THE COMPOSITION OF VEGETATION AND STAND STRUCTURE WITH SOIL QUALITY AT MOUNT GALUNGGUNG FOREST IN TASIKMALAYA

ARIN ANNISA FATHIA

DEPARTMENT OF SILVICULTURE
FACULTY OF FORESTRY
BOGOR AGRICULTURAL UNIVERSITY
BOGOR
2017

STATEMENT REGARDING THE DESCRIPTION AND SOURCES OF INFORMATION AND ALTERATION OF COPYRIGHTS

I hereby declare that the thesis entitled Composition of Species and Structure of Stands and Soil Quality in the Forest of Mount Galunggung, Tasikmalaya is my true work under the direction of the supervisory commission and has not been submitted in any form to any higher education institution. Sources of information derived or quoted from published or unpublished works of other authors have been mentioned in the text and included in the Bibliography at the end of this thesis.

I hereby assign the copyright of my writing to the Bogor Agricultural University.

Bogor, July 2017

Arin Annisa Fathia
NIM E44130011

ABSTRACT

ARIN ANNISA FATHIA. Komposisi Jenis dan Struktur Tegakan serta Kualitas Tanah di Hutan Gunung Galunggung Tasikmalaya. Dibimbing oleh IWAN HILWAN.

Hutan Gunung Galunggung termasuk hutan pegunungan dan merupakan gunung berapi yang berada di Tasikmalaya, Jawa Barat. Letusan terakhir terjadi pada tahun 1982-1983. Letusan tersebut menyebabkan terjadinya perubahan vegetasi dan kondisi lingkungan. Oleh karena itu, penelitian ini bertujuan menganalisis komposisi jenis, struktur tegakan dan kualitas tanah di hutan Gunung Galunggung. Penelitian ini dilakukan dengan menggunakan metode kombinasi antara metode jalur dengan metode garis berpetak pada masing-masing ketinggian (1300, 1400 dan 1600 m dpl). Berdasarkan penelitian, total jumlah jenis yang dijumpai pada tingkat semai adalah 46 jenis, pancang 41 jenis, tiang 41 jenis, pohon 56 jenis, dan tumbuhan bawah 52 jenis. Komposisi jenis di hutan Gunung Galunggung didominasi oleh jenis pionir seperti *Homalanthus populneus, Ficus ribes, Ficus septica, Ficus fistulosa, Ficus cuspidata*, dan *Schima wallichii*, serta jenis klimaks seperti *Castanopsis javanica* dan *Macropanax dispermus*. Struktur tegakan kuantitatif dan horizontal membentuk kurva J terbalik. Struktur tegakan vertikal di ketinggian 1300 dan 1600 m dpl terdiri atas strata B (20-30 m) dan C (4- 20 m). Adapun di ketinggian 1400 m dpl terdiri atas strata A (> 30m), B (20-30 m), dan C (4-20 m). Kesuburan tanah di lokasi penelitian tergolong rendah sampai sedang.

Kata kunci: Gunung Galunggung, komposisi jenis, kualitas tanah, struktur tegakan

ABSTRACT

ARIN ANNISA FATHIA. The Composition of Vegetation Species and Stand Structure with Soil Quality at Mount Galunggung Forest in Tasikmalaya. Supervised by IWAN HILWAN.

Mount Galunggung forest is a montane forest and an active stratovolcano in Tasikmalaya, East Java. Its last major eruption was in 1982-1983. This eruption caused the changes of vegetation and environment. Therefore, this study aims at analyzing the composition of vegetation species, stand structure, and soil quality in Mount Galunggung forest. This study was conducted by using a combination method between transect and line plot methods at each altitude measurement (1300, 1400, and 1600 meters above sea level). Based on the findings, there are 46 species of seedling, 41 species of sapling, 41 species of pole, 56 species of tree, and 52 species of understorey vegetation. The vegetation species composition in Mount Galunggung forest were dominated by pioneer species such as *Homalanthus populneus, Ficus ribes, Ficus septica, Ficus fistulosa, Ficus cuspidata*, and *Schima wallichii*, and climax species such as *Castanopsis javanica* and *Macropanax dispermus*. The vegetation stand structure is quantitative and horizontal shaped in the upside down J curve. Its vertical stand structure at the altitude of 1300 and 1600 meters above the sea level consists of strata B (20-30 m) and C (4-20 m). However, at the altitude of 1400 above sea level consists of strata A (>30 m), B (20-30 m), and C (4-20 m). The soil fertility in the research location is low to medium. at the altitude of 1400 above sea level consists of strata A (>30 m), B (20-30 m), and C (4-20 m). The soil fertility in the research location is low to medium. at the altitude of 1400 above sea level consists of strata A (>30 m), B (20-30 m), and C (4-20 m). The soil fertility in the research location is low to medium.

Keywords: Mount Galunggung, composition of species, soil quality, stand structure

THE COMPOSITION OF VEGETATION SPECIES AND STAND STRUCTURE WITH SOIL QUALITY AT MOUNT GALUNGGUNG FOREST IN TASIKMALAYA

ARIN ANNISA FATHIA

Undergraduate Thesis
as one of the requirements for obtaining a
Bachelor of Forestry degree
at the Silviculture Department

DEPARTMENT OF SILVICULTURE
FACULTY OF FORESTRY
BOGOR AGRICULTURAL UNIVERSITY
BOGOR
2017

Judul Skripsi : Komposisi Jenis dan Struktur Tegakan serta Kualitas Tanah di Hutan Gunung Galunggung Tasikmalaya
Nama : Arin Annisa Fathia
NIM : E44130011

Disetujui oleh

Dr Ir Iwan Hilwan, MS
Pembimbing

Diketahui oleh

Dr Ir Noor Farikhah Haneda, MSi
Ketua Departemen

Tanggal Lulus: 2 4 JUL 2017

FOREWORD

Praise and gratitude the author prays to Allah Subhanahu wa ta'ala for all His gifts so that this scientific work is successfully completed. The theme chosen in the research which was conducted since January 2017 is the composition of the species and structure of the stand, with the title "Composition of the Species and Structure of Stands and Soil Quality in the Forest of Mount Galunggung, Tasikmalaya".

