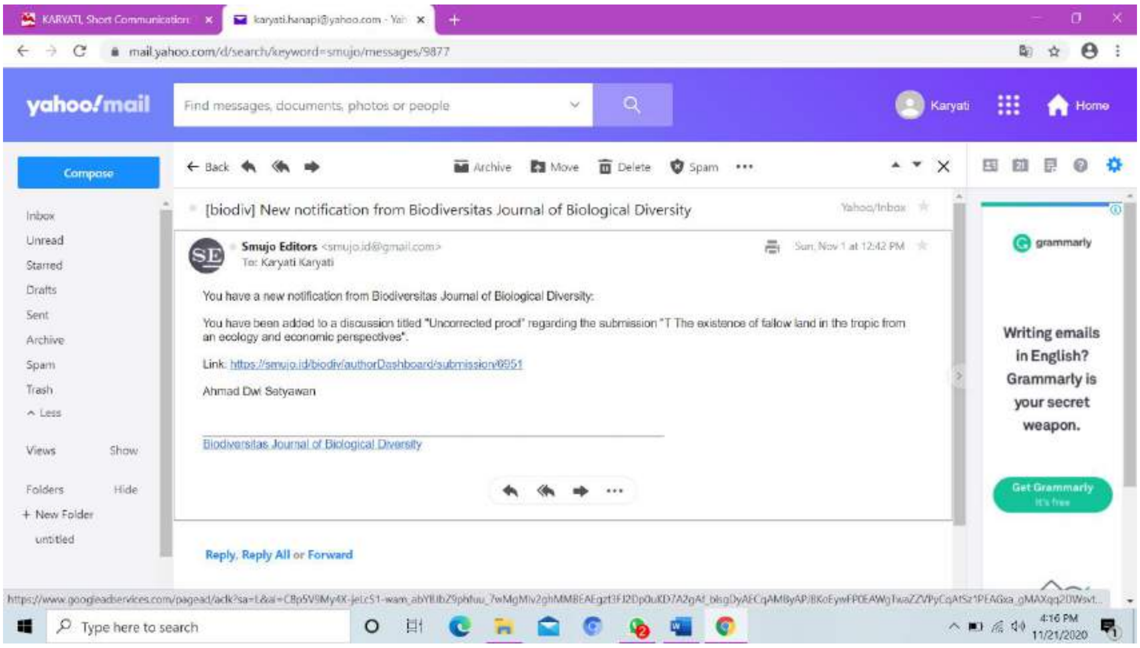
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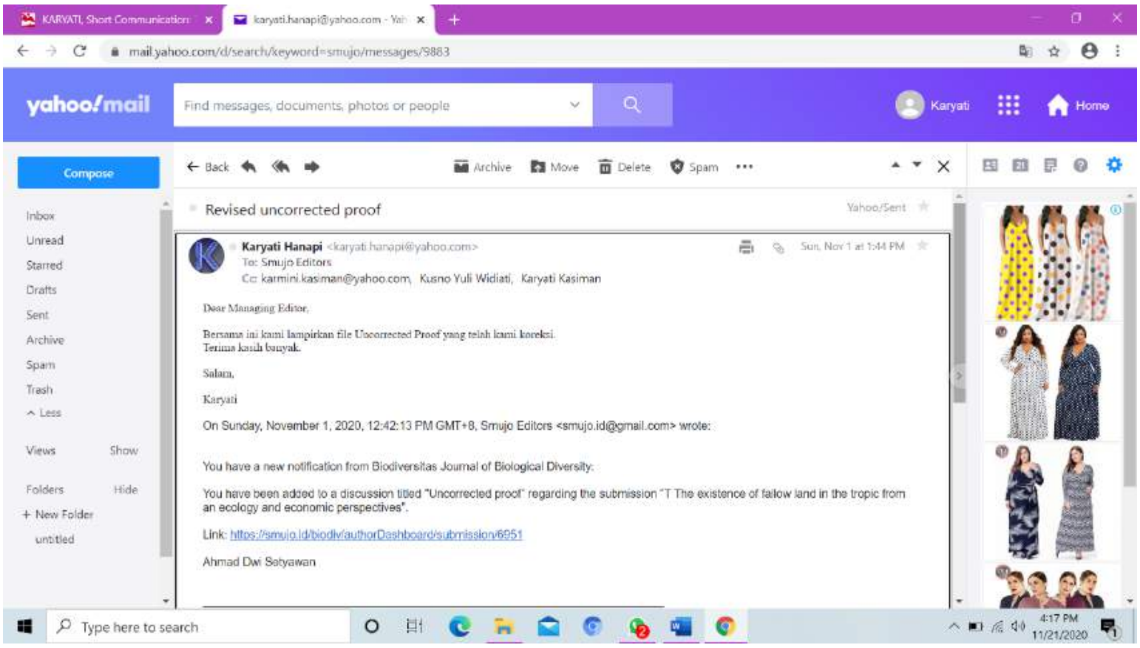
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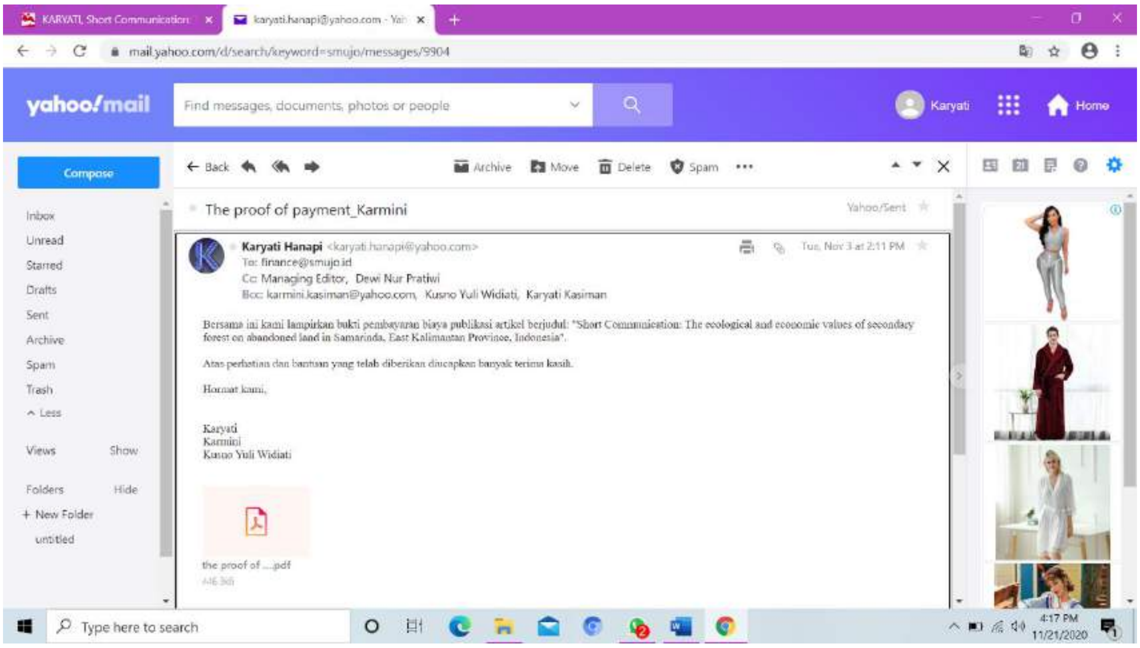
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Atas perhatian dan bantuan yang telah diberikan diucapkan banyak terima kasih.
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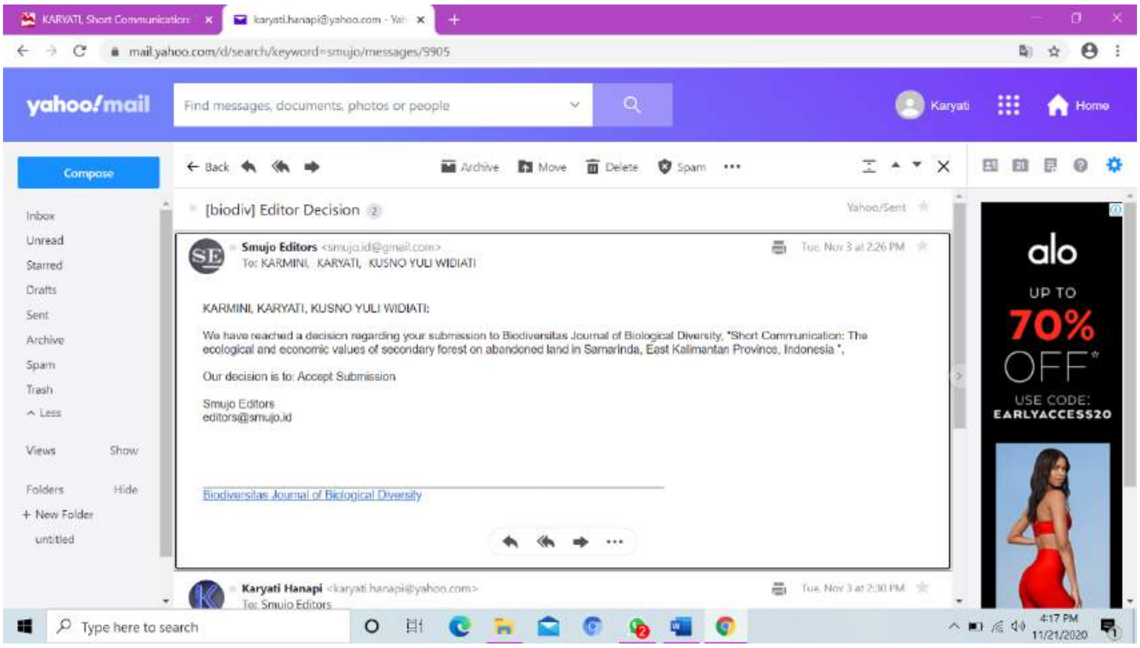

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Our decision is to: Accept Submission

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editors@smujo.id

Biodiversitas Journal of Biological Diversity

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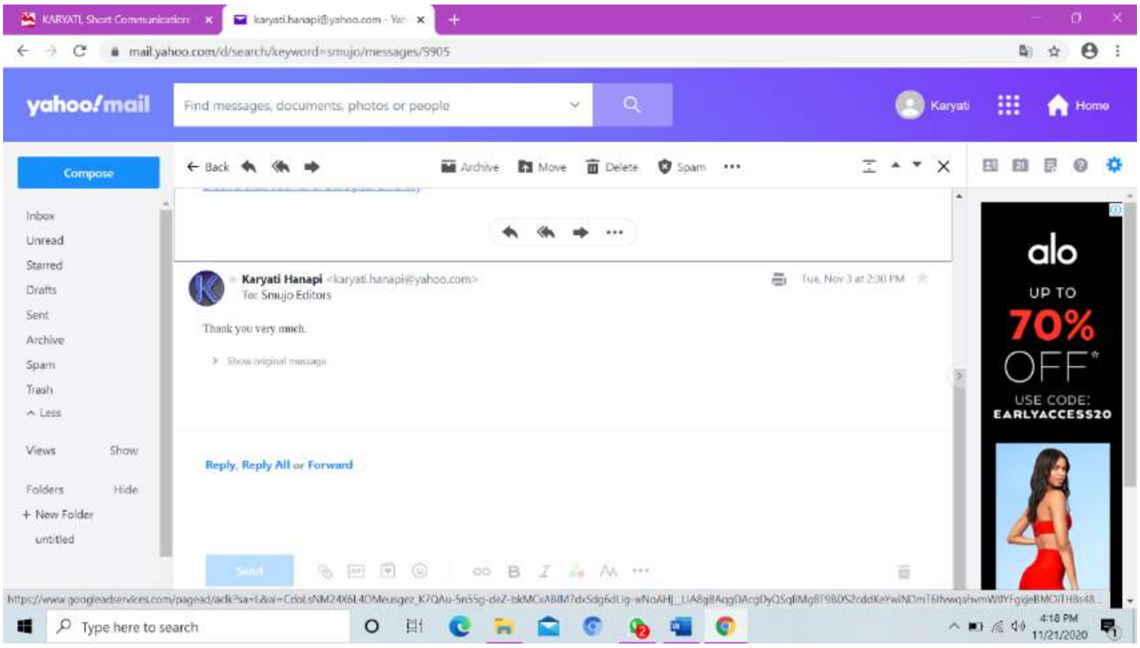

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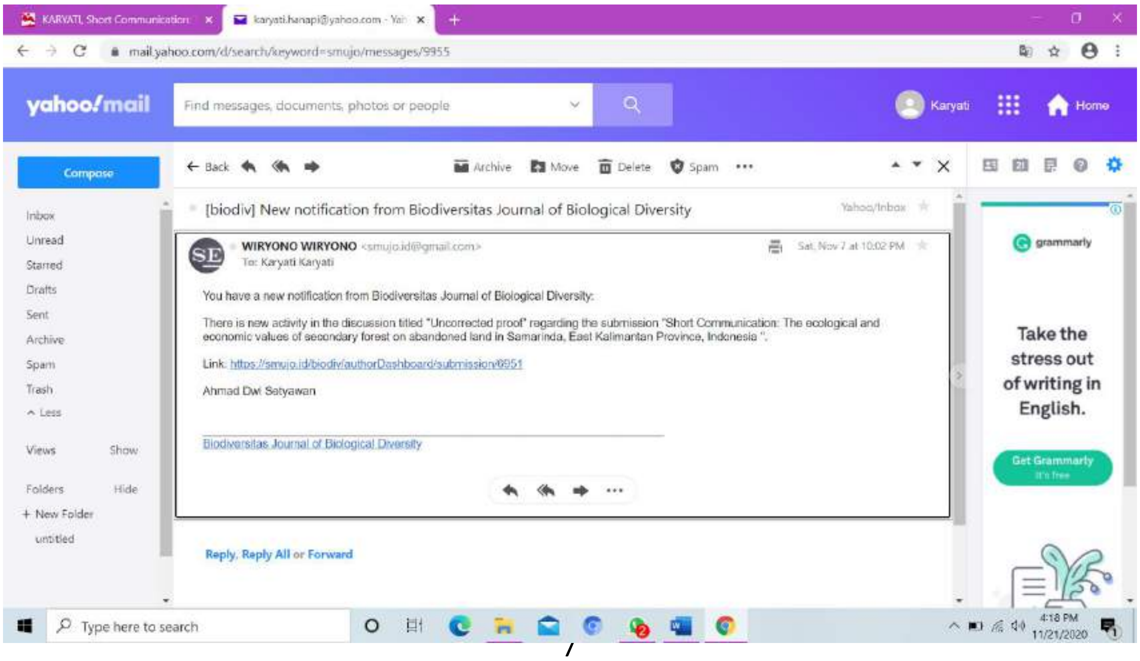

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Link: https://smujo.id/biodiv/authorDashboard/submission/6951

Ahmad Dwi Setyawan

Biodiversitas Journal of Biological Diversity

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The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province ~~The existence of fallow land in the tropic from an ecology and economic perspectives~~

ABSTRACT

There is a large area of abandoned land ~~that is not taken manage of after plantation activities~~ in ~~the tropic~~East Kalimantan Province. These abandoned traditional gardens which have been neglected for a long time have important ecological and economic values. This study ~~aims~~ aimed to assess the ecological and economic values ~~existence~~ of secondary forest on abandoned land in ~~the tropic from an ecological and economic perspective~~Samarinda, East Kalimantan Province. The ecological aspects assessed were stand structure, floristic composition, and species diversity. Meanwhile, the economic aspects analyzed were log price, harvesting cost, profit margin, and stumpage value. The vegetation survey was carried out on all woody trees with a diameter at bresst height (DBH) ≥ 5 cm in 10 subplots, each measuring ~~sized~~ 20 m × 20 m. A total of~~.~~ 192 trees were recorded, ~~of 29 species~~ belonging to 29 species, 19 genera and 17 families. The most dominant species were *Macaranga triloba* (Importance Value, IV of 46.16), *Macaranga tanarius* (IV of 22.97), and *Nephelium lappaceum* (IV of 20.94). The indexes of diversity, dominance, evenness, and richness in the studied plots were 1.33, 0.06, 0.40, and 5.33, respectively. The means of wood price, logging cost, profit margin, and stumpage value ~~at abandoned land~~of the secondary forest were USD199.55 m^{-3}, USD69.01 m^{-3}, USD25.45 m^{-3}, and USD51.56 ha^{-1}, respectively. This study ~~e~~confirmed that the abandoned land~~s~~ ~~with~~ had high ecological and economic values~~ indicate the important role of abandoned lands in the secondary succession process in the tropics~~.

Key words: Abandoned land, diversity, fallow land, stumpage value, tropic.

Running title: The existence of fallow land

INTRODUCTION

In East Kalimantan Province there is about 3 million hectares of abandoned land, consisting mainly of former coal mining land and fallow land of the shifting cultivation system which is no longer cultivated by the owners. The indigenous Dayak tribe usually replanted the land after rice harvesting with multipurpose species, such as fruit trees, rattan, and bamboo. Over time, the abandoned land will turn into secondary forest due to succession.~~The forest growth continues to increase constantly in the tropic.~~ After decades, the species richness in the regrowth forests can approach old forest which can serve as biodiversity repositories (Yirdaw et al. 2018).

~~The planting trees on abandoned land can be done in an effort to accelerate the restoration of vegetation and soil in the area. These activities allow land use and reduce the expansion of cultivated areas (Klanderud et al. 2010).~~ The time required for vegetation recovery to ~~primary succession~~original forest characteristics is influenced by several factors such as type of land use, cycle duration, and large cleared patches (Aththorick et al. 2012). The pioneer ~~and fast growing~~ plant species dominate abandoned land~~s~~ ~~which are~~ indicated by an intermediate diversity, a low dominance index, and a high evenness index (Karmini et al. 2020; Karyati et al. 2013; Karyati et al. 2018). The rate of succession and thus the restoration of soil on abandoned land can be accelerated through plantation programs. These activities can reduce the expansion of forest conversion into cultivated areas (Klanderud et al. 2010).

~~The land use change has significant impacts on biodiversity, carbon sequestration, and local economies (Kunts et al. 2018). The urban growth is contrasts to the spatial distribution of fallow land at the local scale and economic recessions at the regional scale (Zambon et al. 2018). The National Land Agency (BPN) identified an area of 7.3 million hectares of land in Indonesia in 2011 was categorized as abandoned land, while around 4.8 million hectares had been declared as abandoned land. The area of abandoned land increased in 2007 to an area of 7.1 million hectares outside the forest area~~

~~(Nurlinda et al. 2014). The area of abandoned land in East Kalimantan is about 3 million hectares. In general, the abandoned land consists of ex-coal mining land and gardens or fields that are not cultivated by the owner. In East Kalimantan, the indigenous Dayak tribe replanted the land after planting rice with the multifunctions trees, such as fruit trees, rattan, and bamboo.~~ Also, ~~Forest~~ forest planting has an important role in providing ecological, economic, religious, and cultural functions of the secondary forest (Setiawan 2010). The average stumpage value in abandoned land was calculated to be 83.05 USD ha^{-1} and the total ~~was calculated to be~~value 2,159.36 USD ha^{-1} (Karmini et al. 2020).

The calculation of the potential economic value of ~~wood~~ timber and non-~~wood~~ timber forest products that can be used as construction materials for buildings or furniture will illustrate the potential income that might be achieved from managing abandoned land. Some of the results of previous research on abandoned land are mostly related to aspects of agrarian law policy (Afdalis 2016; Dumais 2014; Permana 2012) as well as study on the ecology and economy of abandoned land after cultivation (Karmini et al. 2020). However, research on the potential for carbon stocks and the economic valuation of abandoned land~~s~~ after plantation is rarely reported. The objectives of the study were to assess the ~~existence~~ ecological and economic values of secondary forest ~~of~~ on abandoned land~~ based on ecology and economy perspectives~~. ~~The ecological aspect were assessed 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 used as the basis to make recommendation in ~~conserving and~~ managing the abandoned land in East Kalimantan and in other tropical ~~abandoned lands~~ areas.

Commented [U1]: Dua kalimat ini agak bertentangan, kecuali dalam aspek carbon stock. Sementara carbon stock tidak dibahas dalam artikel ini.

MATERIALS AND METHODS

Study site

The research was carried out on a~~n~~ fallow land of abandoned traditional garden in Bukit Pinang area,~~. Bukit Pinang is~~ in Samarinda Ulu sub district, Samarinda City, East Kalimantan Province, Indonesia. The boundaries of the area are Kutai Kartanegara district at north, Samarinda Utara district at east, Air Putih sub district at south, and Sungai Kunjang district at west. Samarinda City is the capital of East Kalimantan Province, Indonesia and the city with the largest population in the entire island of Kalimantan. The population of Samarinda is 812,597 people. Samarinda has an area of 718 km^2 with a hilly geographical condition with altitudes varying from ~~1 to~~ 10 to 200 meters above sea level. Samarinda City is divided by Mahakan river and becomes the gateway to the area around by river, land, and air. The research plot lies at the coordinate points of 0°25′32.8″S 117°05′56.8″E ~~(as shown in~~ Figure 1~~)~~.

Figure 1. Map of study site.

Procedures

Data collection~~*Vegetation survey*~~

The ~~research~~ vegetation survey was conducted from March to September 2020. A total of 10 subplots, each measuring 20 m × 20 m, were established in the study site. All woody trees with a diameter at breast height (DBH) of ≥ 5 cm were measured for diameter and height, and their species were identified.

~~*Data collection*~~

~~Researchers collected primary and secondary data. Primary data were obtained from vegetation survey. Source of~~The secondary data ~~was~~ were obtained from reports and articles from previous researches.

Data analysis

Ecological characteristics

The following formulas were used to measure individual basal area (BA) and volume (V) (Husch et al. 1982):

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

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

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

The importance value index (IVi) was used to determine the dominant species of community within the studied plots in (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 four diversity indices were analyzed to describe species diversity of standing trees in the studied plots. These diversity indices were 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.