The authors would like to thank Dr. Ir Iwan Hilwan, MS as a supervisor who has given many directions, suggestions and all his assistance in completing this thesis. The author's appreciation goes to KPH Tasikmalaya, in particular to Mr. Ir Henry Gunawan, MSi as the Administrator of KPH Tasikmalaya and all staff who have helped and facilitated this research activity. Expressions of gratitude are also conveyed to Mr. Yanto and Mr. Wawan who have assisted in collecting data in the field.

Thank you to my mother, father and sister and the whole family for the endless prayers and love. Thank you to my friends in Silviculture batch 50, Rani Nurcahyani, M. Agus Salim, Makmur Santoso, and Alfi Ahmad Muntaqo for a very pleasant togetherness at Mount Galunggung, Bang Zakaria Al-Anshori who has helped in this research, best friend Fantastic six, APRT, Pipih S, Egydia S, Ety K, Yeni A, Mariza H, Cholis Q, Elok R, Ganis P, Naeli F, Nuravivi, DPM E 2016, Himalaya 50, Friends of Tropical Silviculture 2016, Friends of Difini and all parties who have helped in completing the writing of this thesis which cannot be mentioned one by one.

Hopefully this scientific work useful.

Bogor, July 2017

Arin Annisa Fathia

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX LIST

INTRODUCTION

Background

Forests in Indonesia based on certain characteristics (climatic factors, edaphic and plant composition in forest stands) are grouped into various species of forest, one of which is tropical rain forest. This forest species is found in areas with a climate that is always wet (climate species A and B), located far from the coast, the stands are dominated by evergreen trees, and do not lose their leaves (Suhendang 2002; Schimper 1903 in Whitmore 1986). Mountain forest is one of the tropical rain forest formations found in mountainous areas. Steenis (1972) explained that mountain forests are forests that grow in mountainous areas at an altitude of between 1000 and 2400 m asl.

One of the mountain forests in West Java is the Mount Galunggung forest, which has an altitude of 2168 m asl. Mount Galunggung is a volcano located in Tasikmalaya, West Java. The status of Mount Galunggung is a protected forest based on the Decree of the Minister of Agriculture No. 837/Kpts/UM/II/1980, November 24, 1980. Mount Galunggung has erupted four times, namely in 1822, 1894, 1918, and 1982. The volcanic eruption caused changes in vegetation and environmental conditions.

Information regarding the condition of vegetation and soil quality on Mount Galunggung after the eruption is still limited. Therefore, it is important to conduct this research to analyze the species composition and stand structure as well as soil quality in the forest of Mount Galunggung. Then, by knowing the species composition and stand structure of a forest, it is also possible to know the potential of the biological natural resources there. This data collection is also one of the steps that can be taken as consideration and reference in managing the protected forest of Mount Galunggung.

Problem Formulation

Mount Galunggung is an active stratovolcano in Tasikmalaya. The eruption of Mount Galunggung caused changes in the structure and composition of vegetation and quality of soil in the forest of Mount Galunggung. After the eruption, Mount Galunggung experienced a secondary succession. The vegetation in the forest of Mount Galunggung is still dominated by pioneer species (Sutanto 2002) and other species have been found (Zuhri *et al.* 2016). Further research on vegetation conditions and soil quality is still limited.

In connection with the explanation above, the questions to be answered are:

1. What is the species composition and stand structure in the Mount Galunggung forest?
2. How is the soil quality in the Mount Galunggung forest?

Research Purposes

The aims of this research are:

1. Analyzing species composition and stand structure in Mount Galunggung forest.
2. Analyzing soil quality in Mount Galunggung Forest.

Benefits of Research

The results of this study are expected to provide benefits in the form of data and information regarding species composition, stand structure, and soil quality in the Mount Galunggung forest so that it can be used as consideration for FMU Tasikmalaya in managing protected forests. For the development of knowledge, the results of this research can increase knowledge about the condition of vegetation and soil quality in the forest of Mount Galunggung for restoration of the forest ecosystem of Mount Galunggung. For the general public, this research can provide knowledge about the potential of biological natural resources found in the forest of Mount Galunggung.

METHOD

Time and Place

This research was carried out in January-April 2017. In January-February data collection was carried out in the forest section of Mount Galunggung, RPH Cisayong, BKPH Tasikmalaya, KPH Tasikmalaya at an altitude of 1300 m asl, 1400 m asl, and 1600 m asl (map of research location contained in Appendix 1). Then in February-April carried out the manufacture of herbarium and identification of plant species in the Laboratory of Forest Ecology, Department of Silviculture and analysis of soil properties at the Laboratory of the Department of Soil Science and Land Resources, Bogor Agricultural University.

Tools and Materials

The tools used in this research are GPS, machete, haga hypsometer, camera, clinometer, compass, sewing meter, work map (regional map), tape measure, wet and dry thermometer, tally sheet, herbarium equipment (alcohol 70%, scissors, label, oven, plastic, sack) and species identification book. The materials used are vegetation and soil in Mount Galunggung Forest.

Collected Data

The data collected in this study are primary and secondary data. Primary data is data directly collected in the field which includes data on vegetation, soil sampling and environmental conditions. Vegetation data taken includes the name of the species and the number of individuals (for all levels of growth and understorey), as well as diameter at breast height (Dbh), branch-free height and total height (for pole and tree levels). Soil samples taken were disturbed soil samples. Environmental condition data taken include altitude, slope, temperature and humidity. Secondary data collected in the form of information about the general condition of the research site which includes the location, area, climate (rainfall data), as well as the results of the analysis of the physical and chemical properties of the soil.

Research Procedure

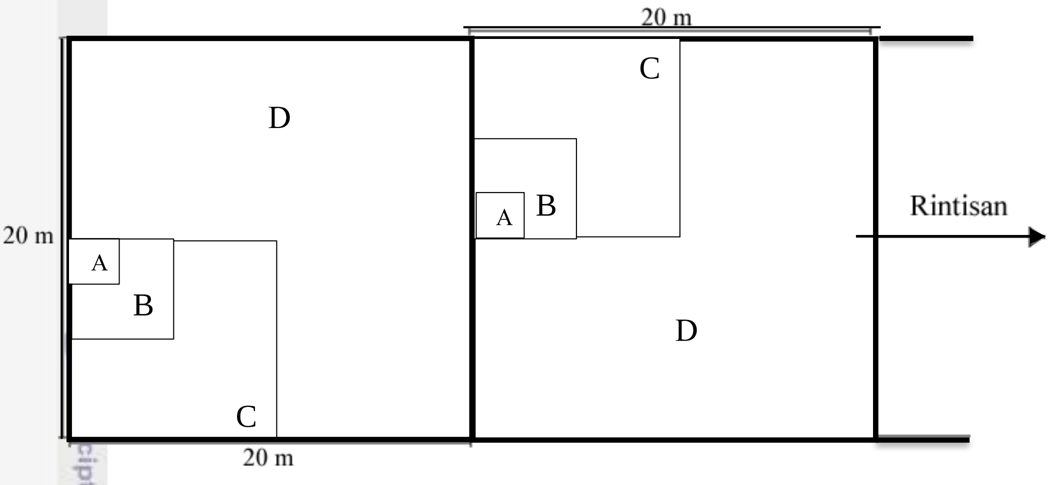
Determination of Research Location

Determination of the research location is done by using purposive sampling method, namely the technique of determining the sample with a specific purpose. The research location is distinguished based on its altitude, namely 1300 m asl, 1400 m asl and 1600 m asl.

Making Vegetation Analysis Sample Plots

The sample plot used is a combination method between the path method and the grid line method. In this method, tree tracts were carried out using the path method, namely on lines with a width of 20 m, while for the rejuvenation phase and understorey using the plotted line method (Indriyanto 2012). Sample plots made to cut contour lines or contours perpendicular to the placement of sample plots at three locations, which have different altitudes, namely 1300 m asl, 1400 m asl, and 1600 m asl.

At each altitude one sample plot line measuring 20 m x 500 m is made. So that on this route there are 25 sub-plots with a size of 20 mx 20 m. Wyatt-Smith (1959) in Soerianegara and Indrawan (2016) stated that the sample plot size of 0.6 ha was sufficient to represent the stand at tropical forest. The sample plot design used is presented in Figure 1.



Description :
Plot A : area of 2 mx 2 m for observation of seedling and understorey level.
Plot B : area of 5 mx 5 m for observation of sapling level.
Plot C : area of 10 mx 10 m for observation at pole level.
Plot D : area of 20 mx 20 m for observation at tree level

Figure 1 Design of sample plots in the field using the combination method (Kusmana 1997)

Forest Stratification

The canopy stratification plots were made using sample plots in the form of strips measuring 20 mx 60 m. The sub-plots whose header profiles are profiled are sub-plots numbered 12, 13 and 14 for each altitude. The track width is considered as the x-axis (20 m) and the track length as the y-axis (60 m). The data required for the stratification of the header are:

1. The position of the tree in the path (x and y coordinates), as measured from the same direction in succession and the initial distance of the measurement to the tree.
2. Name of tree species, diameter at breast height (130 cm) or diameter 20 cm above buttress if tree has buttresses, total height and branch-free height.
3. The projection area (closure) of the canopy to the ground surface from two measurement directions, namely the widest and narrowest canopy direction.
4. Draw vertical and horizontal profile shapes on millimeter block paper with a scale of 1:100 and determine the number of trees that belong to strata A, B and C.

Soil Sampling

Soil samples were taken from subplots no. 1, 13 and 25 measuring 20 mx 20 m as many as 3 samples at each altitude. Soil was taken at 5 points in each subplot with a depth of 0-20 cm (Figure 2). Furthermore, soil samples that have been taken from 5 points are mixed and stirred evenly so that a composite soil sample is produced. Soil samples obtained were 9 samples from all altitudes and analyzed for their physical properties (texture) and chemical properties (CEC, pH, C-organic, N, P, and K).