Economic literature

Data in Table 1 shows number of logs that produced from tree diameter up to 75 cm. Based on diameter class and number of logs, ~~could be known~~ the equivalent merchantable height was determined.

Table 1. Merchantable tree heights.

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
< 15	0.5	2.5*
15 – 30	1	5
+30 – 60	2	10
+60 – 75	3	15
75 ke atas	4	20

Source: * Primary data (2020); Forestry Department of ~~Pinansular~~ Peninsular Malaysia (FDPM) (1997).

Reduction factor of log price was determined based on size class of DBH ~~and its data can be seen in~~ (Table 2). This resea~~r~~arch used assumption ~~if~~ that the reduction factor of log price with size class of DBH < 15 cm ~~is~~ was ~~as many as~~ 0.6.

Table 2. Reduction factor of log price.

DBH size class (cm)	Reduction factor
< 15	0.60*
15 – 29	0.45

30 – 44	0.30
45 – 49	0.15
50 – 54	0.025
≥ 55	0.00

Source: *Primary data (2020); Noor et al. (1992) and Hanum et al. (2001).

Profit ratio ~~is~~ was ~~determined~~ fixed ~~as~~ at ~~many as~~ 30% according to Noor dan Shahwahid (1999). Equation of profit margin ~~is~~ was calculated as follows (Noor dan Shahwahid, 1999):

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

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);
j = an index for diameter class (i = 1, 2, 3, 4, ..., n).

Logging cost of *Eusideroxylon zwageri* ~~spesies~~ was USD102.04 m^{-3} in research location when the research was done. Meanwhile, that of other~~s~~ spesies was USD68.03 m^{-3}. The exchange rate ~~was~~ of 1 USD ~~equal with~~was 14,740 IDR ~~at~~ on 8 October 2020. The equation of stumpage values is presented below:

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

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 = 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);
j = an index for diameter class (i = 1, 2, 3, 4, ..., n).

RESULTS AND DISCUSSION

Ecological Characteristics

Diameter at Breast Height (DBH) and Height Distributions

The diameter distribution in the research plots shows an inverted J shape where an increase in diameter class is followed by a decrease in the number of trees ~~as illustrated in~~ (Figure 2). As much as 70 percent of the tree density ~~is~~ was in the DBH class of 5-15 cm. The number of trees in the DBH class of 5.0-15.0 cm was 134 ~~trees~~ (70%), the DBH class of 15.1-25.0 cm ~~was~~ 32 ~~trees~~ (17%), the DBH class of 25.1-35.0 cm ~~was~~ 20 ~~trees~~ (10%), and the DBH class of > 35.0 cm ~~was~~ 6 ~~trees~~ (3%). Meanwhile, most of the trees (59%) belong to the 5-10 cm height ~~sized~~ class ~~as shown in~~ (Figure 3). The tree heights ~~classes~~ were distributed in height ~~size~~ classes of 0-5.0 m (9 trees or 5%), 5.1-10.0 m (114 trees or 59%), 10.1-15.0 m (53 trees or 28%), and > 15 m (16 trees or 8%). In general, the diameter distribution of trees in secondary forest ~~shows~~ has an inverted J-shape (Feldpausch et al., 2007; Álvarez-Yépiz et al., 2008) while the distribution of ~~high~~ height class ~~shows~~ is ~~a skewed~~ slightly positively skewed (Ohtsuka, 1999). The The similar trends in trees diameter class and height class were also reported on abandoned land after cultivation (Karmini et al. 2020).

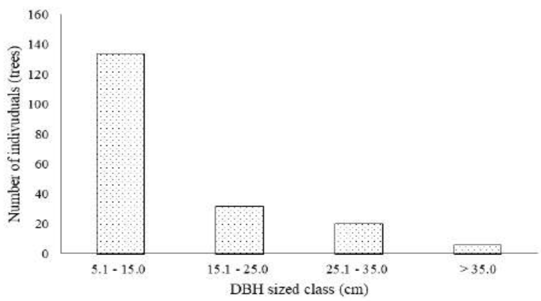

Figure 2. Distribution~~s~~ of diameter at breast height (DBH) in 0.4 ha ~~of abandoned land~~at the study site.

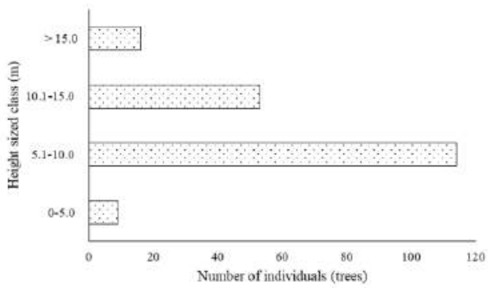

Figure 3. Distribution~~s~~ of height in 0.4 ha ~~of abandoned land.~~at the study site

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Density, Basal Area, and Volume

The number of individuals recorded in the research plots was 192 trees, belonging to 29 species, 19 genera, and 17 families. There were 8 tree species ~~belonging to~~of ~~the~~ Moraceae, 5 tree species of Euphorbiaceae, and 2 tree species of Anacardiaceae. Each of ~~The~~ the other 14 families ~~consisting~~ consisted of 1 tree species. The density, basal area, and volume of species in the study site ~~were~~ are presented in Table 3. The DBH of trees in the study plots ~~ranges~~ ranged from 6.4 cm to 29.1 cm with an average DBH of 16.3 cm. Meanwhile, the tree height ~~ranges~~ ranged from 6.0 m -to17.4 m with an average height of 10.4 m. The total BA and volume of trees in the study plot were 9.44 and 76.86, respectively. These values are smaller than the total BA (9.75) and the total volume (91.97) in abandoned land after cultivation (Karmini et al. 2020). The five dominant species based on total basal area and volume were *Macaranga tanarius* (total BA=0.91 m^2 ha^{-1} and volume=7.86 m^3 ha^{-1}), *Mangifera indica* (total BA=0.67 m^2 ha^{-1} and volume=7.49 m^3 ha^{-1}), *Nephelium lappaceum* (total BA=0.77 m^2 ha^{-1} and volume=6.37 m^3 ha^{-1}), *Macaranga triloba* (total BA=1.00 m^2 ha^{-1} and volume=6.05 m^3 ha^{-1}), and *Artocarpus integer* (total BA=0.62 m^2 ha^{-1} and volume=5.63 m^3 ha^{-1}). The common species in abandoned land were dominated by fast growing species, such as *Macaranga* spp, and *Artocarpus* spp. as also reported by Karyati et al. (2018) and Karmini et al. (2020). The recorded fruit trees showed that the studied plot ~~included~~ was abandoned garden. These fruit species planted ~~such as~~were *Artocarpus integer* (Nangka), *Artocarpus lakoocha*, *Artocarpus anisophyllus* (Mentawa), *Artocarpus odoratissimus* (Terap), *Artocarpus tamaran*, *Artocarpus elasticus* (Benda), *Artocarpus heterophyllus* (Nangka), *Mangifera indica* (Mango), *Mangifera odorata* (Kuweni), *Durio zibethinus* (Durian), *Nephelium lappaceum* (Rambutan). Two tree species could not be identified in this study. *Durio zibethinus* and *Artocarpus odoratissimus* ~~were~~ are ~~included~~ local tree species.

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

No.	Species	Family	N	Average of DBH (cm)	Average of height (m)	Total of BA (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
1	*Macaranga tanarius*	Euphorbiaceae	13	18.3	12.0	0.91	7.86
2	*Mangifera indica*	Anacardiaceae	4	29.1	17.4	0.67	7.49
3	*Nephelium lappaceum*	Sapindaceae	12	15.0	9.5	0.77	6.37
4	*Macaranga triloba*	Euphorbiaceae	48	9.7	8.7	1.00	6.05
5	*Artocarpus integer*	Moraceae	4	26.4	14.0	0.62	5.63
6	*Trema orientalis*	Cannabaceae	8	16.6	13.8	0.51	5.51
7	*Artocarpus lakoocha*	Moraceae	3	28.2	15.5	0.47	4.74
8	*Artocarpus anisophyllus*	Moraceae	9	14.1	9.5	0.48	4.70
9	*Vernonia arborea*	Asteraceae	4	23.6	12.1	0.46	3.69
10	*Artocarpus odoratissimus*	Moraceae	5	21.2	9.6	0.48	3.22
11	*Homalanthus populneus*	Euphorbiaceae	7	12.4	8.2	0.35	2.69

No.	Species	Family	N	Average of DBH (cm)	Average of height (m)	Total of BA (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
12	*Mallotus paniculatus*	Euphorbiaceae	15	9.8	8.4	0.33	2.21
13	*Artocarpus tamaran*	Moraceae	2	22.0	11.5	0.23	2.06
14	*Ficus uncinata*	Moraceae	16	10.2	8.5	0.35	2.01
15	*Symplocos fasciculata*	Symplocaceae	5	16.5	7.1	0.31	1.74
16	*Durio zibethinus*	Malvaceae	2	15.2	12.4	0.13	1.49
17	*Macaranga gigantea*	Euphorbiaceae	2	18.9	9.8	0.19	1.43
18	*Artocarpus elasticus*	Moraceae	4	15.2	8.4	0.23	1.43
19	*Archidendron pauciflorum*	Fabaceae	10	9.5	8.7	0.19	1.19
20	*Unknown species 1*	Unknown family 1	1	27.5	12.0	0.15	1.16
21	*Baccaurea parvifolia*	Phyllanthaceae	2	17.0	14.0	0.11	1.05
22	*Cratoxylum arborescens*	Hypericaceae	3	12.5	7.0	0.12	0.64
23	*Oroxylum indicum*	Bignoniaceae	2	13.7	11.3	0.08	0.60
24	*Couroupita guianensis*	Lecythidaceae	2	12.0	11.2	0.06	0.52
25	*Artocarpus heterophyllus*	Moraceae	2	13.2	11.1	0.07	0.50
26	*Unknown species 2*	Unknown family 2	1	18.5	10.0	0.07	0.44
27	*Eusideroxylon zwageri*	Lauraceae	2	11.8	6.0	0.05	0.21
28	*Alstonia scholaris*	Apocynaceae	3	7.9	7.4	0.04	0.20
29	*Mangifera odorata*	Anacardiaceae	1	6.4	7.3	0.01	0.04
	Total		192.0	472.5	302.3	9.44	76.86
	Average		6.6	16.3	10.4	0.33	2.65
	Minimum		1.0	6.4	6.0	0.01	0.04
	Maximum		48.0	29.1	17.4	1.00	7.86

Note : N = number of individuals (trees), DBH = diameter at breast height, BA = basal area.

Importance value index (IVi)

Most of the dominant trees based on importance value index (IVi) were also dominant trees based on total BA and volume. The light demanding pioneer and fast growing species dominated the studied site (as shown in Table 4). The most dominant species in terms of IVi was *Macaranga triloba* (IVi of 46.16) followed by *Macaranga triloba* (IVi of 22.97), *Nephelium lappaceum* (IVi of 20.94), *Ficus uncinata* (IVi of 18.64), and *Mallotus paniculatus* (IVi of 17.93). Twelve of 29 species recorded had an IVi of more than 10.00 and 5 species of them had an IVi of 5.00-10.00. Meanwhile the other 12 species have had an IVi of less than 5.00. Four dominant species of Euphorbiaceae (*Macaranga triloba*, *Macaranga tanarius*, *Mallotus paniculatus*, and *Homalanthus populneus*) reached a total IVi of 99.72. These four species were included in the 10 most dominant types based on IVi. Similar results studies also reported that tree species from Euphorbiaceae are were important and dominate dominating tropical lands (Danquah et al. 2011; Nizam et al. 2006; Karyati et al. 2018; Karmini et al. 2020). The total IVi of 8 species including Moraceae reached 84.75. Moraceae is was the family that hashad the most species in the research location.

Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.4 hectare of the study plots.

No.	Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
1	*Macaranga triloba*	Euphorbiaceae	25.00	10.53	10.63	46.16
2	*Macaranga tanarius*	Euphorbiaceae	6.77	6.58	9.62	22.97
3	*Nephelium lappaceum*	Sapindaceae	6.25	6.58	8.11	20.94
4	*Ficus uncinata*	Moraceae	8.33	6.58	3.72	18.64
5	*Mallotus paniculatus*	Euphorbiaceae	7.81	6.58	3.54	17.93
6	*Artocarpus anisophyllus*	Moraceae	4.69	6.58	5.11	16.37
7	*Trema orientalis*	Cannabaceae	4.17	5.26	5.44	14.87
8	*Artocarpus odoratissimus*	Moraceae	2.60	5.26	5.08	12.94
9	*Homalanthus populneus*	Euphorbiaceae	3.65	5.26	3.75	12.66
10	*Mangifera indica*	Anacardiaceae	2.08	2.63	7.05	11.77
11	*Artocarpus integer*	Moraceae	2.08	2.63	6.57	11.28
12	*Archidendron pauciflorum*	Fabaceae	5.21	3.95	2.07	11.22
13	*Vernonia arborea*	Asteraceae	2.08	2.63	4.84	9.56
14	*Artocarpus lakoocha*	Moraceae	1.56	2.63	4.99	9.19
15	*Symplocos fasciculata*	Symplocaceae	2.60	2.63	3.28	8.51
16	*Artocarpus elasticus*	Moraceae	2.08	2.63	2.46	7.18
17	*Artocarpus tamaran*	Moraceae	1.04	2.63	2.39	6.06
18	*Baccaurea parvifolia*	Phyllanthaceae	1.04	2.63	1.21	4.89
19	*Macaranga gigantea*	Euphorbiaceae	1.04	1.32	1.99	4.35
20	*Eusideroxylon zwageri*	Lauraceae	1.04	2.63	0.58	4.25
21	*Cratoxylum arborescens*	Hypericaceae	1.56	1.32	1.23	4.10
22	*Durio zibethinus*	Malvaceae	1.04	1.32	1.37	3.73

23	*Unknown species 1*	Unknown family 1	0.52	1.32	1.58	3.41
24	*Alstonia scholaris*	Apocynaceae	1.56	1.32	0.41	3.29
25	*Oroxylum indicum*	Bignoniaceae	1.04	1.32	0.81	3.16
26	*Artocarpus heterophyllus*	Moraceae	1.04	1.32	0.73	3.09
27	*Couroupita guianensis*	Lecythidaceae	1.04	1.32	0.66	3.02
28	*Unknown species 2*	Unknown family 2	0.52	1.32	0.71	2.55
29	*Mangifera odorata*	Anacardiaceae	0.52	1.32	0.09	1.92
	Total		100	100	100	300

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

Species Diversity

The tree diversity index was categorized ~~to~~ as 'intermediate' (*H*' of 1.33), indicating~~. This shows~~ that there ~~is~~ was a sufficient number of trees growing at the research location. A very complex community is indicated by a high diversity of species (Brower et al. 1990). Meanwhile, the dominance index was at low criteria with a *D*s value of 0.06. A low dominance value indicates that no species is dominant in the region. The evenness index was in the high category (*J*' value of 0.91), meaning ~~. This category means~~ that the ~~presence~~ individuals of trees in the studied plots ~~is~~ were evenly distributed among species. Evenness of plant species is determined by the diversity of species and the number of species present in the area. A species richness index of 5.33 showed that there were many tree species growing in the study site. ~~However, t~~There were 192 trees included in 29 tree species recorded in the research plot of 0.4 ha. The species richness in a place is determined by the number of species and the density of the existing plants. Species richness is calculated based on the number of species in an area (Krebs, 2001). The results show that high diversity (H '), evenness (J'), and wealth (R) will lead to low dominance (Ds). The similar results were reported for the diversity indices for trees with DBH of > 5 cm on plots with an abandoned field age of 5, 10, 20 years (Karyati et al. 2018) and on abandoned land after cultivation (Karmini et al. 2020).

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

No.	Diversity indices	Value
1	Shannon-Wiener diversity index (*H*')	1.33
2	Simpson dominance index (D_s)	0.06
3	Pielou evenness index (*J*')	0.91
4	Margalef species richness (*R*)	5.33

~~Note : The values were calculated according to the 10 subplots sized 20 m × 20 m each.~~

Economic Value

Log Price

Th~~e result of th~~is research ~~showed the abandoned land had~~found 7 trees species with higher log prices ~~rather~~ than ~~22~~ the ~~others~~ other 22 tree spesies (Table 6). Their log prices were in the range from USD122.12 m^{-3} to USD651.29 m^{-3}. The log price ~~is variety~~varies ~~depends~~ depending on the species and diameter class of log (Karmini et al., 2020). ~~The highest wood price owned by~~ *Eusideroxylon zwageri* had the highest ~~species~~ price, i.e., ~~which reached~~ USD1,085.48 m^{-3}. The ~~wood~~ timber price is ~~influenced by~~positively correlated with its ~~wood~~ demand in society.~~, the higher demand leads the higher wood prices.~~ *Eusideroxylon zwageri* has good quality of wood, and people like~~ly~~ to use this wood for contruction materials.

Table 6. Number of stems~~ at abandoned land~~, log price, and wood price at the study site.

No.	Species	Family	Number (stems ha^{-1})	Log price (USD m^{-3})	Wood price (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	8	651.29	1,085.48
2	*Alstonia scholaris*	Apocynaceae	13	488.47	814.11
3	*Artocarpus anisophyllus*	Moraceae	38	447.76	814.11
4	*Oroxylum indicum*	Bignoniaceae	8	427.41	814.11
5	*Durio zibethinus*	Malvaceae	8	151.37	288.33
6	*Cratoxylum arborescens*	Hypericaceae	13	130.60	237.45
7	*Artocarpus heterophyllus*	Moraceae	8	122.12	203.53
8	*Artocarpus elasticus*	Moraceae	17	74.80	142.47
9	*Artocarpus lakoocha*	Moraceae	13	64.11	142.47
10	*Archidendron pauciflorum*	Fabaceae	42	79.38	135.69
11	*Nephelium lappaceum*	Sapindaceae	50	64.11	122.12
12	*Baccaurea parvifolia*	Phyllanthaceae	8	54.95	122.12
13	*Mangifera odorata*	Anacardiaceae	4	30.53	50.88
14	*Macaranga triloba*	Euphorbiaceae	200	30.37	50.88
15	*Ficus uncinata*	Moraceae	67	30.05	50.88
16	*Mallotus paniculatus*	Euphorbiaceae	63	29.51	50.88
17	*Homalanthus populneus*	Euphorbiaceae	29	28.35	50.88

Commented [U3]: Mungkin perlu diganti dengan timber. Wood adalah kayu dalam arti substansi/material penyusun batang pohon, sedangkan timber adalah kayu yang diproses untuk konstruksi.

18	*Symplocos fasciculata*	Symplocaceae	21	27.48	50.88
19	*Couroupita guianensis*	Lecythidaceae	8	26.71	50.88
20	*Trema orientalis*	Cannabaceae	33	26.71	50.88
21	*Macaranga gigantea*	Euphorbiaceae	8	26.71	50.88
22	*Macaranga tanarius*	Euphorbiaceae	54	25.83	50.88
23	*Artocarpus odoratissimus*	Moraceae	21	24.42	50.88
24	*Artocarpus tamaran*	Moraceae	8	22.90	50.88
25	*Artocarpus integer*	Moraceae	17	22.90	50.88
26	*Vernonia arborea*	Asteraceae	17	22.90	50.88
27	*Unknown species 1*	Unknown family 1	4	22.90	50.88
28	*Unknown species 2*	Unknown family 2	4	22.90	50.88
29	*Mangifera indica*	Anacardiaceae	17	20.99	50.88
Total			801	3,198.52	5,786.97
Mean			28	110.29	199.55

~~Source: Primary data (analyzed) (2020).~~

Logging Cost

The logging cost of *Eusideroxylon zwageri* species was ~~highest~~ higher ~~rather~~ than that of the other spesies in ~~abandoned land in~~ this research ~~(as shown in~~ Table 7). However, logging cost per hectare was determined by log volume, ~~therefore~~ and this research found difference in logging cost per hectare among trees species. The total logging cost in abandoned land in this research (USD752.54 ha^{-1}) was lower compared to that in another research (USD1,212.24 ha^{-1}) (Karmini et al., 2020). This is relevant because the total log volume in abandoned land in this research location was ~~as many as~~ 76.86 m^3 ha^{-1} ~~was~~, lower ~~rather~~ than that in another research location, i.e., ~~reached as many as~~ 91.97 m^3 ha^{-1}.

Table 7. Logging cost of trees at ~~abandoned land~~the study site.

No.	Species	Family	Logging cost	
			(USD ha^{-1})	(USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	7.51	101.76
2	*Artocarpus integer*	Moraceae	83.25	67.84
3	*Artocarpus tamaran*	Moraceae	74.43	67.84
4	*Mangifera indica*	Anacardiaceae	61.13	67.84
5	*Artocarpus lakoocha*	Moraceae	57.68	67.84
6	*Unknown species 1*	Unknown family 1	54.70	67.84
7	*Vernonia arborea*	Asteraceae	41.96	67.84
8	*Artocarpus odoratissimus*	Moraceae	34.25	67.84
9	*Macaranga gigantea*	Euphorbiaceae	33.42	67.84
10	*Nephelium lappaceum*	Sapindaceae	30.83	67.84
11	*Homalanthus populneus*	Euphorbiaceae	30.55	67.84
12	*Artocarpus anisophyllus*	Moraceae	27.55	67.84
13	*Unknown species 2*	Unknown family 2	23.49	67.84
14	*Macaranga tanarius*	Euphorbiaceae	23.29	67.84
15	*Durio zibethinus*	Malvaceae	23.22	67.84
16	*Trema orientalis*	Cannabaceae	21.35	67.84
17	*Baccaurea parvifolia*	Phyllanthaceae	21.01	67.84
18	*Artocarpus elasticus*	Moraceae	20.02	67.84
19	*Symplocos fasciculata*	Symplocaceae	19.38	67.84
20	*Cratoxylum arborescens*	Hypericaceae	12.23	67.84
21	*Oroxylum indicum*	Bignoniaceae	11.75	67.84
22	*Couroupita guianensis*	Lecythidaceae	10.18	67.84
23	*Artocarpus heterophyllus*	Moraceae	6.32	67.84
24	*Mallotus paniculatus*	Euphorbiaceae	5.73	67.84
25	*Ficus uncinata*	Moraceae	4.59	67.84
26	*Archidendron pauciflorum*	Fabaceae	4.45	67.84
27	*Macaranga triloba*	Euphorbiaceae	4.39	67.84
28	*Alstonia scholaris*	Apocynaceae	2.38	67.84
29	*Mangifera odorata*	Anacardiaceae	1.48	67.84
Total			752.54	2,001.36
Mean			25.95	69.01

~~Source: Primary data (analyzed) (2020).~~

Profit Margin

The ~~wood sellers hope profit from their marketing activities, the~~ 3 trees species ~~contribute~~ contributing big profit margin ~~, namely~~ were *Eusideroxylon zwageri, Alstonia scholaris,* and *Artocarpus anisophyllus*. Those species also ~~have~~

had ~~the~~ high ~~of~~ log and wood prices. This mean~~t~~ prices of buying and selling determine profit in marketing both log and wood. Data in Table 8 present profit margin of selling 29 trees species from abandoned land.