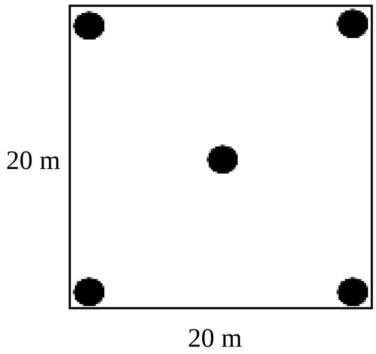


Figure 2. Soil sampling point in 20 mx 20 m sub-plot

Data analysis

Important Value Index (IVI)

The Important Value Index is calculated by adding up the values of relative density (RD), relative frequency (RF), and relative dominance (RDo). Sutisna (1981) in Hafazallah (2014) states that a species has a major role in the community if the IVI value of the species is more than 10% for the seedling and sapling level, and 15% for the pole and tree level. To determine the value of the IVI used the formula (Curtis 1959 in Mueller-Dumbois and Ellenberg 1974):

$$\text{Density (Ind/Ha)} = \frac{\text{No.Individual of the species}}{\text{Total No.of plots sampled}}$$

$$\text{Relative Density (\%)} = \frac{\text{Density of the species}}{\text{Density of all the species}} x\ 100\%$$

$$\text{Frequency} = \frac{\text{No.of plot in which the species ispresent}}{\text{Total No.of plots sampled}}$$

$$\text{Relative Frequency (\%)} = \frac{\text{Frequency of the species}}{\text{Frequency of all the species}}\ x\ 100\%$$

$$\text{Dominance } (m^2/\text{ ha}) = \frac{\text{Basal area}}{\text{Total plots sampled}}$$

$$\text{Relative Dominance (\%)} = \frac{\text{Dominance of the species}}{\text{Dominance all of the specie}}\ x\ 100\%$$

IVI = Relative Density (RD) + Relative Frequency (RF) (for understorey, seedlings and saplings)

IVI = = Relative Density (RD) + Relative Frequency (RF) + Relative Dominance (RDo) (for pole and tree)

Species Dominance Index

Species dominance index is a parameter that can be used to express the level of centralized dominance (poleery) of species in a community. The greater the value of the dominance index, the dominance (poleery) concentrated on a single species. To determine the dominance index used the following formula (Indriyanto 2012):

$$ID = \Sigma \left(\frac{n_i}{N}\right)^2$$

Description :
n_i = Number of individuals of one species
N = Number of individuals whole sample in plot

Mulyasana (2008) states that if the dominance index value is close to 1, then the stand is controlled by one species. However, if the dominance index value is close to zero, then the stand is dominated by several species together.

Species Diversity Index

The species diversity index can be calculated using the formula *Shannon Diversity Index* (Magurran 1988) as follows:

$$H' = -\Sigma (p_i \ln p_i)$$

Description:
H'= Diversity index
p_i= The ratio of the number of individuals of one species to the number of individuals whole sample in plot (n/N)

Margalef (1972) in Magurran (1988) states that the diversity index value ranges from 1.5-3.5. Diversity index value more than
4.5 is very rare.

Specific Evenness Index (E)

Specific evenness index shows the evenness of individuals of each species in an area. Magurran (1988) explained that the evenness index value ranged from 0-1. The evenness index value will reach a maximum (by 1) if all species have the same number of individuals at each altitude. The species evenness index can be calculated using the following formula (Pielou 1975 in Magurran 1988):

$$E = \frac{H'}{\ln(S)}$$

Description:

E= Species evenness index
H'= Diversity index
ln= Natural logarithm
S= Number of species found

Specific Richness Index (R)

The species richness index was determined using the Margallef formula (Clifford and Stephenson 1975 in Magurran 1988) as follows:

$$R = \frac{S - 1}{\ln(N)}$$

Description :
R= Species richness index
S= Number of species found
ln= Natural logarithm
N= Total number of individuals

Magurran (1988) explains that the value of this species of wealth is divided into three categories, namely low (R < 3.5), medium (3.5 < R < 5.0) and high (R > 5.0).

Community Similarity Index

The community similarity index was used to determine the level of plant community similarity of two stands that were compared at each growth stage. To find out the IS value, the following formula can be used (Mueller-Dumbois and Ellenberg 1974):

$$IS = \frac{2W}{a + b}$$

Description:

IS= Community similarity index
W= The sum of the lesser or equal significance values of two paired species found in two communities
a = The number of IVIs of all species found in the community A
b= The number of IVIs of all species found in community B

Odum (1993) in Hilwan and Masyrafina (2015), two communities are considered different if the IS value is < 50%, is considered similar if the value is 50% < IS <75%, and is considered the same if the IS value is 75%.

Analysis of Soil Physical and Chemical Properties

Analysis of soil physical and chemical properties was carried out at the Laboratory of the Department of Soil Science and Land Resources using the methods presented in Table 1.

Table 1 Methods for analyzing soil physical and chemical properties

Soil properties	Analysis method	Unit
Soil texture	Pipette	%
pH	pH 1:5 H_2O	-
C-organic	Walkley and Black	%
N-total	Kjeldahl	%
P	bray 1	ppm
K	bray 1	ppm
CEC	NH4OAc pH 7.0	cmol (+)/kg

GENERAL CONDITIONS OF THE RESEARCH LOCATION

Area and Location

Mount Galunggung is an active volcanic mountain located in Tasikmalaya, West Java. The forest area in Mount Galunggung includes 8 932.92 ha of protected forest and 1120.7 ha of limited production forest. Astronomically, Mount Galunggung is located at 7°03'00"-7°48'10"LS and 107°54'32"-108°28'5"E. Mount Galunggung is bordered to the west by Mount Karasak, to the north by Mount Talaga bodas, to the east by Mount Sawal and to the south by the tertiary rocks of the southern mountains. Based on the area managed by KPH Tasikmalaya, the Mount Galunggung forest area is included in two BKPH areas, namely BKPH Tasikmalaya and BKPH Singaparna.

Physical condition

Mount Galunggung has an altitude of 2168 m asl and has an inactive crater named Guntur Crater. The topography of the Mount Galunggung area ranges from flat to very steep. Mount Galunggung has a lithosol soil species. Mount Galunggung forest is included in species A rain according to Schmidt and Ferguson with an average rainfall of 3 442 mm/year. The lowest rainfall is in August at 130 mm and the highest is in March at 409 mm.