Table 8. Profit margin.

No.	Species	Family	Profit margin (USD m^{-3} ha^{-1})	Profit margin (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	626.24	150.30
2	*Alstonia scholaris*	Apocynaceae	469.68	112.72
3	*Artocarpus anisophyllus*	Moraceae	430.54	103.33
4	*Oroxylum indicum*	Bignoniaceae	410.97	98.63
5	*Durio zibethinus*	Malvaceae	145.55	34.93
6	*Cratoxylum arborescens*	Hypericaceae	125.57	30.14
7	*Artocarpus heterophyllus*	Moraceae	117.42	28.18
8	*Archidendron pauciflorum*	Fabaceae	76.32	18.32
9	*Artocarpus elasticus*	Moraceae	71.92	17.26
10	*Nephelium lappaceum*	Sapindaceae	61.65	14.79
11	*Artocarpus lakoocha*	Moraceae	61.65	14.79
12	*Baccaurea parvifolia*	Phyllanthaceae	52.84	12.68
13	*Mangifera odorata*	Anacardiaceae	29.35	7.05
14	*Macaranga triloba*	Euphorbiaceae	29.20	7.01
15	*Ficus uncinata*	Moraceae	28.90	6.94
16	*Mallotus paniculatus*	Euphorbiaceae	28.38	6.81
17	*Homalanthus populneus*	Euphorbiaceae	27.26	6.54
18	*Symplocos fasciculata*	Symplocaceae	26.42	6.34
19	*Trema orientalis*	Cannabaceae	25.69	6.16
20	*Couroupita guianensis*	Lecythidaceae	25.69	6.16
21	*Macaranga gigantea*	Euphorbiaceae	25.69	6.16
22	*Macaranga tanarius*	Euphorbiaceae	24.84	5.96
23	*Artocarpus odoratissimus*	Moraceae	23.48	5.64
24	*Artocarpus tamaran*	Moraceae	22.02	5.28
25	*Artocarpus integer*	Moraceae	22.02	5.28
26	*Vernonia arborea*	Asteraceae	22.02	5.28
27	*Unknown species 1*	Unknown family 1	22.02	5.28
28	*Unknown species 2*	Unknown family 2	22.02	5.28
29	*Mangifera indica*	Anacardiaceae	20.18	4.84
Total			3,075.50	738.12
Mean			106.05	25.45

~~Source: Primary data (analyzed) (2020).~~

Stumpage Value

The total stumpage value at the abandoned land was estimated as much as USD1,495.31 ha^{-1}. There were 29 trees species ~~has identified~~ and each species ~~contibutes~~ contributed an average of USD51.56 ha^{-1}. ~~Figure 1 describes t~~The highest stumpage value was from *Artocarpus anisophyllus* ~~species~~, i.e., ~~as much as~~ USD168.97 ha^{-1} and the lowest ~~stumpage value was contributed~~one ~~by~~ *Mangifera odorata*, ~~spesies as much as~~i.e., USD2.29 ha^{-1} ~~.~~(Figure 1).

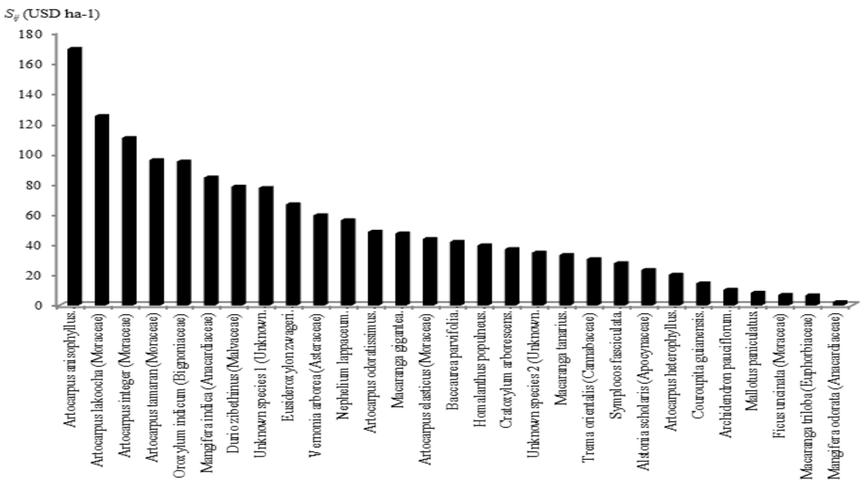

Figure 4. Stumpage value of trees at abandoned land.

ACKNOWLEDGEMENTS

~~The authors~~ We would like to express ~~their~~ our gratitude ~~and highest appreciation~~ to the Ministry of Education and Culture, the Republic of Indonesia for the financial ~~the~~ support for this research ~~by~~ through the scheme of *Hibah Penelitian Dasar Unggulan Perguruan Tinggi* Contract No.: 183/SP2H/AMD/LT/DRPM/2020 ~~for this research~~.

REFERENCES

Afdalis. 2016. Abandonment of Property Rights. [Thesis]. Fakultas Hukum Universitas Hasanuddin, Makassar. [Indonesia]

Álvarez-Yépiz JC, Martínez-Yrízar A, Búrquez A, Lindquist C. 2008. Variation in vegetation structure and soil properties related to land use history of old-growth and secondary tropical dry forests in Northwestern Mexico. Forest Ecology and Management 256: 355-366. doi: https://doi.org/10.1016/j.foreco.2008.04.049

Aththorick TA, Setiadi D, Purwanto Y, Guhardja Y. 2012. Vegetation stands structure and aboveground biomass after the shifting cultivation practices of Karo People in Leuser Ecosystem, North Sumatra. Biodiversitas 13(2): 92-97.

Danquah JA, Appiah M, Ari P. 2011. Comparison of post-fire planted and natural dry semideciduous forest communities in Ghana. African Journal of Agricultural Research 6(23): 5266- 5277. doi: https://doi.org/10.5897/AJAR11.820.

Dumais RO. 2014. Legal arrangements for the existence of abandoned land in Indonesia. Lex et Societatis, II(5). https://ejournal.unsrat.ac.id/index.php/lexetsocietatis/article/viewFile/4890/4415.

Fachrul MF. 2007. Bioecology Sampling Method. Bumi Aksara, Jakarta. [Indonesian]

Feldpausch TR, Prates-Clark CC, Fernandes ECM, Riha SJ. 2007. Secondary forest growth deviation from chronosequence predictions in Central Amazonia. Global Change Biology 13: 967-979. doi: https://doi.org/10.1111/j.1365-2486.2007.01344.x

Husch B, Miller CI, Beers TW. 1982. Forest Mensuration. John Wiley and Sons Publishing, New York.

Karmini, Karyati, Widiati KY. 2020. The role of tropical abandoned land relative to ecological and economic aspects. Forest and Society 4(1): 181-194.

Karyati, Ipor IB, Jusoh I, Wasli ME, Seman IA. 2013. Composition and diversity of plant seedlings and saplings at early secondary succession of fallow lands in Sabal, Sarawak. Acta Biologica Malaysiana 2(3), 85-94. doi: http://dx.doi.org/10.7593/abm/2.3.85

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

Klanderud K, Mbolatiana HZH, Vololomboahangy MN, Radimbison MA, Roger E, Totland O, Rajeriarison C. 2010. Recovery of plant species richness and composition after slash-and-burn agriculture in a tropical rainforest in Madagascar. Biodivers Conserv 19:187-204. DOI 10.1007/s10531-009-9714-3

Kuntz KA, Beaudry F, Porter KL. 2018. Farmers' perceptions of agricultural land abandonment in rural western New York State. Land 7(128): 1-11.

Nizam MS, Norziana J, Sahibin AR, Latiff A. 2006. Edaphic relationships among tree species in the National Park at Merapoh, Pahang, Malaysia. Jurnal Biosains 17(2): 37-53.

Nurlinda I, Pujiwati Y, Ishak M. 2014. Comparison of the handling of abandoned land in Tasikmalaya Regency and Sukabumi Regency in realizing food security in West Java Province. Jurnal Hukum IUS Quia Iustum 21(1): 120-138. [Indonesian]

Odum EP~~E~~. 2005. Fundamentals of Ecology, 5th Ed. Thomson Brooks/Cole, Belmont CA.

Ohtsuka T. 1999. Early stages of secondary succession on abandoned cropland in north-east Borneo island. Ecological Research 14: 281-290. doi: https://doi.org/10.1046/j.1440- 1703.1999.143304.x

Permana EY. 2012. Peralihan Hak Atas Tanah Akibat Tanah Terantar (Studi Kasus Terhadap Keputusan Kepala Badan Pertanahan Nasional Republik Indonesia Nomor 10/PTT-HGU/BPN RI/2012). Tersedia di laman https://media.neliti.com/media/publications/34172-ID-peralihan-hak-atas-tanah-akibat-tanah-terlantar-studi-kasus-terhadap-keputusan-k.pdf. Diakses pada 25 Mei 2017.

Setiawan AD. 2010. Review: Biodiversity conservation strategy in a native perspective; case study of shifting cultivation at the Dayaks of Kalimantan. Bioscience 2(2): 97-108.

Yirdaw E, Monge AM, Austin A, Toure I. 2019. Recovery of foristic diversity, composition and structure of regrowth forests on fallow lands: implications for conservation and restoration of degraded forest lands in Laos. New Forests, 50:1007–1026. https://doi.org/10.1007/s11056-019-09711-2

Zambon I, Serra P, Salvia P, Salvati L. 2018. Fallow land, recession and socio-demographic local contexts: Recent dynamics in a mediterranean urban fringe. Agriculture 8(159): 1-17.

The existence of fallow land in the tropic from an ecology and economic perspectives

ABSTRACT

There is a large area of abandoned land that is not taken manage of after plantation activities in the tropic. These abandoned gardens which have been neglected for a long time have important ecological and economic values. This study aims to assess the existence of abandoned land in the tropic from an ecological and economic perspective. The ecological aspects assessed were stand structure, floristic composition, and species diversity. Meanwhile, the economic aspects analyzed were log price, harvesting cost, profit margin, and stumpage value. The vegetation survey was carried out on all woody trees with a diameter at bresstbreast height (DBH) ≥ 5 cm in 10 subplots each sized 20 m × 20 m. A total of.192 trees were recorded of 29 species belonging to 19 genera and 17 families. The most dominant species were *Macaranga triloba* (Importance Value, IV of 46.16), *Macaranga tanarius* (IV of 22.97), and *Nephelium lappaceum* (IV of 20.94). The indexes of diversity, dominance, evenness, and richness in the studied plots were 1.33, 0.06, 0.40, and 5.33, respectively. The means of wood price, logging cost, profit margin, and stumpage value at abandoned land were USD199.55 m^{-3}, USD69.01 m^{-3}, USD25.45 m^{-3}, and USD51.56 ha^{-1}, respectively. The abandoned lands with high ecological and economic value indicate the important role of abandoned lands in the secondary succession process in the tropics.

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What is the definition of plantation activities? Commercial plantation or smallholder-based farmland. The impact of different types of abandoned plantation will provide different consequences on its ecological and economic value.

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Key words: Abandoned land, diversity, fallow land, stumpage value, tropic.

Running title: The existence of fallow land

INTRODUCTION

The forest growth continues to increase constantly in the tropic. After decades, the species richness in the regrowth forests can approach old forest which can serve as biodiversity repositories (Yirdaw et al. 2018). PThe planting trees on abandoned land can be done in an effort to accelerate the restoration of vegetation and soil in the area. These activities allow land use and reduce the expansion of cultivated areas (Klanderud et al. 2010). The time required for vegetation recovery to primary succession is influenced by several factors such as type of land use, cycle duration, and large cleared patches (Aththorick et al. 2012). PThe pioneer and fast growing plant species dominate abandoned lands which are indicated by an intermediate diversity, a low dominance index, and a high evenness index (Karmini et al. 2020; Karyati et al. 2013; Karyati et al. 2018).

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The land use change has significant impacts on biodiversity, carbon sequestration, and local economies (Kunts et al. 2018). The urban growth is contrasts to the spatial distribution of fallow land at the local scale and economic recessions at the regional scale (Zambon et al. 2018). The National Land Agency (BPN) has identified an area of 7.3 million hectares of land in Indonesia in 2011 was categorized as abandoned land, while around 4.8 million hectares had been declared as abandoned land. The area of abandoned land increased in 2007 to an area of 7.1 million hectares outside the forest area (Nurlinda et al. 2014). The area of abandoned land in East Kalimantan is about 3 million hectares. In general, the abandoned land consists of ex-coal mining land and gardens or fields that are not cultivated by the owner. In East Kalimantan, the indigenous Dayak tribe replanted the land after planting rice with the multifunctions trees, such as fruit trees, rattan, and bamboo. Forest planting has an important role in providing ecological, economic, religious, and cultural

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functions (Setiawan 2010). The average stumpage value in abandoned land was calculated to be 83.05 USD ha^{-1} and the total was calculated to be 2,159.36 USD ha^{-1} (Karmini et al. 2020).

The calculation of the potential economic value of wood and non-wood that can be used as construction materials for buildings or furniture will illustrate the potential income that might be achieved from managing abandoned land. Some of the results of previous research on abandoned land are mostly related to aspects of agrarian law policy (Afdalis 2016; Dumais 2014; Permana 2012) as well as study on the ecology and economy of abandoned land after cultivation (Karmini et al. 2020). However, research on the potential for carbon stocks and the economic valuation of abandoned lands after plantation is rarely reported. The objectives of the study were to assess the existence of abandoned land based on ecology and economy perspectives. The ecological aspect ~~were~~was assessed 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 recommendation in conserving and managing tropical abandoned lands.

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MATERIALS AND METHODS

Study site

The research was carried out on an fallow land of abandoned garden in Bukit Pinang area. Bukit Pinang is in Samarinda Ulu sub district, Samarinda City, East Kalimantan Province, Indonesia. The boundaries of area are Kutai Kartanegara district at north, Samarinda Utara district at east, Air Putih sub district at south, and Sungai Kunjang district at west. Samarinda City is the capital of East Kalimantan Province, Indonesia and the city with the largest population in the entire island of Kalimantan. The population of Samarinda is 812,597 people. Samarinda has an area of 718 km^2 with a hilly geographical condition with altitudes varying from 1o to 200 meters above sea level. Samarinda City is divided by Mahakan river and becomes the gateway to the area around by river, land, and air. The research plot lies at the coordinate point 0°25′32.8″S 117°05′56.8″E as shown in Figure 1.

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The term "fallow" often associated to land abandoned after slash and burn farming. In the case of your study, can it be assumed that the abandoned land that you are referring in this study are fallow land after slash and burn activities?

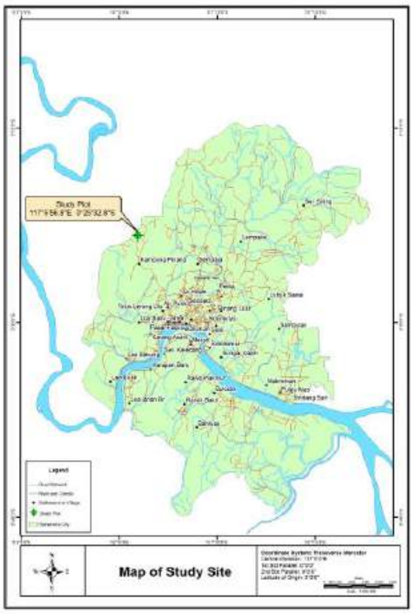

Figure 1. Map of study site.

Procedures

Vegetation survey

The research was conducted from March to September 2020. A total of 10 subplots each measuring 20 m × 20 m were established in the study site. All woody trees with a diameter at breast height (DBH) of ≥ 5 cm were measured for diameter and height, and their species were identified.

Data collection

Researchers collected primary and secondary data. Primary data were obtained from vegetation survey. Source of secondary data was reports and articles from previous researches.

Data analysis

Ecological characteristics

The following formulas were used to measure individual basal area (BA) and volume (V) (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 diameter at breast height (cm), 'H' is tree height (m), and 'f' is form factor.

The importance value index (IVi) was used to determine the dominant species of community within the studied plots in (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 four diversity indices were analyzed to describe species diversity of standing trees in the studied plots. These diversity indices were 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):

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

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

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

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

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.

Economic literature

Data in Table 1 shows number of logs that produced from tree diameter up to 75 cm. Based on diameter class and number of logs could be known the equivalent merchantable height.

Table 1. Merchantable tree heights.

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
< 15	0.5	2.5*
15 – 30	1	5
+30 – 60	2	10
+60 – 75	3	15
75 ke atas	4	20

Source: * Primary data (2020); Forestry Department of Pinansular Malaysia (FDPM) (1997).

Reduction factor of log price was determined based on size class of DBH and its data can be seen in Table 2. This reserach used assumption if reduction factor of log price with size class of DBH < 15 cm is as many as 0.6.

Table 2. Reduction factor of log price.

DBH size class (cm)	Reduction factor
< 15	0.60*
15 – 29	0.45
30 – 44	0.30
45 – 49	0.15
50 – 54	0.025

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Furthermore, is the survey conducted at one specific land area and the subplots were established within this one single land rather than random location of various abandoned land and subplots were established at different locations? Please verify.

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≥ 55	0.00

Source: *Primary data (2020); Noor et al. (1992) and Hanum et al. (2001).

Profit ratio is determined as many as 30% according to Noor dan Shahwahid (1999). Equation of profit margin is as follows (Noor dan Shahwahid, 1999):

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

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);
j = an index for diameter class (i = 1, 2, 3, 4, ..., n).

Logging cost of *Eusideroxylon zwageri* spesies was USD102.04 m^{-3} in research location when research was done. Meanwhile, that of others spesies was USD68.03 m^{-3}. The exchange rate was 1 USD equal with 14,740 IDR at 8 October 2020. The equation of stumpage values is presented below:

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

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 = 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);
j = an index for diameter class (i = 1, 2, 3, 4, ..., n).

RESULTS AND DISCUSSION

Ecological Characteristics

Diameter at Breast Height (DBH) and Height Distributions

The diameter distribution in the research plot shows an inverted J shape where an increase in diameter class is followed by a decrease in the number of trees as illustrated in Figure 2. As much as 70 percent of the tree density is in the DBH class 5-15 cm. The number of trees in DBH class of 5.0-15.0 cm was 134 trees (70%), DBH class of 15.1-25.0 cm was 32 trees (17%), DBH class of 25.1-35.0 cm was 20 trees (10%), and DBH class of > 35.0 cm was 6 trees (3%). Meanwhile, most of the trees (59%) belong to the 5-10 cm height sized class as shown in Figure 3. The tree height classes were distributed in height size of 0.0-5.0 m (9 trees or 5%), 5.1-10.0 m (114 trees or 59%), 10.1-15.0 m (53 trees or 28%), and > 15 m (16 trees or 8%). In general, the diameter distribution of trees in secondary forest shows an inverted J-shape (Feldpausch et al., 2007; Álvarez-Yépiz et al., 2008) while the distribution of high class shows a skewed slightly positively (Ohtsuka, 1999). The The similar trends in trees diameter class and height class were also reported on abandoned land after cultivation (Karmini et al. 2020).

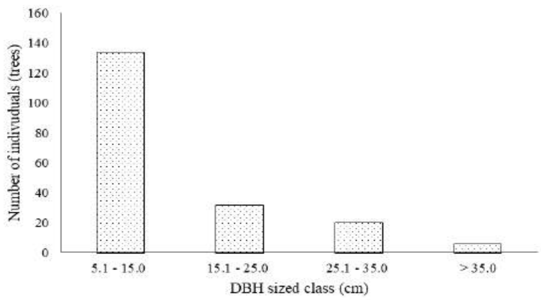

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Figure 2. Distributions of diameter at breast height (DBH) in 0.4 ha of abandoned land.

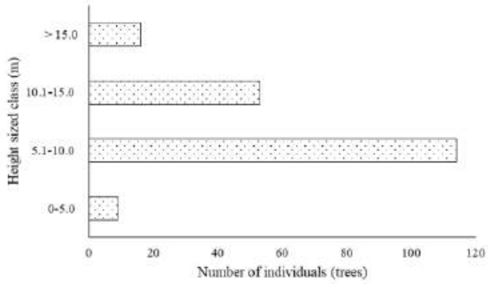

Figure 3. Distributions of height in 0.4 ha of abandoned land.