Flora and fauna

After the eruption in 1982-1983, the tree species in the forest of Mount Galunggung changed. According to research conducted by Sutanto (2002), before the eruption in 1982, the forest area of Mount Galunggung had 85 tree species. However, after the 1982 eruption, 6 tree species were found, namely dawola (*Parasponia parvifolia*), hamerang (*Ficus toxicaria*), puspa (*Schima wallichii*), salam (*Eugenia cuprea*), mereme (*Glochidion arborescens*), and kitambaga (*Syzygium operculata*). Zuhri *et al.* (2016) stated that the locations affected by the eruption around the crater were dominated by *Cyathea contaminans* (tree ferns), *Campylopus* sp., and *C. Callothyrsus*.

In addition to flora, in the forest of Mount Galunggung there are also many bird species. Research conducted by Widodo (2014), showed that around the Galunggung ecotourism area, 39 species of birds were found. Birds found with the highest population were *Cynniris jugularis, Lonchura leucogastroides, Orthotomus sutorius, Orthotomus cucullatus, Zosterops palpebrosus, Pycnonotus aurigaster, Brachypteryx leucophrys, Streptopelia chinensis, Halcyon cyanoventulinus* and *Cacomantis mer*.

RESULTS AND DISCUSSION

Results

Species Composition

Number of Species

Based on the results of the vegetation analysis, the number of plant species found varied at each growth level and understorey at various altitude. Based on the data in Table 2, the highest number of species at the seedling level was at an altitude of 1400 m asl, namely 27 species, at the sapling level there were at an altitude of 1300 m asl, which was 29 species, and at the pole and tree level there were at an altitude of 1400 m asl with a total number of species, successively 25 species and 39 species. Then, the highest number of understorey species is found at an altitude of 1300 m asl, which is 27 species.

Table 2 Number of plant species found at various altitudes

Altitude	Species Number				
	Seedling	Sapling	Pole	Tree	Understorey
1300 m asl	25	29	22	27	27
1400 m asl	27	27	25	39	26
1600 m asl	13	18	23	33	25

Dominant Species (IVI)

The data obtained from the vegetation analysis were used to calculate the important value index of each species found at each level of growth and understorey. The ten highest IVI values at each growth stage and understorey are presented in Tables 3, 4, 5, 6 and 7.

Based on the data in Table 3, the most dominant species of seedling at an altitude of 1300 m asl was Homalanthus populneus (22.59%), at an altitude of 1400 m asl was *Macropanax dispermus* (22.82%) and at an altitude of 1600 m asl *Turpinia montana* (43.13%). There are several species of seedlings that are always found at every altitude, such as *Saurauia nudiflora, Symplocos spicata, Syzygium lineatum,* and *Turpinia montana*. The species of seedlings that were only found at certain altitude were *Homalanthus populneus*, *Syzygium glomeriflorum* and *Syzygium* sp. 2 (1300 m asl), *Ficus septica, Saurauia nudiflora, Saurauia pendula*, and *Symplocos costata* (1400 m asl), as well as *Podocarpus koordersii, Schima wallichii*, *Syzygium lineatum* and *Urophyllum* sp. (1600 m asl).

Table 3 Species of seedlings with IVI values > 10% at 3 altitudes

No.	Species name	Local name	Important Value Index (%)		
			1300 m asl	1400 m asl	1600 m asl
1	*Camellia lanceolata*	Jungle tea	-	10.56	-
2	*Ficus cuspidata*	Darangdan	13.59	-	-
3	*Ficus fistulosa*	Beunying	13.84	-	-
4	*Ficus ribes*	Walen	-	19.00	10.74
5	*Ficus septica*	warning	-	17.52	-
6	*Homalanthus populneus*	Kareumbi	22.59	-	-
7	*Macropanax Dispermus*	Bake	-	22.82	31.85
8	*Magnolia lilifera*	Cempaka goiter	10.84	-	-
9	*Podocarpus koordersii*	Jamuju	-	-	11.11
10	*Saurauia nudiflora*	Ki leho rhino	-	19.96	-
11	*Saurauia pendula*	Ki leho	-	10.56	-
12	*Symplocos spicata*	Jirak	17.51	15.01	29.63
13	*Symplocos costata*	jirak costa	-	14.00	-
14	*Syzygium glomeriflorum*	Kukupaan	14.76	-	-
15	*Syzygium lineatum*	Ki bone	-	-	15.19
16	*Syzygium* sp. 2	-	12.42	-	-
17	*Turpinia montana*	ki bancet	16.34	-	43.13
18	*Urophyllum* sp.	-	-	-	12.59

Table 4 Species of saplings that have IVI values > 10% at 3 altitudes

No.	Species name	Local name	Important Value Index (%)		
			1300 m asl	1400 m asl	1600 m asl
1	*Camellia lanceolata*	Jungle tea	12.16	14.82	11.74
2	*Ficus fistulosa*	Beunying	19.07	16.46	-
3	*Ficus ribes*	Walen	28.91	21.55	-
4	*Ficus septica*	warning	23.14	15.13	39.86
5	*Lasianthus inodorus*	Kahiutan	-	13.01	-
6	*Macropanax* sp.	Bake	-	10.69	14.86
7	*Perrottetia alpestris*	Ki hurang	-	-	15.36
8	*Pyrenaria serrata*	-	-	-	11.74
9	*Saurauia nudiflora*	Ki leho rhino	11.48	-	-
10	*Schefflera fastigiata*	Roast	-	-	13.41
11	*Symplocos costata*	jirak costa	-	18.60	-
12	*Turpinia montana*	ki bancet	-	31.95	-
13	*Saurauia* sp.	-	-	-	14.13

Based on the data in Table 4, the dominant species of sapling at an altitude of 1300 m asl is *Ficus ribes* with an IVI of 28.91%. At an altitude of 1400 m asl the dominant species of sapling is *Turpinia montana* with an IVI of 31.95%, while at an altitude of 1600 m asl, the dominant species of sapling is *Ficus septica* with an IVI of 39.86%. Then, based on the results of the study, it was found that there were several species of saplings that were always found at every altitude, such as *Camellia lanceolata, Ficus ribes*, and *Ficus septica*. The species of saplings that were only found at certain altitudes were *Saurauia nudiflora* and *Syzygium glomeruliferum* (1300 m asl), *Lasianthus inodorus* (1400 m asl), and *Homalanthus populneus, Perrottetia alpestris, Schefflera fastigiata* and *Saurauia* sp. (1600 m asl).

Table 5 Species of pole that have an IVI value > 15% at 3 altitudes

No.	Species name	Local name	Important Value Index (%)		
			1300 m asl	1400 m asl	1600 m asl
1	*Antidesma minus*	Occupy	36.31	16.90	-
2	*Castanopsis javanica*	Ki hiyur	15.14	-	-
3	*Eurya acuminata*	Ki peacock	-	-	16.84
4	*Eurya obovata*	Eurya	19.05	-	-
5	*Ficus cuspidata*	Darangdan	21.52	-	-
6	*Ficus ribes*	Walen	15.94	25.68	-
7	*Ficus septica*	warning	46.85	-	34.92
8	*Homalanthus populneus*	Kareumbi	-	-	36.07
9	*Macropanax dispermus*	Roast beak	-	67.37	25.38
10	*Meliosma ferruginea*	rhino mirror	-	-	35.44
11	*Saurauia pendula*	Ki leho	30.86	-	-
12	*Symplocos costata*	jirak costa	21.62	-	-
13	*Schima wallichii*	Puspa	-	21.30	29.89
14	*Syzygium* sp. 1	Ki copper	16.50	-	-

Based on the data in Table 5, the species of pole that dominates at an altitude of 1300 m asl is *Ficus septica* (46.85%), at an altitude of 1400 m asl is *Macropanax dispermus* (67.37%) and at an altitude of 1600 m asl is *Homalanthus populneus* (36.07%). There are several species of poles that are always found at every altitude, namely *Ficus septica, Macropanax dispermus, Castanopsis javanica, Ficus ribes*, and *Schima wallichii*. The species of poles that were only found at certain altitude were *Eurya obovata, Ficus cuspidata, and Saurauia pendula* (1300 m asl), as well as *Eurya acuminata, Endiandra rubescens, Ficus fistulosa*, and *Schefflera fastigiata* (1600 m asl).

Table 6 Species of trees that have IVI values > 15% at 3 altitudes

No.	Species name	Local name	Important Value Index (%)		
			1300 m asl	1400 m asl	1600 m asl
1	*Antidesma minus*	Occupy	23.61	-	-
2	*Castanopsis javanica*	Ki hiyur	42.16	31.38	-
3	*Ficus ribes*	Walen	22.78	24.24	-
4	*Ficus septica*	warning	22.40	-	18.72
5	*Homalanthus populneus*	Kareumbi	15.80	20.46	29.64
6	*Macropanax Dispermus*	Bake	15.16	41.12	36.17
7	*Meliosma ferruginea*	Bubble	-	-	27.48
8	*Saurauia pendula*	Ki leho canting	15.44	-	-
9	*Schima wallichii*	Puspa	28.65	48.96	39.39
10	*Symplocos costata*	jirak costa	18.44	17.27	-

Based on the data in Table 6, the dominant tree species at an altitude of 1300 m asl is *Castanopsis javanica* with an IVI of 42.16%. At an altitude of 1400 m asl and 1600 m asl, the dominant tree species is *Schima wallichii* with IVI of 48.96% and 39.39%, respectively tree species that are always found at every altitude are *Ficus septica*, *Homalanthus populneus*, and *Schima wallichii* which are pioneer species and *Macropanax dispermus* which is the climax species. The species of trees that are only found at certain altitude are *Saurauia pendula* (1300 m asl), Syzygium sp. 1 (1400 m asl), and *Acronychia pedunculata*, *Ficus fistulosa*, *Myrsine avenis*, *Pyrenaria serrata*, and *Syzygium glomeruliferum* (1600 m asl).

Table 7 Species of understorey that have IVI values > 10% at 3 altitudes

No.	Species name	Local name	Important Value Index (%)		
			1300 m asl	1400 m asl	1600 m asl
1	*Alpinia* sp.	Ell	15.57	16.66	13.36
2	*Athyrium sorgonense*	-	18.38	25.10	22.67
3	*Begonia robusta*	Begonia	36.24	26.58	16.67
4	*Blechnum capense*	nail hejo	16.43	21.09	-
5	*caladium* sp.	Taro	17.23	15.41	-
6	*Chromolaena odorata*	Ki groan	-	-	10.27
7	*Decaspermum* sp. 2	-	-	-	10.02
8	*Elatostema* sp. 2	wood potion	20.74	13.73	-
9	*Gonostegia hirta*	-	-	-	10.17
10	*Pilea melastomoides*	Poh-pohan	14.48	11.61	47.27
11	*Rubus molluccanus*	Big Hareeus	-	-	16.91
12	Unident 8	-	12.29	-	-
13	Unident 10	-	-	15.19	-

Based on Table 7, the dominant understorey species at an altitude of 1300 m asl and 1400 m asl is Begonia robusta with IVIs of 36.24% and 26.58%, respectively. Furthermore, at an altitude of 1600 m asl is the species of *Pilea melastomoides* with an IVI of 47.27 %. Species of *Alpinia* sp., *Athyrium sorgonense*, *Begonia robusta* and *Pilea melastomoides* were always found at every altitude. The species of understorey that are only found at certain altitudes are species C (1300 m asl), *Elatostema* sp. (1400 m asl), as well as *Chromolaena odorata* and *Decaspermum* sp. 2 (1600 m asl).