Density, Basal Area, and Volume

The number of individuals recorded in the research plot was 192 trees belonging to 29 species, 19 genera, and 17 families. There were 8 tree species belonging to the Moraceae, 5 tree species of Euphorbiaceae, and 2 tree species of Anacardiaceae. The other 14 families consisting of 1 tree species. The density, basal area, and volume of species in the study site were presented in Table 3. The DBH of trees in the study plots ranges from 6.4 to 29.1 cm with an average DBH of 16.3 cm. Meanwhile, the tree height ranges from 6.0-17.4 m with an average height of 10.4 m. The total BA and volume of trees in the study plot were 9.44 and 76.86, respectively. These values are smaller than the total BA (9.75) and the total volume (91.97) in abandoned land after cultivation (Karmini et al. 2020). The five dominant species based on total basal area and volume were *Macaranga tanarius* (total BA=0.91 m^2 ha^{-1} and volume=7.86 m^3 ha^{-1}), *Mangifera indica* (total BA=0.67 m^2 ha^{-1} and volume=7.49 m^3 ha^{-1}), *Nephelium lappaceum* (total BA=0.77 m^2 ha^{-1} and volume=6.37 m^3 ha^{-1}), *Macaranga triloba* (total BA=1.00 m^2 ha^{-1} and volume=6.05 m^3 ha^{-1}), and *Artocarpus integer* (total BA=0.62 m^2 ha^{-1} and volume=5.63 m^3 ha^{-1}). The common species in abandoned land were dominated by fast growing species, such as Macaranga spp, and Artocarpus spp. as also reported by Karyati et al. (2018) and Karmini et al. (2020). The recorded fruit trees showed that the studied plot included abandoned garden. These fruit species planted such as *Artocarpus integer* (Nangka), *Artocarpus lakoocha*, *Artocarpus anisophyllus* (Mentawa), *Artocarpus odoratissimus* (Terap), *Artocarpus tamaran*, *Artocarpus elasticus* (Benda), *Artocarpus heterophyllus* (Nangka), *Mangifera indica* (Mango), *Mangifera odorata* (Kuweni), *Durio zibethinus* (Durian), *Nephelium lappaceum* (Rambutan). Two tree species could not be identified in this study. *Durio zibethinus* and *Artocarpus odoratissimus* were included local trees.

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

No.	Species	Family	N	Average of DBH (cm)	Average of height (m)	Total of BA (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
1	*Macaranga tanarius*	Euphorbiaceae	13	18.3	12.0	0.91	7.86
2	*Mangifera indica*	Anacardiaceae	4	29.1	17.4	0.67	7.49
3	*Nephelium lappaceum*	Sapindaceae	12	15.0	9.5	0.77	6.37
4	*Macaranga triloba*	Euphorbiaceae	48	9.7	8.7	1.00	6.05
5	*Artocarpus integer*	Moraceae	4	26.4	14.0	0.62	5.63
6	*Trema orientalis*	Cannabaceae	8	16.6	13.8	0.51	5.51
7	*Artocarpus lakoocha*	Moraceae	3	28.2	15.5	0.47	4.74
8	*Artocarpus anisophyllus*	Moraceae	9	14.1	9.5	0.48	4.70
9	*Vernonia arborea*	Asteraceae	4	23.6	12.1	0.46	3.69
10	*Artocarpus odoratissimus*	Moraceae	5	21.2	9.6	0.48	3.22
11	*Homalanthus populneus*	Euphorbiaceae	7	12.4	8.2	0.35	2.69
12	*Mallotus paniculatus*	Euphorbiaceae	15	9.8	8.4	0.33	2.21
13	*Artocarpus tamaran*	Moraceae	2	22.0	11.5	0.23	2.06
14	*Ficus uncinata*	Moraceae	16	10.2	8.5	0.35	2.01
15	*Symplocos fasciculata*	Symplocaceae	5	16.5	7.1	0.31	1.74

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No.	Species	Family	N	Average of DBH (cm)	Average of height (m)	Total of BA (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
16	*Durio zibethinus*	Malvaceae	2	15.2	12.4	0.13	1.49
17	*Macaranga gigantea*	Euphorbiaceae	2	18.9	9.8	0.19	1.43
18	*Artocarpus elasticus*	Moraceae	4	15.2	8.4	0.23	1.43
19	*Archidendron pauciflorum*	Fabaceae	10	9.5	8.7	0.19	1.19
20	*Unknown species 1*	Unknown family 1	1	27.5	12.0	0.15	1.16
21	*Baccaurea parvifolia*	Phyllanthaceae	2	17.0	14.0	0.11	1.05
22	*Cratoxylum arborescens*	Hypericaceae	3	12.5	7.0	0.12	0.64
23	*Oroxylum indicum*	Bignoniaceae	2	13.7	11.3	0.08	0.60
24	*Couroupita guianensis*	Lecythidaceae	2	12.0	11.2	0.06	0.52
25	*Artocarpus heterophyllus*	Moraceae	2	13.2	11.1	0.07	0.50
26	*Unknown species 2*	Unknown family 2	1	18.5	10.0	0.07	0.44
27	*Eusideroxylon zwageri*	Lauraceae	2	11.8	6.0	0.05	0.21
28	*Alstonia scholaris*	Apocynaceae	3	7.9	7.4	0.04	0.20
29	*Mangifera odorata*	Anacardiaceae	1	6.4	7.3	0.01	0.04
	Total		192.0	472.5	302.3	9.44	76.86
	Average		6.6	16.3	10.4	0.33	2.65
	Minimum		1.0	6.4	6.0	0.01	0.04
	Maximum		48.0	29.1	17.4	1.00	7.86

Note : N = number of individuals (trees), DBH = diameter at breast height, BA = basal area.

Importance value index (IVi)

Most of the dominant trees based on importance value index (IVi) were also dominant trees based on total BA and volume. The light demanding pioneer and fast growing species dominate the studied site as shown in Table 4. The most dominant species in terms of IVi was *Macaranga triloba* (IVi of 46.16) followed by *Macaranga triloba* (IVi of 22.97), *Nephelium lappaceum* (IVi of 20.94), *Ficus uncinata* (IVi of 18.64), and *Mallotus paniculatus* (IVi of 17.93). Twelve of 29 species recorded had an IVi of more than 10.00 and 5 species of them had an IVi of 5.00-10.00. Meanwhile the other 12 species have an IVi of less than 5.00. Four dominant species of Euphorbiacea (*Macaranga triloba*, *Macaranga tanarius*, *Mallotus paniculatus*, and *Homalanthus populneus*) reached a total IVi of 99.72. These four species were included in the 10 most dominant types based on IVi. Similar results report that tree species from Euphorbiaceae are important and dominate tropical lands (Danquah et al. 2011; Nizam et al. 2006; Karyati et al. 2018; Karmini et al. 2020). The total IVi of 8 species including Moraceae reached 84.75. Moraceae is the family that has the most species in the research location.

Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.4 hectare of the study plot.

No.	Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
1	*Macaranga triloba*	Euphorbiaceae	25.00	10.53	10.63	46.16
2	*Macaranga tanarius*	Euphorbiaceae	6.77	6.58	9.62	22.97
3	*Nephelium lappaceum*	Sapindaceae	6.25	6.58	8.11	20.94
4	*Ficus uncinata*	Moraceae	8.33	6.58	3.72	18.64
5	*Mallotus paniculatus*	Euphorbiaceae	7.81	6.58	3.54	17.93
6	*Artocarpus anisophyllus*	Moraceae	4.69	6.58	5.11	16.37
7	*Trema orientalis*	Cannabaceae	4.17	5.26	5.44	14.87
8	*Artocarpus odoratissimus*	Moraceae	2.60	5.26	5.08	12.94
9	*Homalanthus populneus*	Euphorbiaceae	3.65	5.26	3.75	12.66
10	*Mangifera indica*	Anacardiaceae	2.08	2.63	7.05	11.77
11	*Artocarpus integer*	Moraceae	2.08	2.63	6.57	11.28
12	*Archidendron pauciflorum*	Fabaceae	5.21	3.95	2.07	11.22
13	*Vernonia arborea*	Asteraceae	2.08	2.63	4.84	9.56
14	*Artocarpus lakoocha*	Moraceae	1.56	2.63	4.99	9.19
15	*Symplocos fasciculata*	Symplocaceae	2.60	2.63	3.28	8.51
16	*Artocarpus elasticus*	Moraceae	2.08	2.63	2.46	7.18
17	*Artocarpus tamaran*	Moraceae	1.04	2.63	2.39	6.06
18	*Baccaurea parvifolia*	Phyllanthaceae	1.04	2.63	1.21	4.89
19	*Macaranga gigantea*	Euphorbiaceae	1.04	1.32	1.99	4.35
20	*Eusideroxylon zwageri*	Lauraceae	1.04	2.63	0.58	4.25
21	*Cratoxylum arborescens*	Hypericaceae	1.56	1.32	1.23	4.10
22	*Durio zibethinus*	Malvaceae	1.04	1.32	1.37	3.73
23	*Unknown species 1*	Unknown family 1	0.52	1.32	1.58	3.41
24	*Alstonia scholaris*	Apocynaceae	1.56	1.32	0.41	3.29
25	*Oroxylum indicum*	Bignoniaceae	1.04	1.32	0.81	3.16
26	*Artocarpus heterophyllus*	Moraceae	1.04	1.32	0.73	3.09
27	*Couroupita guianensis*	Lecythidaceae	1.04	1.32	0.66	3.02

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28	*Unknown species 2*	Unknown family 2	0.52	1.32	0.71	2.55
29	*Mangifera odorata*	Anacardiaceae	0.52	1.32	0.09	1.92
	Total		100	100	100	300

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

Species Diversity

The tree diversity index was categorized to 'intermediate' (*H*' of 1.33). This shows that there is a sufficient number of trees growing at the research location. A very complex community is indicated by a high diversity of species (Brower et al. 1990). Meanwhile, the dominance index was at low criteria with a *D*s value of 0.06. A low dominance value indicates that no species is dominant in the region. The evenness index was in the high category (*J*' value of 0.91). This category means that the presence of trees in the studied plots is evenly distributed. Evenness of plant species is determined by the diversity of species and the number of species present in the area. A species richness index of 5.33 showed that there were many tree species grow in the study site. However, there were 192 trees included in 29 tree species ecorded in the ~~research~~ studied plots of 0.4 ha. The species richness in a place is determined by the number of species and the density of the existing plants. Species richness is calculated based on the number of species in an area (Krebs, 2001). The results show that high diversity (H '), evenness (J'), and wealth (R) will lead to low dominance (Ds). The similar results were reported for the diversity indices for trees with DBH of > 5 cm on plots with an abandoned field age of 5, 10, 20 years (Karyati et al. 2018) and on abandoned land after cultivation (Karmini et al. 2020).

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

No.	Diversity indices	Value
1	Shannon-Wiener diversity index (*H*')	1.33
2	Simpson dominance index (D_s)	0.06
3	Pielou evenness index (*J'*)	0.91
4	Margalef species richness (*R*)	5.33

Note : The values were calculated according to the 10 subplots sized 20 m × 20 m each.

Economic Value

Log Price

The result of this research showed the abandoned land had 7 trees species with high log prices rather than 22 others tree spesies (Table 6). Their log prices were in the range from USD122.12 m^{-3} to USD651.29 m^{-3}. The log price is variety depends on the species and diameter class of log (Karmini et al., 2020). The highest wood price owned by *Eusideroxylon zwageri* species which reached USD1,085.48 m^{-3}. The wood price is influenced by wood demand in society, the higher demand leads the higher wood prices. *Eusideroxylon zwageri* has good quality of wood, people likely use this wood for contruction materials.

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

No.	Species	Family	Number (stems ha^{-1})	Log price (USD m^{-3})	Wood price (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	8	651.29	1,085.48
2	*Alstonia scholaris*	Apocynaceae	13	488.47	814.11
3	*Artocarpus anisophyllus*	Moraceae	38	447.76	814.11
4	*Oroxylum indicum*	Bignoniaceae	8	427.41	814.11
5	*Durio zibethinus*	Malvaceae	8	151.37	288.33
6	*Cratoxylum arborescens*	Hypericaceae	13	130.60	237.45
7	*Artocarpus heterophyllus*	Moraceae	8	122.12	203.53
8	*Artocarpus elasticus*	Moraceae	17	74.80	142.47
9	*Artocarpus lakoocha*	Moraceae	13	64.11	142.47
10	*Archidendron pauciflorum*	Fabaceae	42	79.38	135.69
11	*Nephelium lappaceum*	Sapindaceae	50	64.11	122.12
12	*Baccaurea parvifolia*	Phyllanthaceae	8	54.95	122.12
13	*Mangifera odorata*	Anacardiaceae	4	30.53	50.88
14	*Macaranga triloba*	Euphorbiaceae	200	30.37	50.88
15	*Ficus uncinata*	Moraceae	67	30.05	50.88
16	*Mallotus paniculatus*	Euphorbiaceae	63	29.51	50.88
17	*Homalanthus populneus*	Euphorbiaceae	29	28.35	50.88
18	*Symplocos fasciculata*	Symplocaceae	21	27.48	50.88
19	*Couroupita guianensis*	Lecythidaceae	8	26.71	50.88
20	*Trema orientalis*	Cannabaceae	33	26.71	50.88
21	*Macaranga gigantea*	Euphorbiaceae	8	26.71	50.88
22	*Macaranga tanarius*	Euphorbiaceae	54	25.83	50.88
23	*Artocarpus odoratissimus*	Moraceae	21	24.42	50.88
24	*Artocarpus tamaran*	Moraceae	8	22.90	50.88

25	*Artocarpus integer*	Moraceae	17	22.90	50.88
26	*Vernonia arborea*	Asteraceae	17	22.90	50.88
27	*Unknown species 1*	Unknown family 1	4	22.90	50.88
28	*Unknown species 2*	Unknown family 2	4	22.90	50.88
29	*Mangifera indica*	Anacardiaceae	17	20.99	50.88
Total			801	3,198.52	5,786.97
Mean			28	110.29	199.55

Source: Primary data (analyzed) (2020).

Logging Cost

The logging cost of *Eusideroxylon zwageri* species was highest rather than other spesies in abandoned land in this research as shown in Table 7. However, logging cost per hectare was determined by log volume therefore this research found difference logging cost per hectare among trees species. The total logging cost in abandoned land in this research (USD752.54 ha^{-1}) was lower compared to that in other research (USD1,212.24 ha^{-1}) (Karmini et al., 2020). This is relevant because the total log volume in abandoned land in this research location was as many as 76.86 m^3 ha^{-1} was lower rather than that in other research location reached as many as 91.97 m^3 ha^{-1}.

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Table 7. Logging cost of trees at abandoned land.

No.	Species	Family	Logging cost (USD ha^{-1})	Logging cost (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	7.51	101.76
2	*Artocarpus integer*	Moraceae	83.25	67.84
3	*Artocarpus tamaran*	Moraceae	74.43	67.84
4	*Mangifera indica*	Anacardiaceae	61.13	67.84
5	*Artocarpus lakoocha*	Moraceae	57.68	67.84
6	*Unknown species 1*	Unknown family 1	54.70	67.84
7	*Vernonia arborea*	Asteraceae	41.96	67.84
8	*Artocarpus odoratissimus*	Moraceae	34.25	67.84
9	*Macaranga gigantea*	Euphorbiaceae	33.42	67.84
10	*Nephelium lappaceum*	Sapindaceae	30.83	67.84
11	*Homalanthus populneus*	Euphorbiaceae	30.55	67.84
12	*Artocarpus anisophyllus*	Moraceae	27.55	67.84
13	*Unknown species 2*	Unknown family 2	23.49	67.84
14	*Macaranga tanarius*	Euphorbiaceae	23.29	67.84
15	*Durio zibethinus*	Malvaceae	23.22	67.84
16	*Trema orientalis*	Cannabaceae	21.35	67.84
17	*Baccaurea parvifolia*	Phyllanthaceae	21.01	67.84
18	*Artocarpus elasticus*	Moraceae	20.02	67.84
19	*Symplocos fasciculata*	Symplocaceae	19.38	67.84
20	*Cratoxylum arborescens*	Hypericaceae	12.23	67.84
21	*Oroxylum indicum*	Bignoniaceae	11.75	67.84
22	*Couroupita guianensis*	Lecythidaceae	10.18	67.84
23	*Artocarpus heterophyllus*	Moraceae	6.32	67.84
24	*Mallotus paniculatus*	Euphorbiaceae	5.73	67.84
25	*Ficus uncinata*	Moraceae	4.59	67.84
26	*Archidendron pauciflorum*	Fabaceae	4.45	67.84
27	*Macaranga triloba*	Euphorbiaceae	4.39	67.84
28	*Alstonia scholaris*	Apocynaceae	2.38	67.84
29	*Mangifera odorata*	Anacardiaceae	1.48	67.84
Total			752.54	2,001.36
Mean			25.95	69.01

Source: Primary data (analyzed) (2020).

Profit Margin

The wood sellers hope profit from their marketing activities, the 3 trees species contribute big profit margin, namely *Eusideroxylon zwageri*, *Alstonia scholaris*, and *Artocarpus anisophyllus*. Those also have the high of log and wood prices. This meant prices of buying and selling determine profit in marketing both log and wood. Data in Table 8 present profit margin of selling 29 trees species from abandoned land.

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Table 8. Profit margin.

No.	Species	Family	Profit margin (USD m^{-3} ha^{-1})	Profit margin (USD m^{-3})
1	*Eusideroxylon zwageri*	Lauraceae	626.24	150.30
2	*Alstonia scholaris*	Apocynaceae	469.68	112.72

No.	Species	Family	Profit margin	
			(USD m^{-3} ha^{-1})	(USD m^{-3})
3	*Artocarpus anisophyllus*	Moraceae	430.54	103.33
4	*Oroxylum indicum*	Bignoniaceae	410.97	98.63
5	*Durio zibethinus*	Malvaceae	145.55	34.93
6	*Cratoxylum arborescens*	Hypericaceae	125.57	30.14
7	*Artocarpus heterophyllus*	Moraceae	117.42	28.18
8	*Archidendron pauciflorum*	Fabaceae	76.32	18.32
9	*Artocarpus elasticus*	Moraceae	71.92	17.26
10	*Nephelium lappaceum*	Sapindaceae	61.65	14.79
11	*Artocarpus lakoocha*	Moraceae	61.65	14.79
12	*Baccaurea parvifolia*	Phyllanthaceae	52.84	12.68
13	*Mangifera odorata*	Anacardiaceae	29.35	7.05
14	*Macaranga triloba*	Euphorbiaceae	29.20	7.01
15	*Ficus uncinata*	Moraceae	28.90	6.94
16	*Mallotus paniculatus*	Euphorbiaceae	28.38	6.81
17	*Homalanthus populneus*	Euphorbiaceae	27.26	6.54
18	*Symplocos fasciculata*	Symplocaceae	26.42	6.34
19	*Trema orientalis*	Cannabaceae	25.69	6.16
20	*Couroupita guianensis*	Lecythidaceae	25.69	6.16
21	*Macaranga gigantea*	Euphorbiaceae	25.69	6.16
22	*Macaranga tanarius*	Euphorbiaceae	24.84	5.96
23	*Artocarpus odoratissimus*	Moraceae	23.48	5.64
24	*Artocarpus tamaran*	Moraceae	22.02	5.28
25	*Artocarpus integer*	Moraceae	22.02	5.28
26	*Vernonia arborea*	Asteraceae	22.02	5.28
27	*Unknown species 1*	Unknown family 1	22.02	5.28
28	*Unknown species 2*	Unknown family 2	22.02	5.28
29	*Mangifera indica*	Anacardiaceae	20.18	4.84
Total			3,075.50	738.12
Mean			106.05	25.45

Source: Primary data (analyzed) (2020).

Stumpage Value

The total stumpage value at the abandoned land was estimated as much as USD1,495.31 ha^{-1}. There 29 trees species has identified and each species contibutes an average of USD51.56 ha^{-1}. Figure 1 describes the highest stumpage value was from *Artocarpus anisophyllus* species as much as USD168.97 ha^{-1} and the lowest stumpage value was contributed by *Mangifera odorata* spesies as much as USD2.29 ha^{-1}.

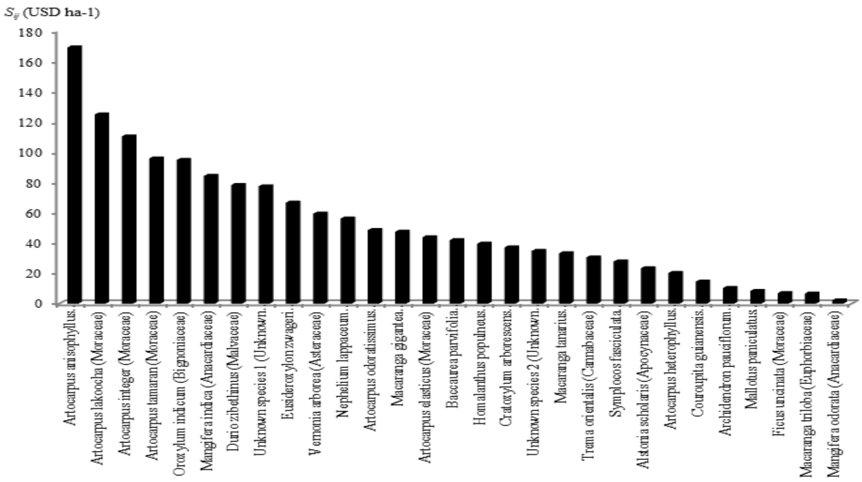

Figure 4. Stumpage value of trees at abandoned land.

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ACKNOWLEDGEMENTS

The authors would like to express their gratitude and highest appreciation to the Ministry of Education and Culture, the Republic of Indonesia for financial the support by *Hibah Penelitian Dasar Unggulan Perguruan Tinggi* Contract No.: 183/SP2H/AMD/LT/DRPM/2020 for this research.

REFERENCES

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Afdalis. 2016. Abandonment of Property Rights. [Thesis]. Fakultas Hukum Universitas Hasanuddin, Makassar. [Indonesia]

Álvarez-Yépiz JC, Martínez-Yrízar A, Búrquez A, Lindquist C. 2008. Variation in vegetation structure and soil properties related to land use history of old-growth and secondary tropical dry forests in Northwestern Mexico. Forest Ecology and Management 256: 355-366. doi: https://doi.org/10.1016/j.foreco.2008.04.049

Aththorick TA, Setiadi D, Purwanto Y, Guhardja Y. 2012. Vegetation stands structure and aboveground biomass after the shifting cultivation practices of Karo People in Leuser Ecosystem, North Sumatra. Biodiversitas 13(2): 92-97.