Species Dominance Index (C)

Based on Table 8, the value of the species dominance index for each growth stage and understorey at various altitude is low because 0 C 0.5. This shows that all species of plants found dominate together.

Table 8 Species dominance index values at various altitudes

Altitude	Species Dominance Index				
	Seedling	Sapling	Pole	Tree	Understorey
1300 m asl	0.064	0.075	0.084	0.071	0.095
1400 m asl	0.081	0.086	0.092	0.092	0.076
1600 m asl	0.195	0.101	0.075	0.079	0.129

Species Diversity Index (H')

Table 9 shows that the species diversity index obtained is moderate (2 < H' < 3) at all levels of growth and understorey. The highest diversity index value for understorey is at an altitude of 1400 m asl, which is 2.77. At the seedling and sapling levels, the highest diversity index was found at an altitude of 1300 m asl at 2.93 and 2.91, respectively. At the pole level, the highest diversity index is at an altitude of 1400 m asl which is 2.84 and at the tree level it is at an altitude of 1600 m asl at 2.91.

Table 9 Values of species diversity index at various altitudes

Altitude	Species Diversity Index				
	Seedling	Sapling	Pole	Tree	Understorey
1300 m asl	2.93	2.91	2.74	2.89	2.64
1400 m asl	2.80	2.77	2.84	2.85	2.77
1600 m asl	2.01	2.56	2.81	2.91	2.53

Species Richness Index (R)

Table 10 shows that the wealth index value obtained is low (< 3.5) to high (R > 5.0). The highest species richness index at the seedling and sapling levels was at an altitude of 1300 m asl with R values of 5.97 and 5.60, respectively, at the pole and tree level at an altitude of 1400 m asl with R values of 5.15 and 6.92, respectively, and plants The bottom is located at an altitude of 1300 m asl with an R value of 4.44.

Table 10 Species richness index values at various altitudes

Altitude	Species Richness Index				
	Seedling	Sapling	Pole	Tree	Understorey
1300 m asl	5.97	5.60	4.68	4.80	4.44
1400 m asl	5.13	5.09	5.15	6.92	4.22
1600 m asl	2.45	3.45	4.95	5.56	3.93

Species Evenness Index (E)

Table 11 shows that overall, the value of the species evenness index obtained is high because it tends to approach 1. The highest value of the species evenness index is at an altitude of 1600 m asl at the pile level.

Table 11 Species evenness index values at various altitudes

Altittude	Species Evenness Index				
	Seedling	Sapling	Pole	Tree	Understorey
1300 m asl	0.87	0.86	0.89	0.88	0.79
1400 m asl	0.83	0.83	0.88	0.78	0.84
1600 m asl	0.79	0.88	0.90	0.83	0.79

Community Similarity Index (IS)

Based on the data in table 12, the community similarity index values obtained ranged from 21.76-67.30%. The greater the similarity index value, the more similar the species composition between the two communities being compared. The highest similarity index value is found at the tree level at an altitude of 1300 m asl with 1400 m asl with a similarity index of 62.50% and at an altitude of 1400 m asl with 1600 m asl of 51.22%. Then, the understorey is found at an altitude of 1300 m asl with 1400 m asl with a community similarity index value of 67.30%.

Table 12 Community similarity index values at each growth stage and understorey at various altitudes

Growth level	Altitude	Similarity Index (%)		
		1300 m asl	1400 m asl	1 600 m asl
Seedling	1300 m asl	100	25.17	21.76
	1400 m asl	-	100	38.47
	1600 m asl	-	-	100
Sapling	1300 m asl	100	37.43	24.79
	1400 m asl	-	100	21.2
	1600 m asl	-	-	100
Pole	1300 m asl	100	37.54	30.22
	1400 m asl	-	100	39.15
	1600 m asl	-	-	100
Tree	1300 m asl	100	62.50	39.82
	1400 m asl	-	100	51.22
	1600 m asl	-	-	100
Understorey	1300 m asl	100	67.30	38.68
	1400 m asl	-	100	39.77
	1600 m asl	-	-	100

Stand Structure

Individual Density

Based on the data in Table 13, individual density decreases with increasing growth rate. The highest density at the seedling, sapling and pole levels was found at an altitude of 1400 m asl with density values of 23 500 ind/ha, 3 232 ind/ha, and 424 ind/ha, respectively. Then, at the tree level, there are at an altitude of 1600 m asl at 315 ind/ha.

Table 13 Density at each growth stage at various altitudes

Altitude	Density (ind/ha)			
	Seedling	Sapling	Pole	Tree
1300 m asl	10 900	2 832	356	224
1400 m asl	23 500	3 232	424	242
1600 m asl	13 500	2 208	340	315

Horizontal Structure

The horizontal structure of a stand can be seen from the relationship between tree density and the distribution of diameter classes. The horizontal structure of forest stands in Figure 3 shows that the larger the diameter of the tree, the lower the density. The highest tree density at each height was in the 20-30 cm diameter class. Tree density in the diameter class 20-30 cm at an altitude of 1300 m asl, 1400 m asl and 1600 m asl are 94 ind/ha, 130 ind/ha and 177 ind/ha, respectively.