Danquah JA, Appiah M, Ari P. 2011. Comparison of post-fire planted and natural dry semideciduous forest communities in Ghana. African Journal of Agricultural Research 6(23): 5266- 5277. doi: https://doi.org/10.5897/AJAR11.820.

Dumais RO. 2014. Legal arrangements for the existence of abandoned land in Indonesia. Lex et Societatis, II(5). https://ejournal.unsrat.ac.id/index.php/lexetsocietatis/article/vie wFile/4890/4415.

Fachrul MF. 2007. Bioecology Sampling Method. Bumi Aksara, Jakarta. [Indonesian]

Feldpausch TR, Prates-Clark CC, Fernandes ECM, Riha SJ. 2007. Secondary forest growth deviation from chronosequence predictions in Central Amazonia. Global Change Biology 13: 967-979. doi: https://doi.org/10.1111/j.1365-2486.2007.01344.x

Husch B, Miller CI, Beers TW. 1982. Forest Mensuration. John Wiley and Sons Publishing, New York.

Karmini, Karyati, Widiati KY. 2020. The role of tropical abandoned land relative to ecological and economic aspects. Forest and Society 4(1): 181-194.

Karyati, Ipor IB, Jusoh I, Wasli ME, Seman IA. 2013. Composition and diversity of plant seedlings and saplings at early secondary succession of fallow lands in Sabal, Sarawak. Acta Biologica Malaysiana 2(3), 85-94. doi: http://dx.doi.org/10.7593/abm/2.3.85

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

Klanderud K, Mbolatiana HZH, Vololomboahangy MN, Radimbison MA, Roger E, Totland O, Rajeriarison C. 2010. Recovery of plant species richness and composition after slash-and-burn agriculture in a tropical rainforest in Madagascar. Biodivers Conserv 19:187-204. DOI 10.1007/s10531-009-9714-3

Kuntz KA, Beaudry F, Porter KL. 2018. Farmers' perceptions of agricultural land abandonment in rural western New York State. Land 7(128): 1-11.

Nizam MS, Norziana J, Sahibin AR, Latiff A. 2006. Edaphic relationships among tree species in the National Park at Merapoh, Pahang, Malaysia. Jurnal Biosains 17(2): 37-53.

Nurlinda I, Pujiwati Y, Ishak M. 2014. Comparison of the handling of abandoned land in Tasikmalaya Regency and Sukabumi Regency in realizing food security in West Java Province. Jurnal Hukum IUS Quia Iustum 21(1): 120-138. [Indonesian]

Odum PE. 2005. Fundamentals of Ecology, 5th Ed. Thomson Brooks/Cole, Belmont CA.

Ohtsuka T. 1999. Early stages of secondary succession on abandoned cropland in north-east Borneo island. Ecological Research 14: 281-290. doi: https://doi.org/10.1046/j.1440- 1703.1999.143304.x

Permana EY. 2012. Peralihan Hak Atas Tanah Akibat Tanah Terantar (Studi Kasus Terhadap Keputusan Kepala Badan Pertanahan Nasional Republik Indonesia Nomor 10/PTT-HGU/BPN RI/2012). Tersedia di laman https://media.neliti.com/media/publications/34172-ID-peralihan-hak-atas-tanah-akibat-tanah-terlantar-studi-kasus-terhadap-keputusan-k.pdf. Diakses pada 25 Mei 2017.

Setiawan AD. 2010. Review: Biodiversity conservation strategy in a native perspective; case study of shifting cultivation at the Dayaks of Kalimantan. Bioscience 2(2): 97-108.

Yirdaw E, Monge AM, Austin A, Toure I. 2019. Recovery of foristic diversity, composition and structure of regrowth forests on fallow lands: implications for conservation and restoration of degraded forest lands in Laos. New Forests, 50:1007–1026. https://doi.org/10.1007/s11056-019-09711-2

Zambon I, Serra P, Salvia P, Salvati L. 2018. Fallow land, recession and socio-demographic local contexts: Recent dynamics in a mediterranean urban fringe. Agriculture 8(159): 1-17.

Dear Managing Editor,

Bersama ini kami sampaikan beberapa perbaikan pada manuskrip terlampir.
The comment on review of manuscript dengan :
Judul asli : “The existence of fallow land in the tropic from an ecology and economic perspectives”
Judul yang direvisi : “The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province”

No. Comments	**Page/Line**	**Review**	**Feedback and revision**
Reviewer A			
	Artikel	Perubahan judul dan perbaikan/revisi kalimat.	Kami menerima dengan terbuka dan sangat berterima kasih atas saran-saran dan perbaikan yang telah diberikan terhadap keseluruhan artikel ini.
1	Introduction, hal. 1, baris 42-45	Dua kalimat ini agak bertentangan, kecuali dalam aspek carbon stock. Sementara carbon stock tidak dibahas dalam artikel ini. Artikel ini hanya membahas nilai ekologi dan ekonomi, sama dengan yang sudah dilakukan sebelumnya. Saya sarankan penulis menambahkan beberapa kalimat yang menunjukkan kebaruan artikel ini.	Kami telah mengganti dua kalimat ini sesuai saran yang diberikan.
2	Results and Discussion, Figure 3, hal. 4	Sebaiknya disain grafik disamakan dengan Figure 2.	Disain grafik Figure 3 telah disamakan dengan Figure 2.
3	Results and Discussion, Table 6, hal. 7	Mungkin perlu diganti dengan timber. Wood adalah kayu dalam arti substansi/material penyusun batang pohon, sedangkan timber adalah kayu yang diproses untuk konstruksi.	Kata “wood” telah diganti menjadi “timber”.
4	References, hal. 10	References yang tidak lagi digunakan perlu dihapus.	References sudah disesuaikan.
5	References, hal. 10	Odum PE. 2005. Seharusnya Odum EP. 2005.	Telah direvisi.
Reviewer B			
1	Abstract, hal 1, baris 11-12	Paraphrase these sentences to provide much clearer justification of this research work. i.e. Abandoned farmland often neglected of its ecological and economic values.... What is the definition of plantation activities? Commercial plantation or smallholder-based farmland. The impact of different types of abandoned plantation will provide different consequences on its ecological and economic value.	Kalimat ini telah direvisi.
2	Abstract, hal. 1, baris 15-16	What would be the estimated age after abandonment of these selected sites? Were these abandoned land form after similar past land uses?	Informasi tentang umur lahan terbiarkan dan bentuk penggunaan lahan sebelumnya kami tambahkan pada bagian Study Site (hal. 2, baris 52-54).
3	Introduction, hal. 1, baris 27	Paraphrase this statement.	Kalimat ini telah direvisi.
4	Introduction, hal. 1, baris 27	Only richness? How about composition?	Kalimat ini telah direvisi.

No. Comments	Page/Line	Review	Feedback and revision
5	Introduction, hal. 1, baris 38-39	Abandoned land? And declared abandoned land? Paraphrase this sentence to provide simple and clear logic.	Kalimat ini telah direvisi.
6	Introduction, hal. 1, baris 39	Provide a clear timeline on the rate of increment in abandoned land in Indonesia i.e. From 2007 xxxha of abandoned land had been reported. In 2011, the abandoned land area has expanded to...xxxha...	Kalimat ini telah direvisi.
7	Introduction, hal. 2, baris 50-55	I think this parts needs paraphrasing for better explanation on the justification and importance of this study.	Kalimat ini telah direvisi.
8	Material and methods, hal. 2, baris 58	Only at one location? The term “fallow” often associated to land abandoned after slash and burn farming. In the case of your study, can it be assumed that the abandoned land that you are referring in this study are fallow land after slash and burn activities?	Kalimat ini telah direvisi.
9	Material and methods, hal. 3, baris 101-102	Do these selected plots possess similar land use history? Elaborate in brief the land use history of the selected study plots i.e post shifting cultivation land, previous cultivation history, etc Furthermore, is the survey conducted at one specific land area and the subplots were established within this one single land rather than random location of various abandoned land and subplots were established at different locations? Please verify.	Informasi tentang sejarah penggunaan lahan telah kami tambahkan pada bagian Study Site (hal. 2, baris 52-54). Informasi tentang letak plot telah ditambahkan (hal. 2, baris 99).
10	Material and methods, hal 3, baris 102-103	Include reference where you adapted the method for vegetation survey here.	Informasi telah ditambahkan.
11	Material and methods, hal 3, baris 106	You can include the reference of the past studies here.	Referensi telah ditambahkan.
12	Material and methods, hal. 3, baris 124	State the reference	Narasi telah disesuaikan.
13	Material and methods, hal. 3, baris 124	Not included in the reference list	Referensi telah ditambahkan.
14	Material and methods, hal. 4, baris 132	Not listed in the reference list	Referensi telah ditambahkan.
15	Material and methods, hal. 4, baris 133	Not in reference list	Referensi telah ditambahkan.
16	Material and methods, hal. 4, baris 143-153	So, this equation is only used for estimating the logging cost of *Eusideroxylon zwageri* only? Or can it be applicable for logging cost of other timber species? Please verify.	Kalimat telah direvisi.
17	Results and Discussion, hal. 4, baris 158	If this value is not stated or presented in the Figure, avoid using specific values to explain the trend of your results.	Kalimat telah dihapus.
18	Results and	Density or number of tree stand?	Kalimat telah dihapus.

No. Comments	Page/Line	Review	Feedback and revision
	Discussion, hal. 4, baris 158		
19	Results and Discussion, hal. 5, baris 219	Italic the scientific names of plant species	Penulisan jenis tumbuhan (cetak miring) telah direvisi.
20	Results and Discussion, hal. 5, baris 223-224	Can it be identified even at Family level?	Dua jenis yang tidak diketahui berhasil diidentifikasi yaitu *Glochidion obscurum* (Pyllantaceae) dan *Mangifera* sp. (Anacardiaceae). Penyesuaian jenis pada teks dan tabel terhadap dua jenis ini telah dilakukan.
21	Results and Discussion, hal. 5, baris 224	I do not understand this statement	Kalimat telah direvisi.
22	Results and Discussion, hal. 6, baris 235	Euphorbiaceae	Kata telah direvisi.
23	Results and Discussion, hal. 6, baris 238	Dominate tropical land in general or, fallow land?	Kalimat telah direvisi.
24	Results and Discussion, hal 7, baris 249-250	This sentence – not necessary as it was already explained in the Methodology section on what is the definition of Species Evenness.	Kalimat telah dihapus.
25	Results and Discussion, hal. 7, baris 250-251	High number of tree stand exiting in the study sites.	Kalimat telah direvisi sesuai saran yang diberikan.
26	Results and Discussion, hal. 7, baris 251	recorded	Telah direvisi menjadi “recorded”.
27	Results and Discussion, hal. 7, baris 252	??	Kalimat telah direvisi.
28	Results and Discussion, hal. 7, baris 252-253	This sentence – not necessary as it was already explained in the Methodology section	Kalimat telah dihapus.
29	Results and Discussion, hal 7, baris 256	Shifting cultivation?	Kalimat telah direvisi.
30	Results and Discussion, hal. 8, baris 277-279	Revise this sentence to provide clear logic of your explanation	Kalimat telah direvisi.
31	Results and Discussion, hal. 8, baris 286	Revise this sentence.	Kalimat telah direvisi.
32	Reference, hal. 10	Please recheck the reference list I find some in-text citation were missing in the reference list	References telah disesuaikan dengan teks.

Samarinda, 31 Oktober 2020

Karyati

BIODIVERSITAS
Volume 21, Number 11, November 2020
Pages: xxxx

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d2111xx

Short Communication: The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province, Indonesia

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Manuscript received: xxx. Revision accepted: xxx October 2020.

Abstract. *Karmini, Karyati, Widiati KY. 2020. Short Communication: The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province, Indonesia. Biodiversitas 21: xxxx.* There is a large area of abandoned land in East Kalimantan Province. These abandoned traditional gardens which have been neglected for a long time have important ecological and economic values. This study aimed to assess the ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province. The ecological aspects assessed were stand structure, floristic composition, and species diversity. Meanwhile, the economic aspects analyzed were log price, harvesting cost, profit margin, and stumpage value. The vegetation survey was carried out on all woody trees with a diameter at breast height (DBH) $\geq$ 5 cm in 10 subplots, each measuring 20 m × 20 m. A total of 192 trees were recorded, belonging to 29 species, 19 genera and 17 families. The most dominant species were *Macaranga triloba* (Importance Value, IV of 46.16), *Macaranga tanarius* (IV of 22.97), and *Nephelium lappaceum* (IV of 20.94). The indexes of diversity, dominance, evenness, and richness in the studied plots were 1.33, 0.06, 0.40, and 5.33, respectively. The means of wood price, logging cost, profit margin, and stumpage value of the secondary forest were USD199.55 m^{-3}, USD69.01 m^{-3}, USD25.45 m^{-3}, and USD51.56 ha^{-1}, respectively. This study confirmed that the abandoned land had high ecological and economic values.

Keywords: Abandoned land, diversity, fallow land, stumpage value, tropic

INTRODUCTION

In East Kalimantan Province there is about 3 million hectares of abandoned land, consisting mainly of former coal mining land and fallow land of the shifting cultivation system which is no longer cultivated by the owners. The indigenous Dayak tribe usually replanted the land after rice harvesting with multipurpose species, such as fruit trees, rattan, and bamboo. Over time, the abandoned land will turn into secondary forest due to succession. After decades, the species richness and composition in the regrowth forests can approach old forest which can serve as biodiversity repositories (Karyati et al. 2018; Yirdaw et al. 2019).

The time required for vegetation recovery to original forest characteristics is influenced by several factors such as type of land use, cycle duration, and large cleared patches (Aththorick et al. 2012). The pioneer plant species dominate abandoned land indicated by an intermediate diversity, a low dominance index, and a high evenness index (Karmini et al. 2020; Karyati et al. 2013; Karyati et al. 2018). The rate of succession and thus the restoration of soil on abandoned land can be accelerated through plantation programs. These activities can reduce the expansion of forest conversion into cultivated areas (Klanderud et al. 2010).

Also, forest planting has an important role in providing ecological, economic, religious, and cultural functions of the secondary forest (Setiawan 2010). The average stumpage value in abandoned land was calculated to be 83.05 USD ha^{-1} and the total value 2,159.36 USD ha^{-1} (Karmini et al. 2020).

The calculation of the potential economic value of timber and non-timber forest products that can be used as onstruction materials for buildings or furniture will illustrate the potential income that might be achieved from managing abandoned land. Most of the previous studies reported information on the ecological and economic value of abandoned lands separately. The previous similar study reported the ecological and economic value of abandoned land where the previous land use was shifting cultivation (Karmini et al. 2020). However, study that provides comprehensive information on the ecological and economic value of abandoned land after being used as traditional gardens in the tropics is still very limited. The objectives of the study were to assess the ecological and economic values of secondary forest on abandoned land. The findings are expected to be used as the basis to make recommendation in managing the abandoned land in East Kalimantan and in other tropical areas.

MATERIALS AND METHODS

Study site

The research was carried out on a land area of abandoned traditional garden in Bukit Pinang area, in

Samarinda Ulu Subdistrict, Samarinda City, East Kalimantan Province, Indonesia. The research plot is located on land which is a traditional garden that has been left for more than 44 years based on land owner confirmation. The previous similar land use type of traditional gardening on this land was also reported based on interviews with land owners. The boundaries of the area are Kutai Kartanegara district at north, Samarinda Utara district at east, Air Putih Subdistrict at south, and Sungai Kunjang district at west. Samarinda City is the capital of East Kalimantan Province, Indonesia and the city with the largest population in the entire island of Kalimantan. The population of Samarinda is 812,597 people. Samarinda has an area of 718 km^2 with a hilly geographical condition with altitudes varying from 10 to 200 meters above sea level. Samarinda City is divided by Mahakan river and becomes the gateway to the area around by river, land, and air. The research plot lies at the coordinate points of 0°25′32.8″S 117°05′56.8″E (Figure 1).

Procedures

Data collection

The vegetation survey was conducted from March to September 2020. A total of 10 subplots, each measuring 20 m × 20 m, were established in the study site (Fachrul 2007; Kusmana 2017). Sub plots were established within a same abandoned land. All woody trees with a diameter at breast height (DBH) of ≥ 5 cm were measured for diameter and height, and their species were identified. The secondary data were obtained from reports and articles from previous researches (Forestry Department of Peninsular Malaysia (FDPM) (1997); Hanum et al. 2001; Noor et al. 1992; Noor and Shahwahid 1999).

Data analysis

Ecological characteristics

The following formulas were used to measure individual basal area (BA) and volume (V) (Husch et al. 1982):

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

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

Where: DBH is diameter at breast height (cm), ‘H’ is tree height (m), and ‘f’ is form factor.

The importance value index (IVi) was used to determine the dominant species of community within the studied plots in (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.

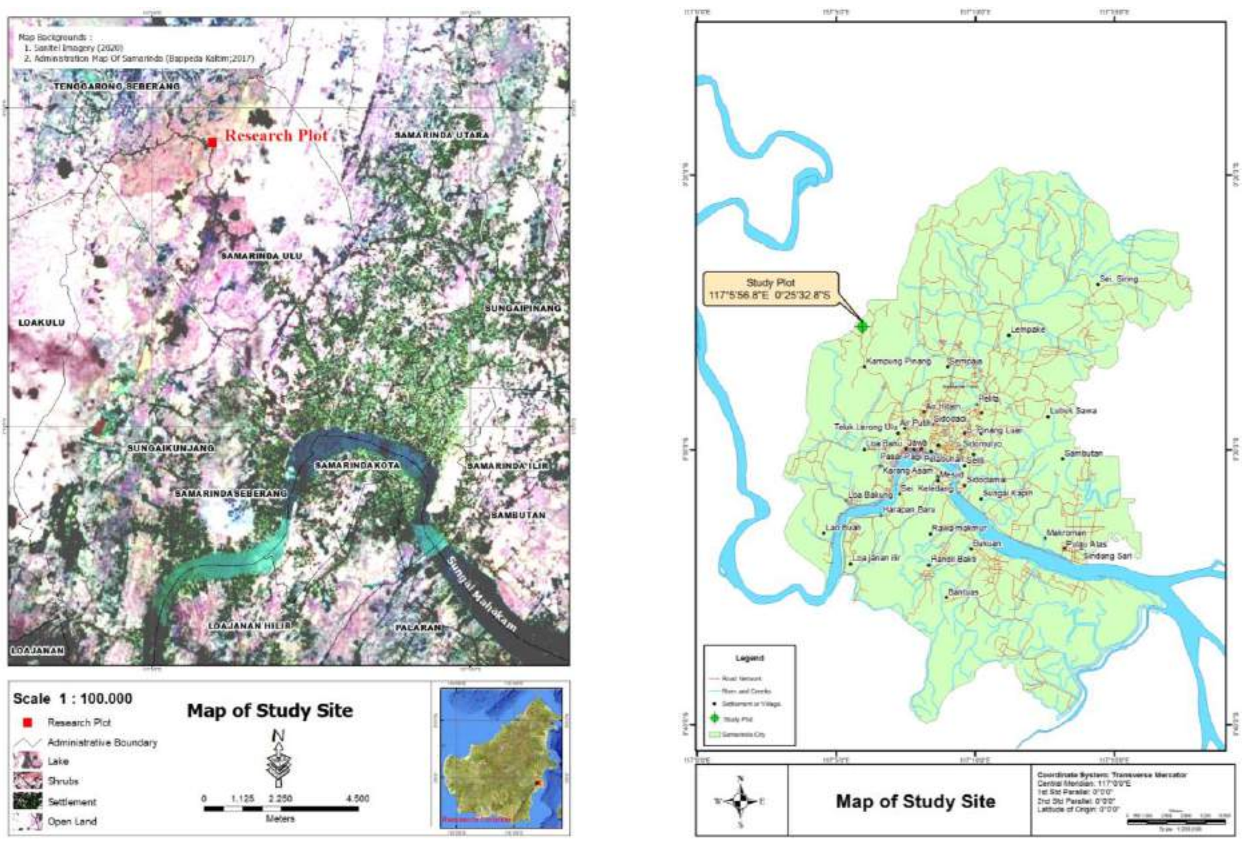

Figure 1. Map of study site in Bukit Pinang area, in Samarinda Ulu Subdistrict, Samarinda City, East Kalimantan Province, Indonesia

BIODIVERSITAS ISSN: 1412-033X
Volume 21, Number 11, November 2020 E-ISSN: 2085-4722
Pages: xxxx DOI: 10.13057/biodiv/d2111xx

The four diversity indices were analyzed to describe species diversity of standing trees in the studied plots. These diversity indices were Shannon-Wiener's diversity index (*H'*), Simpson's dominance index (D_s), Pielou's evenness index (*J'*), and Margalef's richness index (*R*) (Odum and Barrett 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.

Economic literature

Data in Table 1 shows number of logs that produced from tree diameter up to 75 cm. Based on diameter class and number of logs, the equivalent merchantable height was determined.

Reduction factor of log price was determined based on size class of DBH (Table 2). This research used assumption that the reduction factor of log price with size class of DBH < 15 cm was 0.6.

Profit ratio was fixed at 30% according to Noor and Shahwahid (1999).

Equation of profit margin was calculated as follows (Noor and Shahwahid, 1999):

Table 1. Merchantable tree heights

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
< 15	0.5	2.5*
15 - 30	1	5
+30 - 60	2	10
+60 - 75	3	15
75 ke atas	4	20

Note: *Analyzed data; FDPM (Forestry Department of Peninsular Malaysia) (1997)

Table 2. Reduction factor of log price

DBH size class (cm)	Reduction factor
< 15	0.60*
15 - 29	0.45
30 - 44	0.30
45 - 49	0.15
50 - 54	0.025
≥ 55	0.00

Note: *Analyzed data; Noor et al. (1992) and Hanum et al. (2001)

$$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij}\, xPR)/(1+PR) \quad (11)$$

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);
j : an index for diameter class (i = 1, 2, 3, 4, ..., n).

Logging cost of all species was USD68.03 m^{-3} (except logging cost of *Eusideroxylon zwageri* was USD102.04 m^{-3}) in research location when the research was done. The exchange rate of 1 USD was 14,740 IDR on 8 October 2020. The equation of stumpage values is presented below:

$$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij} + C + PM) \quad (12)$$

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 : 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);
j : an index for diameter class (i = 1, 2, 3, 4, ..., n).

RESULTS AND DISCUSSION

Ecological characteristics

Diameter at Breast Height (DBH) and height distributions

The diameter distribution in the research plots shows an inverted J shape where an increase in diameter class is followed by a decrease in the number of trees (Figure 2). The number of trees in the DBH class of 5.0-15.0 cm was 134 (70%), the DBH class of 15.1-25.0 cm 32 (17%), the DBH class of 25.1-35.0 cm 20 (10%), and the DBH class of > 35.0 cm 6 (3%). Meanwhile, most of the trees (59%) belong to the 5-10 cm height class (Figure 3). The tree heights were distributed in height classes of 0.0-5.0 m (9 trees or 5%), 5.1-10.0 m (114 trees or 59%), 10.1-15.0 m (53 trees or 28%), and > 15 m (16 trees or 8%). In general, the diameter distribution of trees in secondary forest has an inverted J-shape (Feldpausch et al., 2007; Álvarez-Yépiz et al., 2008) while the distribution of height class is slightly positively skewed (Ohtsuka, 1999). The The similar trends in trees diameter class and height class were also reported on abandoned land after cultivation (Karmini et al. 2020).

Density, basal area, and volume

The number of individuals recorded in the research plots was 192 trees, belonging to 29 species, 19 genera, and

17 families. There were 8 tree species of Moraceae, 5 tree species of Euphorbiaceae, 3 tree species of Anacardiaceae, and 2 tree species of Phyllanthaceae. Each of the other 11 families consisted of 1 tree species. The density, basal area, and volume of species in the study site are presented in Table 3. The DBH of trees in the study plots ranged from 6.4 cm to 29.1 cm with an average DBH of 16.3 cm. Meanwhile, the tree height ranged from 6.0 m to17.4 m with an average height of 10.4 m. The total BA and volume of trees in the study plot were 9.44 and 76.86, respectively. These values are smaller than the total BA (9.75) and the total volume (91.97) in abandoned land after cultivation (Karmini et al. 2020).

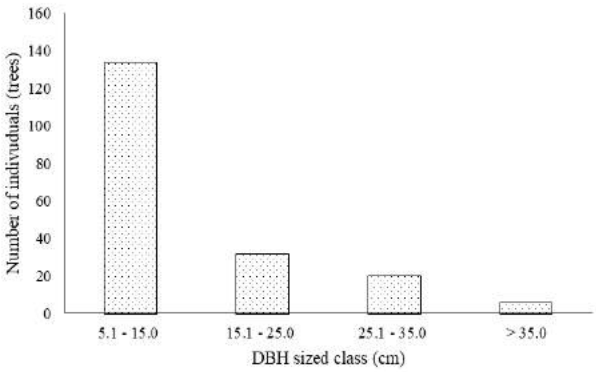

Figure 2. Distribution of diameter at breast height (DBH) in 0.4 ha at the study plot

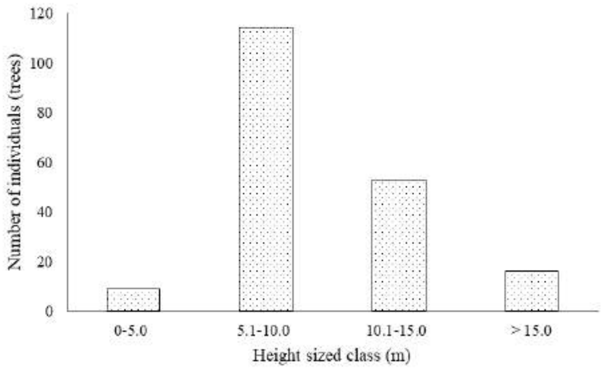

Figure 3. Distribution of height in 0.4 ha at the study plot

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

Species	Family	N	Average of DBH (cm)	Average of height (m)	Total of BA (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
Macaranga tanarius	Euphorbiaceae	13	18.3	12.0	0.91	7.86
Mangifera indica	Anacardiaceae	4	29.1	17.4	0.67	7.49
Nephelium lappaceum	Sapindaceae	12	15.0	9.5	0.77	6.37
Macaranga triloba	Euphorbiaceae	48	9.7	8.7	1.00	6.05
Artocarpus integer	Moraceae	4	26.4	14.0	0.62	5.63
Trema orientalis	Cannabaceae	8	16.6	13.8	0.51	5.51
Artocarpus dadah	Moraceae	3	28.2	15.5	0.47	4.74
Artocarpus anisophyllus	Moraceae	9	14.1	9.5	0.48	4.70
Vernonia arborea	Asteraceae	4	23.6	12.1	0.46	3.69
Artocarpus odoratissimus	Moraceae	5	21.2	9.6	0.48	3.22
Homalanthus populneus	Euphorbiaceae	7	12.4	8.2	0.35	2.69
Mallotus paniculatus	Euphorbiaceae	15	9.8	8.4	0.33	2.21
Artocarpus tamaran	Moraceae	2	22.0	11.5	0.23	2.06
Ficus uncinata	Moraceae	16	10.2	8.5	0.35	2.01
Symplocos fasciculata	Symplocaceae	5	16.5	7.1	0.31	1.74
Durio zibethinus	Malvaceae	2	15.2	12.4	0.13	1.49
Macaranga gigantea	Euphorbiaceae	2	18.9	9.8	0.19	1.43
Artocarpus elasticus	Moraceae	4	15.2	8.4	0.23	1.43
Archidendron pauciflorum	Fabaceae	10	9.5	8.7	0.19	1.19
Glochidion obscurum	Phyllanthaceae	1	27.5	12.0	0.15	1.16
Baccaurea parvifolia	Phyllanthaceae	2	17.0	14.0	0.11	1.05
Cratoxylum arborescens	Hypericaceae	3	12.5	7.0	0.12	0.64
Oroxylum indicum	Bignoniaceae	2	13.7	11.3	0.08	0.60
Couroupita guianensis	Lecythidaceae	2	12.0	11.2	0.06	0.52
Artocarpus heterophyllus	Moraceae	2	13.2	11.1	0.07	0.50
Mangifera sp.	Anacardiaceae	1	18.5	10.0	0.07	0.44
Eusideroxylon zwageri	Lauraceae	2	11.8	6.0	0.05	0.21
Alstonia scholaris	Apocynaceae	3	7.9	7.4	0.04	0.20
Mangifera odorata	Anacardiaceae	1	6.4	7.3	0.01	0.04
Total		192.0	472.5	302.3	9.44	76.86
Average		6.6	16.3	10.4	0.33	2.65
Minimum		1.0	6.4	6.0	0.01	0.04
Maximum		48.0	29.1	17.4	1.00	7.86

Note: N: number of individuals (trees), DBH: diameter at breast height, BA: basal area

The five dominant species based on total basal area and volume were *Macaranga tanarius* (total BA=0.91 m^2 ha^{-1} and volume=7.86 m^3 ha^{-1}), *Mangifera indica* (total BA=0.67 m^2 ha^{-1} and volume=7.49 m^3 ha^{-1}), *Nephelium lappaceum* (total BA=0.77 m^2 ha^{-1} and volume=6.37 m^3 ha^{-1}), *Macaranga triloba* (total BA=1.00 m^2 ha^{-1} and volume=6.05 m^3 ha^{-1}), and *Artocarpus integer* (total BA=0.62 m^2 ha^{-1} and volume=5.63 m^3 ha^{-1}). The common species in abandoned land were dominated by fast growing species, such as *Macaranga* spp. and *Artocarpus* spp. as also reported by Karyati et al. (2018) and Karmini et al. (2020). The recorded fruit trees showed that the studied plot was abandoned garden. These fruit species planted were *Artocarpus anisophyllus* (Mentawa), *Artocarpus elasticus* (Benda), *Artocarpus heterophyllus* (Nangka), *Artocarpus integer* (Cempedak), *Artocarpus odoratissimus* (Terap), *Mangifera indica* (Mangga), *Mangifera odorata* (Kuweni), *Durio zibethinus* (Durian), and *Nephelium lappaceum* (Rambutan). *Artocarpus odoratissimus* is a native tree species, while *Artocarpus tamaran* is an endemic tree species.

Importance value index (IVi)

Most of the dominant trees based on importance value index (IVi) were also dominant trees based on total BA and volume. The light demanding pioneer and fast growing species dominated the studied site (Table 4). The most dominant species in terms of IVi was *Macaranga triloba* (IVi of 46.16) followed by *Macaranga triloba* (IVi of 22.97), *Nephelium lappaceum* (IVi of 20.94), *Ficus uncinata* (IVi of 18.64), and *Mallotus paniculatus* (IVi of 17.93). Twelve of 29 species recorded had an IVi of more than 10.00 and 5 species of them had an IVi of 5.00-10.00. Meanwhile the other 12 species had an IVi of less than 5.00. Four dominant species of Euphorbiaceae (*Macaranga triloba*, *Macaranga tanarius*, *Mallotus paniculatus*, and *Homalanthus populneus*) reached a total IVi of 99.72. These four species were included in the 10 most dominant types based on IVi. Similar studies also reported that tree species from Euphorbiaceae were important and dominating tropical fallow lands (Karyati et al. 2018; Karmini et al. 2020). The total IVi of 8 species including Moraceae reached 84.75. Moraceae was the family that had the most species in the research location.

Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.4 hectare of the study plots

Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
Macaranga triloba	Euphorbiaceae	25.00	10.53	10.63	46.16
Macaranga tanarius	Euphorbiaceae	6.77	6.58	9.62	22.97
Nephelium lappaceum	Sapindaceae	6.25	6.58	8.11	20.94
Ficus uncinata	Moraceae	8.33	6.58	3.72	18.64
Mallotus paniculatus	Euphorbiaceae	7.81	6.58	3.54	17.93
Artocarpus anisophyllus	Moraceae	4.69	6.58	5.11	16.37
Trema orientalis	Cannabaceae	4.17	5.26	5.44	14.87
Artocarpus odoratissimus	Moraceae	2.60	5.26	5.08	12.94
Homalanthus populneus	Euphorbiaceae	3.65	5.26	3.75	12.66
Mangifera indica	Anacardiaceae	2.08	2.63	7.05	11.77
Artocarpus integer	Moraceae	2.08	2.63	6.57	11.28
Archidendron pauciflorum	Fabaceae	5.21	3.95	2.07	11.22
Vernonia arborea	Asteraceae	2.08	2.63	4.84	9.56
Artocarpus dadah	Moraceae	1.56	2.63	4.99	9.19
Symplocos fasciculata	Symplocaceae	2.60	2.63	3.28	8.51
Artocarpus elasticus	Moraceae	2.08	2.63	2.46	7.18
Artocarpus tamaran	Moraceae	1.04	2.63	2.39	6.06
Baccaurea parvifolia	Phyllanthaceae	1.04	2.63	1.21	4.89
Macaranga gigantea	Euphorbiaceae	1.04	1.32	1.99	4.35
Eusideroxylon zwageri	Lauraceae	1.04	2.63	0.58	4.25
Cratoxylum arborescens	Hypericaceae	1.56	1.32	1.23	4.10
Durio zibethinus	Malvaceae	1.04	1.32	1.37	3.73
Glochidion obscurum	Phyllanthaceae	0.52	1.32	1.58	3.41
Alstonia scholaris	Apocynaceae	1.56	1.32	0.41	3.29
Oroxylum indicum	Bignoniaceae	1.04	1.32	0.81	3.16
Artocarpus heterophyllus	Moraceae	1.04	1.32	0.73	3.09
Couroupita guianensis	Lecythidaceae	1.04	1.32	0.66	3.02
Mangifera sp.	Anacardiaceae	0.52	1.32	0.71	2.55
Mangifera odorata	Anacardiaceae	0.52	1.32	0.09	1.92
Total		100	100	100	300

Note: RF: relative frequency, Rd: relative density, RD: relative dominance, IVI: importance value index.

Species diversity

The tree diversity index was categorized as 'intermediate' (*H*' of 1.33), indicating that there was a sufficient number of trees growing at the research location (Table 5). A very complex community is indicated by a high diversity of species (Brower et al. 1990). Meanwhile, the dominance index was at low criteria with a *D*s value of 0.06. A low dominance value indicates that no species is dominant in the region. The evenness index was in the high category (*J*' value of 0.91), meaning that the individuals of trees in the studied plots were evenly distributed among species. A species richness index of 5.33 showed that high number of tree stand exiting in the study site. There were 192 trees included in 29 tree species recorded in the studied plots. Species richness is calculated based on the number of species in an area (Krebs, 2001). The results show that high diversity (H '), evenness (J'), and wealth (R) will lead to low dominance (Ds). The similar results were reported for the diversity indices for trees with DBH of > 5 cm on plots with an abandoned field age of 5, 10, 20 years (Karyati et al. 2018) and on abandoned land after shifting cultivation (Karmini et al. 2020).

Economic value

Log price

This research found 7 trees species with higher log prices than the other 22 tree spesies (Table 6). Their log prices were in the range from USD122.12 m^{-3} to USD651.29 m^{-3}. The log price varies depending on the species and diameter class of log (Karmini et al. 2020). *Eusideroxylon zwageri* had the highest price, i.e., USD1,085.48 m^{-3}. The timber price is positively correlated with its demand in society. *Eusideroxylon zwageri* has good quality of wood, and people like to use this wood for contruction materials.

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

Diversity indices	Value
Shannon-Wiener diversity index (*H*')	1.33
Simpson dominance index (D_s)	0.06
Pielou evenness index (*J'*)	0.91
Margalef species richness (*R*)	5.33

Table 6. Number of stems, log price, and wood price at the study site

Species	Family	Number (stems ha^{-1})	Log price (USD m^{-3})	Timber price (USD m^{-3})
Eusideroxylon zwageri	Lauraceae	8	651.29	1,085.48
Alstonia scholaris	Apocynaceae	13	488.47	814.11
Artocarpus anisophyllus	Moraceae	38	447.76	814.11
Oroxylum indicum	Bignoniaceae	8	427.41	814.11
Durio zibethinus	Malvaceae	8	151.37	288.33
Cratoxylum arborescens	Hypericaceae	13	130.60	237.45
Artocarpus heterophyllus	Moraceae	8	122.12	203.53
Artocarpus elasticus	Moraceae	17	74.80	142.47
Artocarpus dadah	Moraceae	13	64.11	142.47
Archidendron pauciflorum	Fabaceae	42	79.38	135.69
Nephelium lappaceum	Sapindaceae	50	64.11	122.12
Baccaurea parvifolia	Phyllanthaceae	8	54.95	122.12
Mangifera odorata	Anacardiaceae	4	30.53	50.88
Macaranga triloba	Euphorbiaceae	200	30.37	50.88
Ficus uncinata	Moraceae	67	30.05	50.88
Mallotus paniculatus	Euphorbiaceae	63	29.51	50.88
Homalanthus populneus	Euphorbiaceae	29	28.35	50.88
Symplocos fasciculata	Symplocaceae	21	27.48	50.88
Couroupita guianensis	Lecythidaceae	8	26.71	50.88
Trema orientalis	Cannabaceae	33	26.71	50.88
Macaranga gigantea	Euphorbiaceae	8	26.71	50.88
Macaranga tanarius	Euphorbiaceae	54	25.83	50.88
Artocarpus odoratissimus	Moraceae	21	24.42	50.88
Artocarpus tamaran	Moraceae	8	22.90	50.88
Artocarpus integer	Moraceae	17	22.90	50.88
Vernonia arborea	Asteraceae	17	22.90	50.88
Glochidion obscurum	Phyllanthaceae	4	22.90	50.88
Mangifera sp.	Anacardiaceae	4	22.90	50.88
Mangifera indica	Anacardiaceae	17	20.99	50.88
Total		801	3,198.52	5,786.97
Mean		28	110.29	199.55

BIODIVERSITAS
Volume 21, Number 11, November 2020
Pages: xxxx
ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d2111xx

Logging cost

The logging cost of *Eusideroxylon zwageri* species was higher than that of the other spesies in this research (Table 7). However, logging cost per hectare was determined by log volume, and this research found difference in logging cost per hectare among trees species. The total logging cost in abandoned land in this research (USD752.54 ha^{-1}) was lower compared to that in another research (USD1,212.24 ha^{-1}) (Karmini et al. 2020). This is relevant because the total log volume in abandoned land in this research location was 76.86 m^3 ha^{-1} (Table 3), lower than that in another research location, i.e., 91.97 m^3 ha^{-1} (Karmini et al. 2020).

Profit margin

The 3 trees species contributing big profit margin were *Eusideroxylon zwageri, Alstonia scholaris,* and *Artocarpus anisophyllus*. Those species also had high log and wood prices. This mean prices of buying and selling determine profit in marketing both log and wood. Data in Table 8 present profit margin of selling 29 trees species from abandoned land.

Stumpage value

The total stumpage value at the abandoned land was estimated as much as USD1,495.31 ha^{-1}. There were 29 trees species and each species contributed an average of USD51.56 ha^{-1}. The highest stumpage value was from *Artocarpus anisophyllus*, i.e., USD168.97 ha^{-1} and the lowest one *Mangifera odorata*, i.e., USD2.29 ha^{-1} (Figure 4).

Table 7. Logging cost of trees at the study site

Species	Family	Logging cost	
		(USD ha^{-1})	(USD m^{-3})
Eusideroxylon zwageri	Lauraceae	7.51	101.76
Artocarpus integer	Moraceae	83.25	67.84
Artocarpus tamaran	Moraceae	74.43	67.84
Mangifera indica	Anacardiaceae	61.13	67.84
Artocarpus dadah	Moraceae	57.68	67.84
Glochidion obscurum	Phyllanthaceae	54.70	67.84
Vernonia arborea	Asteraceae	41.96	67.84
Artocarpus odoratissimus	Moraceae	34.25	67.84
Macaranga gigantea	Euphorbiaceae	33.42	67.84
Nephelium lappaceum	Sapindaceae	30.83	67.84
Homalanthus populneus	Euphorbiaceae	30.55	67.84
Artocarpus anisophyllus	Moraceae	27.55	67.84
Mangifera sp.	Anacardiaceae	23.49	67.84
Macaranga tanarius	Euphorbiaceae	23.29	67.84
Durio zibethinus	Malvaceae	23.22	67.84
Trema orientalis	Cannabaceae	21.35	67.84
Baccaurea parvifolia	Phyllanthaceae	21.01	67.84
Artocarpus elasticus	Moraceae	20.02	67.84
Symplocos fasciculata	Symplocaceae	19.38	67.84
Cratoxylum arborescens	Hypericaceae	12.23	67.84
Oroxylum indicum	Bignoniaceae	11.75	67.84
Couroupita guianensis	Lecythidaceae	10.18	67.84
Artocarpus heterophyllus	Moraceae	6.32	67.84
Mallotus paniculatus	Euphorbiaceae	5.73	67.84
Ficus uncinata	Moraceae	4.59	67.84
Archidendron pauciflorum	Fabaceae	4.45	67.84
Macaranga triloba	Euphorbiaceae	4.39	67.84
Alstonia scholaris	Apocynaceae	2.38	67.84
Mangifera odorata	Anacardiaceae	1.48	67.84
Total		752.54	2,001.36
Mean		25.95	69.01

Table 8. Profit margin

Species	Family	Profit margin	
		(USDm^{-3} ha^{-1})	(USDm^{-3})
Eusideroxylon zwageri	Lauraceae	626.24	150.30
Alstonia scholaris	Apocynaceae	469.68	112.72
Artocarpus anisophyllus	Moraceae	430.54	103.33
Oroxylum indicum	Bignoniaceae	410.97	98.63
Durio zibethinus	Malvaceae	145.55	34.93
Cratoxylum arborescens	Hypericaceae	125.57	30.14
Artocarpus heterophyllus	Moraceae	117.42	28.18
Archidendron pauciflorum	Fabaceae	76.32	18.32
Artocarpus elasticus	Moraceae	71.92	17.26
Nephelium lappaceum	Sapindaceae	61.65	14.79
Artocarpus dadah	Moraceae	61.65	14.79
Baccaurea parvifolia	Phyllanthaceae	52.84	12.68
Mangifera odorata	Anacardiaceae	29.35	7.05
Macaranga triloba	Euphorbiaceae	29.20	7.01
Ficus uncinata	Moraceae	28.90	6.94
Mallotus paniculatus	Euphorbiaceae	28.38	6.81
Homalanthus populneus	Euphorbiaceae	27.26	6.54
Symplocos fasciculata	Symplocaceae	26.42	6.34
Trema orientalis	Cannabaceae	25.69	6.16
Couroupita guianensis	Lecythidaceae	25.69	6.16
Macaranga gigantea	Euphorbiaceae	25.69	6.16
Macaranga tanarius	Euphorbiaceae	24.84	5.96
Artocarpus odoratissimus	Moraceae	23.48	5.64
Artocarpus tamaran	Moraceae	22.02	5.28
Artocarpus integer	Moraceae	22.02	5.28
Vernonia arborea	Asteraceae	22.02	5.28
Glochidion obscurum	Phyllanthaceae	22.02	5.28
Mangifera sp.	Anacardiaceae	22.02	5.28
Mangifera indica	Anacardiaceae	20.18	4.84
Total		3,075.50	738.12
Mean		106.05	25.45

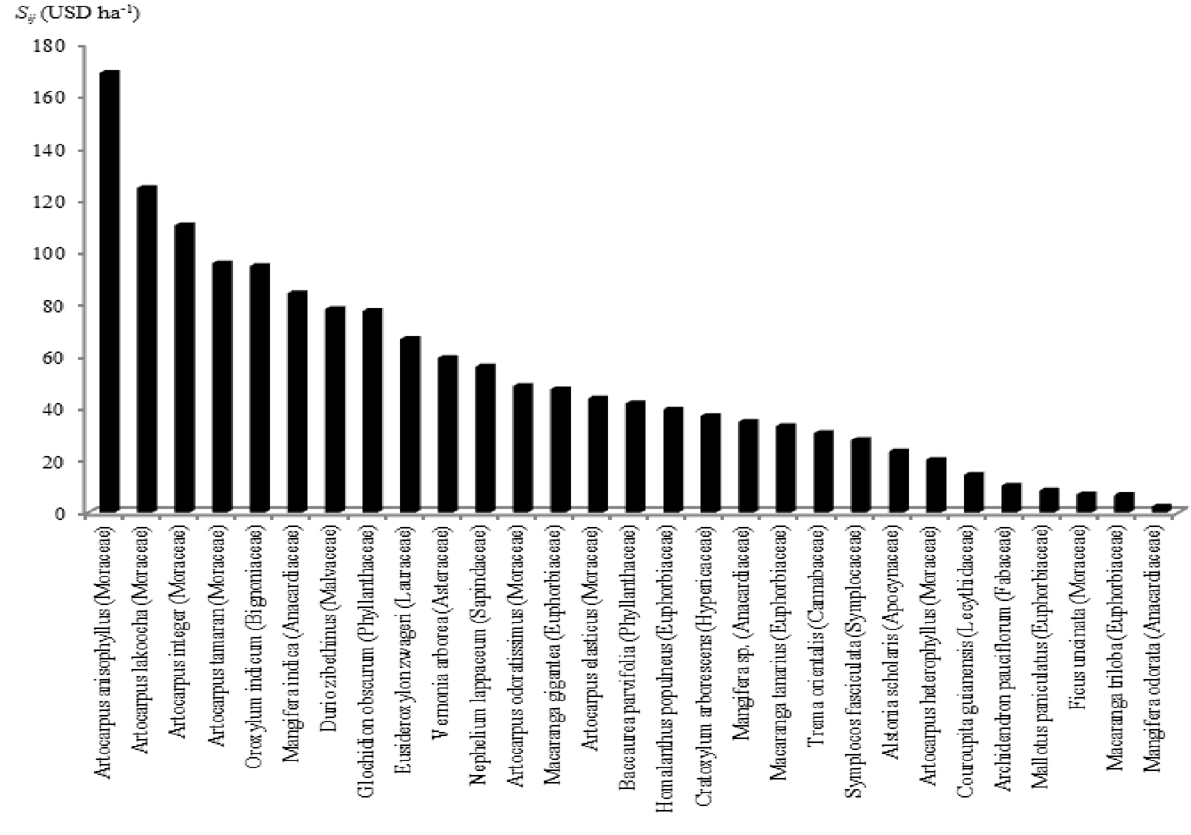

Figure 4. Stumpage value of trees at abandoned land

ACKNOWLEDGEMENTS

We would like to express our gratitude to the Ministry of Education and Culture, the Republic of Indonesia for the financial support for this research through the scheme of *Hibah Penelitian Dasar Unggulan Perguruan Tinggi* Contract No.: 183/SP2H/AMD/LT/DRPM/2020.

REFERENCES

Álvarez-Yépiz JC, Martínez-Yrízar A, Búrquez A, Lindquist C. 2008. Variation in vegetation structure and soil properties related to land use history of old-growth and secondary tropical dry forests in Northwestern Mexico. For Ecol Manage 256: 355-366. DOI: 10.1016/j.foreco.2008.04.049

Aththorick TA, Setiadi D, Purwanto Y, Guhardja Y. 2012. Vegetation stands structure and aboveground biomass after the shifting cultivation practices of Karo People in Leuser Ecosystem, North Sumatra. Biodiversitas 13 (2): 92-97. DOI: 10.13057/biodiv/d130207

Brower JE, Zar JH, Von Ende CN. 1990. Field and Laboratory Methods for General Ecology, 3rd Ed. Wm. C. Brown Publishers, USA.

Fachrul MF. 2007. Metode Sampling Bioekologi. Bumi Aksara, Jakarta. [Indonesian]

Feldpausch TR, Prates-Clark CC, Fernandes ECM, Riha SJ. 2007. Secondary forest growth deviation from chronosequence predictions in Central Amazonia. Global Change Biol 13: 967-979. DOI: 10.1111/j.1365-2486.2007.01344.x

FDPM. 1997. Manual Kerja Luar Sistem Pengurusan Memilih. Forestry Department of Peninsular Malaysia, Kuala Lumpur. [Malaysian]

Hanum IF, Pius P, Noor AAG. 2001. Economic valuation of tree species diversity at Ayer Hitam Forest, Selangor, Peninsular Malaysia. Petranika J Trop Agric Sci 22 (2): 167-170.

Husch B, Miller CI, Beers TW. 1982. Forest Mensuration. John Wiley and Sons Publishing, New York.

Karmini, Karyati, Widiati KY. 2020. The role of tropical abandoned land relative to ecological and economic aspects. For Soc 4 (1): 181-194. DOI: 10.24259/fs.v4i1.8939

Karyati, Ipor IB, Jusoh I, Wasli ME, Seman IA. 2013. Composition and diversity of plant seedlings and saplings at early secondary succession of fallow lands in Sabal, Sarawak. Acta Biologica Malaysiana 2 (3), 85-94. DOI: 10.7593/abm/2.3.85

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

Klanderud K, Mbolatiana HZH, Vololomboahangy MN, Radimbison MA, Roger E, Totland O, Rajeriarison C. 2010. Recovery of plant species richness and composition after slash-and-burn agriculture in a tropical rainforest in Madagascar. Biodivers Conserv 19:187-204. DOI: 10.1007/s10531-009-9714-3

Krebs CJ. 2001. Ecology, 5th Ed. Addison Wesley Longman Inc., USA.

Kusmana C. 2017. Metode Survey dan Interpretasi Data Vegetasi. IPB Press, Bogor. [Indonesian]

Noor AGA, Vincent JR, Yusuf H. 1992. Comparative Economic Analysis of Forest Revenue System in Peninsular Malaysia. Osborn Center Forestry Policy Grants Program Final Report, USA.

Noor AGA, Shahwahid MHO. 1999. Price-Based Valuation Method: Stumpage Appraisal of Timber Resources Peat Swamp Forest. Manual on Economic Valuation of Environmental Goods and Services of Peat Swamp Forests. Forestry Department of Peninsular Malaysia, Kuala Lumpur.

Odum EP, Barrett GW. 2005. Fundamentals of Ecology, 5th Ed. Thomson Brooks/Cole, Belmont, CA.

Ohtsuka T. 1999. Early stages of secondary succession on abandoned cropland in north-east Borneo island. Ecol Res 14: 281-290. DOI: 10.1046/j.1440- 1703.1999.143304.x

Setiawan AD. 2010. Review: Biodiversity conservation strategy in a native perspective; case study of shifting cultivation at the Dayaks of

Kalimantan. Nusantara Biosci 2 (2): 97-108. DOI: 10.13057/nusbiosci/n020208
Yirdaw E, Monge AM, Austin A, Toure I. 2019. Recovery of foristic diversity, composition and structure of regrowth forests on fallow lands: implications for conservation and restoration of degraded forest lands in Laos. New Forests 50: 1007-1026. DOI: 10.1007/s11056-019-09711-2.

BIODIVERSITAS
Volume 21, Number 11, November 2020
Pages: xxxx

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d2111xx

Short Communication: The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province, Indonesia

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Manuscript received: xxx. Revision accepted: xxx October 2020.

Abstract. *Karmini, Karyati, Widiati KY. 2020. Short Communication: The ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province, Indonesia. Biodiversitas 21: xxxx.* There is a large area of abandoned land in East Kalimantan Province. These abandoned traditional gardens which have been neglected for a long time have important ecological and economic values. This study aimed to assess the ecological and economic values of secondary forest on abandoned land in Samarinda, East Kalimantan Province. The ecological aspects assessed were stand structure, floristic composition, and species diversity. Meanwhile, the economic aspects analyzed were log price, harvesting cost, profit margin, and stumpage value. The vegetation survey was carried out on all woody trees with a diameter at breast height (DBH) $\geq$ 5 cm in 10 subplots, each measuring 20 m × 20 m. A total of 192 trees were recorded, belonging to 29 species, 19 genera and 17 families. The most dominant species were *Macaranga triloba* (Importance Value, IV of 46.16), *Macaranga tanarius* (IV of 22.97), and *Nephelium lappaceum* (IV of 20.94). The indexes of diversity, dominance, evenness, and richness in the studied plots were 1.33, 0.06, 0.40, and 5.33, respectively. The means of wood price, logging cost, profit margin, and stumpage value of the secondary forest were USD199.55 m^{-3}, USD69.01 m^{-3}, USD25.45 m^{-3}, and USD51.56 ha^{-1}, respectively. This study confirmed that the abandoned land had high ecological and economic values.

Keywords: Abandoned land, diversity, fallow land, stumpage value, tropic

INTRODUCTION

In East Kalimantan Province there is about 3 million hectares of abandoned land, consisting mainly of former coal mining land and fallow land of the shifting cultivation system which is no longer cultivated by the owners. The indigenous Dayak tribe usually replanted the land after rice harvesting with multipurpose species, such as fruit trees, rattan, and bamboo. Over time, the abandoned land will turn into secondary forest due to succession. After decades, the species richness and composition in the regrowth forests can approach old forest which can serve as biodiversity repositories (Karyati et al. 2018; Yirdaw et al. 2019).

The time required for vegetation recovery to original forest characteristics is influenced by several factors such as type of land use, cycle duration, and large cleared patches (Aththorick et al. 2012). The pioneer plant species dominate abandoned land indicated by an intermediate diversity, a low dominance index, and a high evenness index (Karmini et al. 2020; Karyati et al. 2013; Karyati et al. 2018). The rate of succession and thus the restoration of soil on abandoned land can be accelerated through plantation programs. These activities can reduce the expansion of forest conversion into cultivated areas (Klanderud et al. 2010).

Also, forest planting has an important role in providing ecological, economic, religious, and cultural functions of the secondary forest (Setiawan 2010). The average stumpage value in abandoned land was calculated to be 83.05 USD ha^{-1} and the total value 2,159.36 USD ha^{-1} (Karmini et al. 2020).

The calculation of the potential economic value of timber and non-timber forest products that can be used as onstruction materials for buildings or furniture will illustrate the potential income that might be achieved from managing abandoned land. Most of the previous studies reported information on the ecological and economic value of abandoned lands separately. The previous similar study reported the ecological and economic value of abandoned land where the previous land use was shifting cultivation (Karmini et al. 2020). However, study that provides comprehensive information on the ecological and economic value of abandoned land after being used as traditional gardens in the tropics is still very limited. The objectives of the study were to assess the ecological and economic values of secondary forest on abandoned land. The findings are expected to be used as the basis to make recommendation in managing the abandoned land in East Kalimantan and in other tropical areas.

MATERIALS AND METHODS

Study site

The research was carried out on a land area of abandoned traditional garden in Bukit Pinang area, in

Samarinda Ulu Subdistrict, Samarinda City, East Kalimantan Province, Indonesia. The research plot is located on land which is a traditional garden that has been left for more than 44 years based on land owner confirmation. The previous similar land use type of traditional gardening on this land was also reported based on interviews with land owners. The boundaries of the area are Kutai Kartanegara district at north, Samarinda Utara district at east, Air Putih Subdistrict at south, and Sungai Kunjang district at west. Samarinda City is the capital of East Kalimantan Province, Indonesia and the city with the largest population in the entire island of Kalimantan. The population of Samarinda is 812,597 people. Samarinda has an area of 718 km^2 with a hilly geographical condition with altitudes varying from 10 to 200 meters above sea level. Samarinda City is divided by Mahakan river and becomes the gateway to the area around by river, land, and air. The research plot lies at the coordinate points of $0^\circ 25'32.8''$S $117^\circ 05'56.8''$E (Figure 1).

Procedures

Data collection

The vegetation survey was conducted from March to September 2020. A total of 10 subplots, each measuring 20 m × 20 m, were established in the study site (Fachrul 2007; Kusmana 2017). Sub plots were established within a same abandoned land. All woody trees with a diameter at breast height (DBH) of ≥ 5 cm were measured for diameter and height, and their species were identified. The secondary data were obtained from reports and articles from previous researches (Forestry Department of Peninsular Malaysia (FDPM) (1997); Hanum et al. 2001; Noor et al. 1992; Noor and Shahwahid 1999).

Data analysis

Ecological characteristics

The following formulas were used to measure individual basal area (BA) and volume (V) (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 diameter at breast height (cm), 'H' is tree height (m), and '*f*' is form factor.

The importance value index (IVi) was used to determine the dominant species of community within the studied plots in (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.

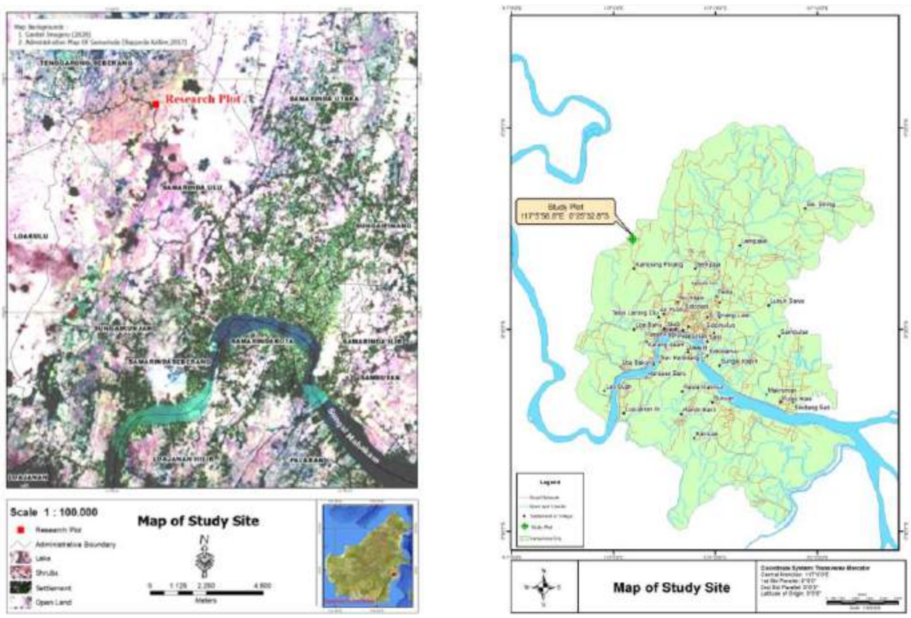

Figure 1. Map of study site in Bukit Pinang area, in Samarinda Ulu Subdistrict, Samarinda City, East Kalimantan Province, Indonesia

BIODIVERSITAS ISSN: 1412-033X
Volume 21, Number 11, November 2020 E-ISSN: 2085-4722
Pages: xxxx DOI: 10.13057/biodiv/d2111xx

The four diversity indices were analyzed to describe species diversity of standing trees in the studied plots. These diversity indices were Shannon-Wiener's diversity index (*H'*), Simpson's dominance index (D_s), Pielou's evenness index (*J'*), and Margalef's richness index (*R*) (Odum and Barrett 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.

Economic literature

Data in Table 1 shows number of logs that produced from tree diameter up to 75 cm. Based on diameter class and number of logs, the equivalent merchantable height was determined.

Reduction factor of log price was determined based on size class of DBH (Table 2). This research used assumption that the reduction factor of log price with size class of DBH < 15 cm was 0.6.

Profit ratio was fixed at 30% according to Noor and Shahwahid (1999).

Equation of profit margin was calculated as follows (Noor and Shahwahid, 1999):

Table 1. Merchantable tree heights

Diameter class (cm)	Number of logs (5 m long)	Equivalent merchantable height (m)
< 15	0.5	2.5*
15 - 30	1	5
+30 - 60	2	10
+60 - 75	3	15
75 ke atas	4	20

Note: *Analyzed data; FDPM (Forestry Department of Peninsular Malaysia) (1997)

Table 2. Reduction factor of log price

DBH size class (cm)	Reduction factor
< 15	0.60*
15 - 29	0.45
30 - 44	0.30
45 - 49	0.15
50 - 54	0.025
≥ 55	0.00

Note: *Analyzed data; Noor et al. (1992) and Hanum et al. (2001)

$$PM_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}(P_{ij} xPR)/(1+PR) \quad (11)$$

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);
j : an index for diameter class (i = 1, 2, 3, 4, ..., n).

Logging cost of all species was USD68.03 m^{-3} (except logging cost of *Eusideroxylon zwageri* was USD102.04 m^{-3}) in research location when the research was done. The exchange rate of 1 USD was 14,740 IDR on 8 October 2020. The equation of stumpage values is presented below:

$$S_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{k}V_{ij}(P_{ij} + C + PM) \quad (12)$$

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 : 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);
j : an index for diameter class (i = 1, 2, 3, 4, ..., n).

RESULTS AND DISCUSSION

Ecological characteristics

Diameter at Breast Height (DBH) and height distributions

The diameter distribution in the research plots shows an inverted J shape where an increase in diameter class is followed by a decrease in the number of trees (Figure 2). The number of trees in the DBH class of 5.0-15.0 cm was 134 (70%), the DBH class of 15.1-25.0 cm 32 (17%), the DBH class of 25.1-35.0 cm 20 (10%), and the DBH class of > 35.0 cm 6 (3%). Meanwhile, most of the trees (59%) belong to the 5-10 cm height class (Figure 3). The tree heights were distributed in height classes of 0.0-5.0 m (9 trees or 5%), 5.1-10.0 m (114 trees or 59%), 10.1-15.0 m (53 trees or 28%), and > 15 m (16 trees or 8%). In general, the diameter distribution of trees in secondary forest has an inverted J-shape (Feldpausch et al., 2007; Álvarez-Yépiz et al., 2008) while the distribution of height class is slightly positively skewed (Ohtsuka, 1999). The The similar trends in trees diameter class and height class were also reported on abandoned land after cultivation (Karmini et al. 2020).

Density, basal area, and volume

The number of individuals recorded in the research plots was 192 trees, belonging to 29 species, 19 genera, and 17 families. There were 8 tree species of Moraceae, 5 tree species of Euphorbiaceae, 3 tree species of Anacardiaceae, and 2 tree species of Phyllanthaceae. Each of the other 11 families consisted of 1 tree species. The density, basal area, and volume of species in the study site are presented in Table 3. The DBH of trees in the study plots ranged from 6.4 cm to 29.1 cm with an average DBH of 16.3 cm. Meanwhile, the tree height ranged from 6.0 m to17.4 m with an average height of 10.4 m. The total BA and volume of trees in the study plot were 9.44 and 76.86, respectively. These values are smaller than the total BA (9.75) and the total volume (91.97) in abandoned land after cultivation (Karmini et al. 2020).

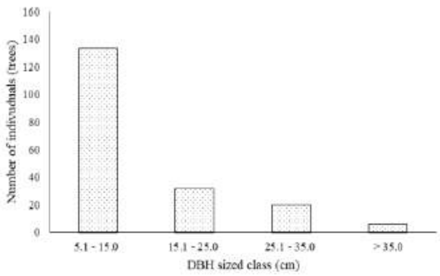

Figure 2. Distribution of diameter at breast height (DBH) in 0.4 ha at the study plot

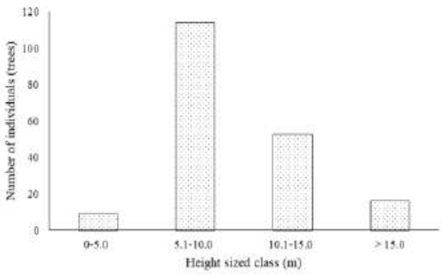

Figure 3. Distribution of height in 0.4 ha at the study plot

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

Species	Family	N	Average of DBH (cm)	Average of height (m)	Total of BA (m^2 ha^{-1})	Total volume (m^3 ha^{-1})
Macaranga tanarius	Euphorbiaceae	13	18.3	12.0	0.91	7.86
Mangifera indica	Anacardiaceae	4	29.1	17.4	0.67	7.49
Nephelium lappaceum	Sapindaceae	12	15.0	9.5	0.77	6.37
Macaranga triloba	Euphorbiaceae	48	9.7	8.7	1.00	6.05
Artocarpus integer	Moraceae	4	26.4	14.0	0.62	5.63
Trema orientalis	Cannabaceae	8	16.6	13.8	0.51	5.51
Artocarpus dadah	Moraceae	3	28.2	15.5	0.47	4.74
Artocarpus anisophyllus	Moraceae	9	14.1	9.5	0.48	4.70
Vernonia arborea	Asteraceae	4	23.6	12.1	0.46	3.69
Artocarpus odoratissimus	Moraceae	5	21.2	9.6	0.48	3.22
Homalanthus populneus	Euphorbiaceae	7	12.4	8.2	0.35	2.69
Mallotus paniculatus	Euphorbiaceae	15	9.8	8.4	0.33	2.21
Artocarpus tamaran	Moraceae	2	22.0	11.5	0.23	2.06
Ficus uncinata	Moraceae	16	10.2	8.5	0.35	2.01
Symplocos fasciculata	Symplocaceae	5	16.5	7.1	0.31	1.74
Durio zibethinus	Malvaceae	2	15.2	12.4	0.13	1.49
Macaranga gigantea	Euphorbiaceae	2	18.9	9.8	0.19	1.43
Artocarpus elasticus	Moraceae	4	15.2	8.4	0.23	1.43
Archidendron pauciflorum	Fabaceae	10	9.5	8.7	0.19	1.19
Glochidion obscurum	Phyllanthaceae	1	27.5	12.0	0.15	1.16
Baccaurea parvifolia	Phyllanthaceae	2	17.0	14.0	0.11	1.05
Cratoxylum arborescens	Hypericaceae	3	12.5	7.0	0.12	0.64
Oroxylum indicum	Bignoniaceae	2	13.7	11.3	0.08	0.60
Couroupita guianensis	Lecythidaceae	2	12.0	11.2	0.06	0.52
Artocarpus heterophyllus	Moraceae	2	13.2	11.1	0.07	0.50
Mangifera sp.	Anacardiaceae	1	18.5	10.0	0.07	0.44
Eusideroxylon zwageri	Lauraceae	2	11.8	6.0	0.05	0.21
Alstonia scholaris	Apocynaceae	3	7.9	7.4	0.04	0.20
Mangifera odorata	Anacardiaceae	1	6.4	7.3	0.01	0.04
Total		192.0	472.5	302.3	9.44	76.86
Average		6.6	16.3	10.4	0.33	2.65
Minimum		1.0	6.4	6.0	0.01	0.04
Maximum		48.0	29.1	17.4	1.00	7.86

Note: N: number of individuals (trees), DBH: diameter at breast height, BA: basal area

The five dominant species based on total basal area and volume were *Macaranga tanarius* (total BA=0.91 m^2 ha^{-1} and volume=7.86 m^3 ha^{-1}), *Mangifera indica* (total BA=0.67 m^2 ha^{-1} and volume=7.49 m^3 ha^{-1}), *Nephelium lappaceum* (total BA=0.77 m^2 ha^{-1} and volume=6.37 m^3 ha^{-1}), *Macaranga triloba* (total BA=1.00 m^2 ha^{-1} and volume=6.05 m^3 ha^{-1}), and *Artocarpus integer* (total BA=0.62 m^2 ha^{-1} and volume=5.63 m^3 ha^{-1}). The common species in abandoned land were dominated by fast growing species, such as *Macaranga* spp. and *Artocarpus* spp. as also reported by Karyati et al. (2018) and Karmini et al. (2020). The recorded fruit trees showed that the studied plot was abandoned garden. These fruit species planted were *Artocarpus anisophyllus* (Mentawa), *Artocarpus elasticus* (Benda), *Artocarpus heterophyllus* (Nangka), *Artocarpus integer* (Cempedak), *Artocarpus odoratissimus* (Terap), *Mangifera indica* (Mangga), *Mangifera odorata* (Kuweni), *Durio zibethinus* (Durian), and *Nephelium lappaceum* (Rambutan). *Artocarpus odoratissimus* is a native tree species, while *Artocarpus tamaran* is an endemic tree species.

Importance value index (IVi)

Most of the dominant trees based on importance value index (IVi) were also dominant trees based on total BA and volume. The light demanding pioneer and fast growing species dominated the studied site (Table 4). The most dominant species in terms of IVi was *Macaranga triloba* (IVi of 46.16) followed by *Macaranga triloba* (IVi of 22.97), *Nephelium lappaceum* (IVi of 20.94), *Ficus uncinata* (IVi of 18.64), and *Mallotus paniculatus* (IVi of 17.93). Twelve of 29 species recorded had an IVi of more than 10.00 and 5 species of them had an IVi of 5.00-10.00. Meanwhile the other 12 species had an IVi of less than 5.00. Four dominant species of Euphorbiaceae (*Macaranga triloba*, *Macaranga tanarius*, *Mallotus paniculatus*, and *Homalanthus populneus*) reached a total IVi of 99.72. These four species were included in the 10 most dominant types based on IVi. Similar studies also reported that tree species from Euphorbiaceae were important and dominating tropical fallow lands (Karyati et al. 2018; Karmini et al. 2020). The total IVi of 8 species including Moraceae reached 84.75. Moraceae was the family that had the most species in the research location.

Table 4. Importance value index (IVi) of trees (DBH of > 5 cm) in 0.4 hectare of the study plots

Species	Family	RF (%)	Rd (%)	RD (%)	IVi (%)
Macaranga triloba	Euphorbiaceae	25.00	10.53	10.63	46.16
Macaranga tanarius	Euphorbiaceae	6.77	6.58	9.62	22.97
Nephelium lappaceum	Sapindaceae	6.25	6.58	8.11	20.94
Ficus uncinata	Moraceae	8.33	6.58	3.72	18.64
Mallotus paniculatus	Euphorbiaceae	7.81	6.58	3.54	17.93
Artocarpus anisophyllus	Moraceae	4.69	6.58	5.11	16.37
Trema orientalis	Cannabaceae	4.17	5.26	5.44	14.87
Artocarpus odoratissimus	Moraceae	2.60	5.26	5.08	12.94
Homalanthus populneus	Euphorbiaceae	3.65	5.26	3.75	12.66
Mangifera indica	Anacardiaceae	2.08	2.63	7.05	11.77
Artocarpus integer	Moraceae	2.08	2.63	6.57	11.28
Archidendron pauciflorum	Fabaceae	5.21	3.95	2.07	11.22
Vernonia arborea	Asteraceae	2.08	2.63	4.84	9.56
Artocarpus dadah	Moraceae	1.56	2.63	4.99	9.19
Symplocos fasciculata	Symplocaceae	2.60	2.63	3.28	8.51
Artocarpus elasticus	Moraceae	2.08	2.63	2.46	7.18
Artocarpus tamaran	Moraceae	1.04	2.63	2.39	6.06
Baccaurea parvifolia	Phyllanthaceae	1.04	2.63	1.21	4.89
Macaranga gigantea	Euphorbiaceae	1.04	1.32	1.99	4.35
Eusideroxylon zwageri	Lauraceae	1.04	2.63	0.58	4.25
Cratoxylum arborescens	Hypericaceae	1.56	1.32	1.23	4.10
Durio zibethinus	Malvaceae	1.04	1.32	1.37	3.73
Glochidion obscurum	Phyllanthaceae	0.52	1.32	1.58	3.41
Alstonia scholaris	Apocynaceae	1.56	1.32	0.41	3.29
Oroxylum indicum	Bignoniaceae	1.04	1.32	0.81	3.16
Artocarpus heterophyllus	Moraceae	1.04	1.32	0.73	3.09
Couroupita guianensis	Lecythidaceae	1.04	1.32	0.66	3.02
Mangifera sp.	Anacardiaceae	0.52	1.32	0.71	2.55
Mangifera odorata	Anacardiaceae	0.52	1.32	0.09	1.92
Total		100	100	100	300

Note: RF: relative frequency, Rd: relative density, RD: relative dominance, IVI: importance value index.

Species diversity

The tree diversity index was categorized as 'intermediate' (*H*' of 1.33), indicating that there was a sufficient number of trees growing at the research location (Table 5). A very complex community is indicated by a high diversity of species (Brower et al. 1990). Meanwhile, the dominance index was at low criteria with a *D*s value of 0.06. A low dominance value indicates that no species is dominant in the region. The evenness index was in the high category (*J*' value of 0.91), meaning that the individuals of trees in the studied plots were evenly distributed among species. A species richness index of 5.33 showed that high number of tree stand exiting in the study site. There were 192 trees included in 29 tree species recorded in the studied plots. Species richness is calculated based on the number of species in an area (Krebs, 2001). The results show that high diversity (H '), evenness (J'), and wealth (R) will lead to low dominance (Ds). The similar results were reported for the diversity indices for trees with DBH of > 5 cm on plots with an abandoned field age of 5, 10, 20 years (Karyati et al. 2018) and on abandoned land after shifting cultivation (Karmini et al. 2020).

Economic value

Log price

This research found 7 trees species with higher log prices than the other 22 tree spesies (Table 6). Their log prices were in the range from USD122.12 m^{-3} to USD651.29 m^{-3}. The log price varies depending on the species and diameter class of log (Karmini et al. 2020). *Eusideroxylon zwageri* had the highest price, i.e., USD1,085.48 m^{-3}. The timber price is positively correlated with its demand in society. *Eusideroxylon zwageri* has good quality of wood, and people like to use this wood for contruction materials.

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

Diversity indices	Value
Shannon-Wiener diversity index (*H*')	1.33
Simpson dominance index (D_s)	0.06
Pielou evenness index (*J'*)	0.91
Margalef species richness (*R*)	5.33

Table 6. Number of stems, log price, and wood price at the study site

Species	Family	Number (stems ha^{-1})	Log price (USD m^{-3})	Timber price (USD m^{-3})
Eusideroxylon zwageri	Lauraceae	8	651.29	1,085.48
Alstonia scholaris	Apocynaceae	13	488.47	814.11
Artocarpus anisophyllus	Moraceae	38	447.76	814.11
Oroxylum indicum	Bignoniaceae	8	427.41	814.11
Durio zibethinus	Malvaceae	8	151.37	288.33
Cratoxylum arborescens	Hypericaceae	13	130.60	237.45
Artocarpus heterophyllus	Moraceae	8	122.12	203.53
Artocarpus elasticus	Moraceae	17	74.80	142.47
Artocarpus dadah	Moraceae	13	64.11	142.47
Archidendron pauciflorum	Fabaceae	42	79.38	135.69
Nephelium lappaceum	Sapindaceae	50	64.11	122.12
Baccaurea parvifolia	Phyllanthaceae	8	54.95	122.12
Mangifera odorata	Anacardiaceae	4	30.53	50.88
Macaranga triloba	Euphorbiaceae	200	30.37	50.88
Ficus uncinata	Moraceae	67	30.05	50.88
Mallotus paniculatus	Euphorbiaceae	63	29.51	50.88
Homalanthus populneus	Euphorbiaceae	29	28.35	50.88
Symplocos fasciculata	Symplocaceae	21	27.48	50.88
Couroupita guianensis	Lecythidaceae	8	26.71	50.88
Trema orientalis	Cannabaceae	33	26.71	50.88
Macaranga gigantea	Euphorbiaceae	8	26.71	50.88
Macaranga tanarius	Euphorbiaceae	54	25.83	50.88
Artocarpus odoratissimus	Moraceae	21	24.42	50.88
Artocarpus tamaran	Moraceae	8	22.90	50.88
Artocarpus integer	Moraceae	17	22.90	50.88
Vernonia arborea	Asteraceae	17	22.90	50.88
Glochidion obscurum	Phyllanthaceae	4	22.90	50.88
Mangifera sp.	Anacardiaceae	4	22.90	50.88
Mangifera indica	Anacardiaceae	17	20.99	50.88
Total		801	3,198.52	5,786.97
Mean		28	110.29	199.55

BIODIVERSITAS
Volume 21, Number 11, November 2020
Pages: xxxx
ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d2111xx

Logging cost

The logging cost of *Eusideroxylon zwageri* species was higher than that of the other spesies in this research (Table 7). However, logging cost per hectare was determined by log volume, and this research found difference in logging cost per hectare among trees species. The total logging cost in abandoned land in this research (USD752.54 ha^{-1}) was lower compared to that in another research (USD1,212.24 ha^{-1}) (Karmini et al. 2020). This is relevant because the total log volume in abandoned land in this research location was 76.86 m^3 ha^{-1} (Table 3), lower than that in another research location, i.e., 91.97 m^3 ha^{-1} (Karmini et al. 2020).

Profit margin

The 3 trees species contributing big profit margin were *Eusideroxylon zwageri, Alstonia scholaris,* and *Artocarpus anisophyllus.* Those species also had high log and wood prices. This mean prices of buying and selling determine profit in marketing both log and wood. Data in Table 8 present profit margin of selling 29 trees species from abandoned land.

Stumpage value

The total stumpage value at the abandoned land was estimated as much as USD1,495.31 ha^{-1}. There were 29 trees species and each species contributed an average of USD51.56 ha^{-1}. The highest stumpage value was from *Artocarpus anisophyllus*, i.e., USD168.97 ha^{-1} and the lowest one *Mangifera odorata,* i.e., USD2.29 ha^{-1} (Figure 4).

Table 7. Logging cost of trees at the study site

Species	Family	Logging cost	
		(USD ha^{-1})	(USD m^{-3})
Eusideroxylon zwageri	Lauraceae	7.51	101.76
Artocarpus integer	Moraceae	83.25	67.84
Artocarpus tamaran	Moraceae	74.43	67.84
Mangifera indica	Anacardiaceae	61.13	67.84
Artocarpus dadah	Moraceae	57.68	67.84
Glochidion obscurum	Phyllanthaceae	54.70	67.84
Vernonia arborea	Asteraceae	41.96	67.84
Artocarpus odoratissimus	Moraceae	34.25	67.84
Macaranga gigantea	Euphorbiaceae	33.42	67.84
Nephelium lappaceum	Sapindaceae	30.83	67.84
Homalanthus populneus	Euphorbiaceae	30.55	67.84
Artocarpus anisophyllus	Moraceae	27.55	67.84
Mangifera sp.	Anacardiaceae	23.49	67.84
Macaranga tanarius	Euphorbiaceae	23.29	67.84
Durio zibethinus	Malvaceae	23.22	67.84
Trema orientalis	Cannabaceae	21.35	67.84
Baccaurea parvifolia	Phyllanthaceae	21.01	67.84
Artocarpus elasticus	Moraceae	20.02	67.84
Symplocos fasciculata	Symplocaceae	19.38	67.84
Cratoxylum arborescens	Hypericaceae	12.23	67.84
Oroxylum indicum	Bignoniaceae	11.75	67.84
Couroupita guianensis	Lecythidaceae	10.18	67.84
Artocarpus heterophyllus	Moraceae	6.32	67.84
Mallotus paniculatus	Euphorbiaceae	5.73	67.84
Ficus uncinata	Moraceae	4.59	67.84
Archidendron pauciflorum	Fabaceae	4.45	67.84
Macaranga triloba	Euphorbiaceae	4.39	67.84
Alstonia scholaris	Apocynaceae	2.38	67.84
Mangifera odorata	Anacardiaceae	1.48	67.84
Total		752.54	2,001.36
Mean		25.95	69.01

Table 8. Profit margin

Species	Family	Profit margin	
		(USDm^{-3} ha^{-1})	(USDm^{-3})
Eusideroxylon zwageri	Lauraceae	626.24	150.30
Alstonia scholaris	Apocynaceae	469.68	112.72
Artocarpus anisophyllus	Moraceae	430.54	103.33
Oroxylum indicum	Bignoniaceae	410.97	98.63
Durio zibethinus	Malvaceae	145.55	34.93
Cratoxylum arborescens	Hypericaceae	125.57	30.14
Artocarpus heterophyllus	Moraceae	117.42	28.18
Archidendron pauciflorum	Fabaceae	76.32	18.32
Artocarpus elasticus	Moraceae	71.92	17.26
Nephelium lappaceum	Sapindaceae	61.65	14.79
Artocarpus dadah	Moraceae	61.65	14.79
Baccaurea parvifolia	Phyllanthaceae	52.84	12.68
Mangifera odorata	Anacardiaceae	29.35	7.05
Macaranga triloba	Euphorbiaceae	29.20	7.01
Ficus uncinata	Moraceae	28.90	6.94
Mallotus paniculatus	Euphorbiaceae	28.38	6.81
Homalanthus populneus	Euphorbiaceae	27.26	6.54
Symplocos fasciculata	Symplocaceae	26.42	6.34
Trema orientalis	Cannabaceae	25.69	6.16
Couroupita guianensis	Lecythidaceae	25.69	6.16
Macaranga gigantea	Euphorbiaceae	25.69	6.16
Macaranga tanarius	Euphorbiaceae	24.84	5.96
Artocarpus odoratissimus	Moraceae	23.48	5.64
Artocarpus tamaran	Moraceae	22.02	5.28
Artocarpus integer	Moraceae	22.02	5.28
Vernonia arborea	Asteraceae	22.02	5.28
Glochidion obscurum	Phyllanthaceae	22.02	5.28
Mangifera sp.	Anacardiaceae	22.02	5.28
Mangifera indica	Anacardiaceae	20.18	4.84
Total		3,075.50	738.12
Mean		106.05	25.45

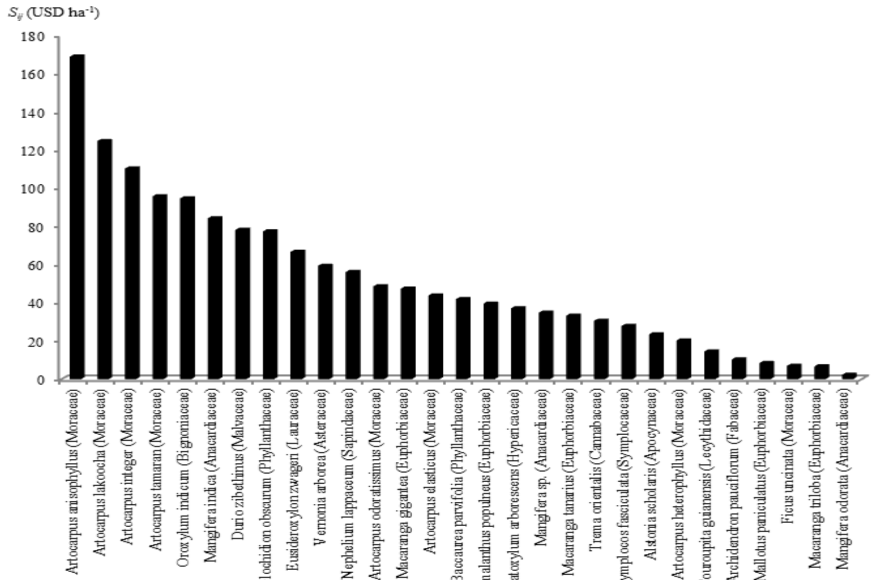

Figure 4. Stumpage value of trees at abandoned land

ACKNOWLEDGEMENTS

We would like to express our gratitude to the Ministry of Education and Culture, the Republic of Indonesia for the financial support for this research through the scheme of *Hibah Penelitian Dasar Unggulan Perguruan Tinggi* Contract No.: 183/SP2H/AMD/LT/DRPM/2020.

REFERENCES

Álvarez-Yépiz JC, Martínez-Yrízar A, Búrquez A, Lindquist C. 2008. Variation in vegetation structure and soil properties related to land use history of old-growth and secondary tropical dry forests in Northwestern Mexico. For Ecol Manage 256: 355-366. DOI: 10.1016/j.foreco.2008.04.049

Aththorick TA, Setiadi D, Purwanto Y, Guhardja Y. 2012. Vegetation stands structure and aboveground biomass after the shifting cultivation practices of Karo People in Leuser Ecosystem, North Sumatra. Biodiversitas 13 (2): 92-97. DOI: 10.13057/biodiv/d130207

Brower JE, Zar JH, Von Ende CN. 1990. Field and Laboratory Methods for General Ecology, 3rd Ed. Wm. C. Brown Publishers, USA.

Fachrul MF. 2007. Metode Sampling Bioekologi. Bumi Aksara, Jakarta. [Indonesian]

Feldpausch TR, Prates-Clark CC, Fernandes ECM, Riha SJ. 2007. Secondary forest growth deviation from chronosequence predictions in Central Amazonia. Global Change Biol 13: 967-979. DOI: 10.1111/j.1365-2486.2007.01344.x

FDPM. 1997. Manual Kerja Luar Sistem Pengurusan Memilih. Forestry Department of Peninsular Malaysia, Kuala Lumpur. [Malaysian]

Hanum IF, Pius P, Noor AAG. 2001. Economic valuation of tree species diversity at Ayer Hitam Forest, Selangor, Peninsular Malaysia. Petranika J Trop Agric Sci 22 (2): 167-170.

Husch B, Miller CI, Beers TW. 1982. Forest Mensuration. John Wiley and Sons Publishing, New York.

Karmini, Karyati, Widiati KY. 2020. The role of tropical abandoned land relative to ecological and economic aspects. For Soc 4 (1): 181-194. DOI: 10.24259/fs.v4i1.8939

Karyati, Ipor IB, Jusoh I, Wasli ME, Seman IA. 2013. Composition and diversity of plant seedlings and saplings at early secondary succession of fallow lands in Sabal, Sarawak. Acta Biologica Malaysiana 2 (3):, 85-94. DOI: 10.7593/abm/2.3.85

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

Klanderud K, Mbolatiana HZH, Vololomboahangy MN, Radimbison MA, Roger E, Totland O, Rajeriarison C. 2010. Recovery of plant species richness and composition after slash-and-burn agriculture in a tropical rainforest in Madagascar. Biodivers Conserv 19:187-204. DOI: 10.1007/s10531-009-9714-3

Krebs CJ. 2001. Ecology, 5th Ed. Addison Wesley Longman Inc., USA.

Kusmana C. 2017. Metode Survey dan Interpretasi Data Vegetasi. IPB Press, Bogor. [Indonesian]

Noor AGA, Vincent JR, Yusuf H. 1992. Comparative Economic Analysis of Forest Revenue System in Peninsular Malaysia. Osborn Center Forestry Policy Grants Program Final Report, USA.

Noor AGA, Shahwahid MHO. 1999. Price-Based Valuation Method: Stumpage Appraisal of Timber Resources Peat Swamp Forest. Manual on Economic Valuation of Environmental Goods and Services of Peat Swamp Forests. Forestry Department of Peninsular Malaysia, Kuala Lumpur.

Odum EP, Barrett GW. 2005. Fundamentals of Ecology, 5th Ed. Thomson Brooks/Cole, Belmont, CA.

Ohtsuka T. 1999. Early stages of secondary succession on abandoned cropland in north-east Borneo island. Ecol Res 14: 281-290. DOI: 10.1046/j.1440- 1703.1999.143304.x

Setiawan AD. 2010. Review: Biodiversity conservation strategy in a native perspective; case study of shifting cultivation at the Dayaks of

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Kalimantan. Nusantara Biosci 2 (2): 97-108. DOI: 10.13057/nusbiosci/n020208
Yirdaw E, Monge AM, Austin A, Toure I. 2019. Recovery of foristic diversity, composition and structure of regrowth forests on fallow lands: implications for conservation and restoration of degraded forest lands in Laos. New Forests 50: 1007-1026. DOI: 10.1007/s11056-019-09711-2.