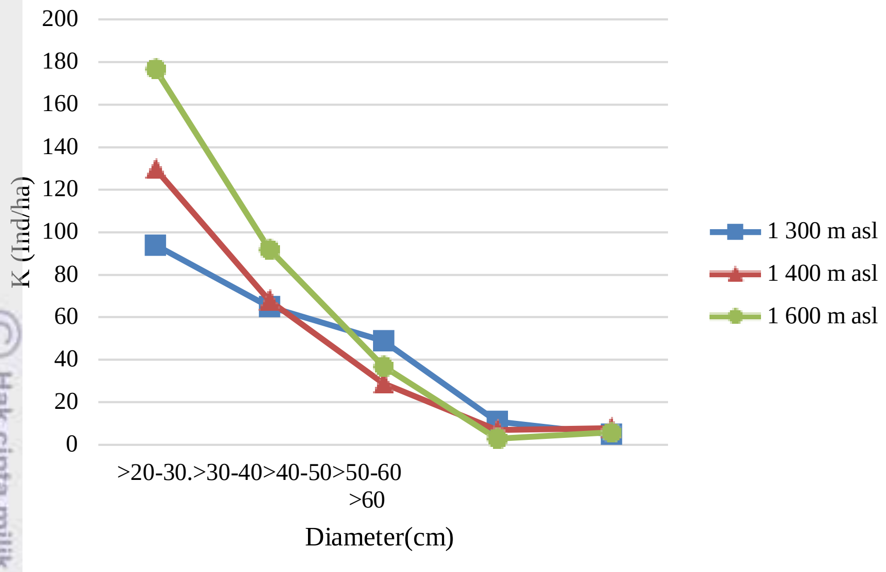


Figure 3 Horizontal structure of tree-level forest stands at various altitudes

Vertical Structure

The vertical stand structure can be identified from the relationship between tree density and tree height class (stratum). Figure 4 shows that trees 10-20 m tall have the highest densities at various altitudes. Tree density in the 10-20 m high class at an altitude of 1300 m asl, 1400 m asl and 1600 m asl are 165 ind/ha, 168 ind/ha and 222 ind/ha, respectively. Tree density decreases with increasing tree height.

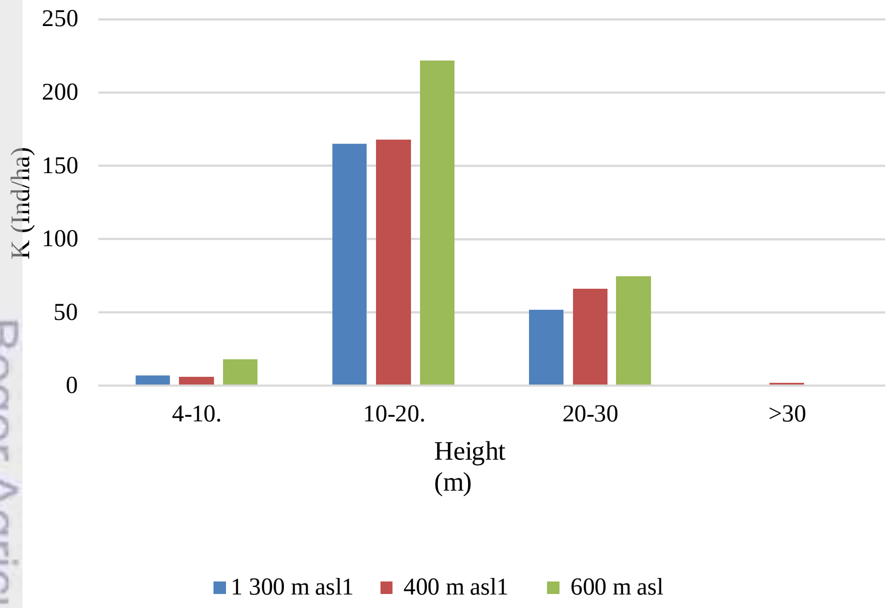
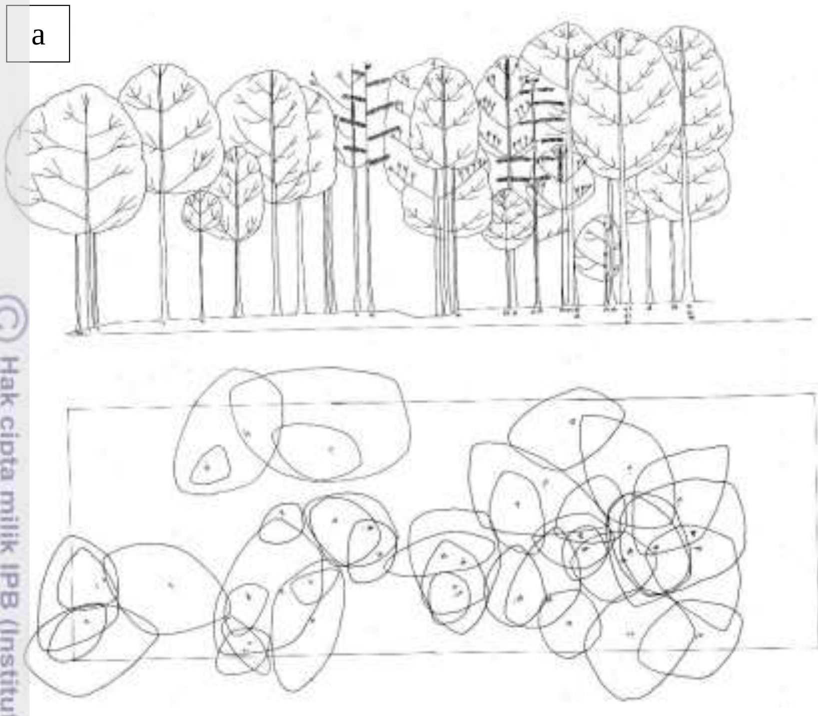


Figure 4 Vertical structure of forest stands at various altitudes

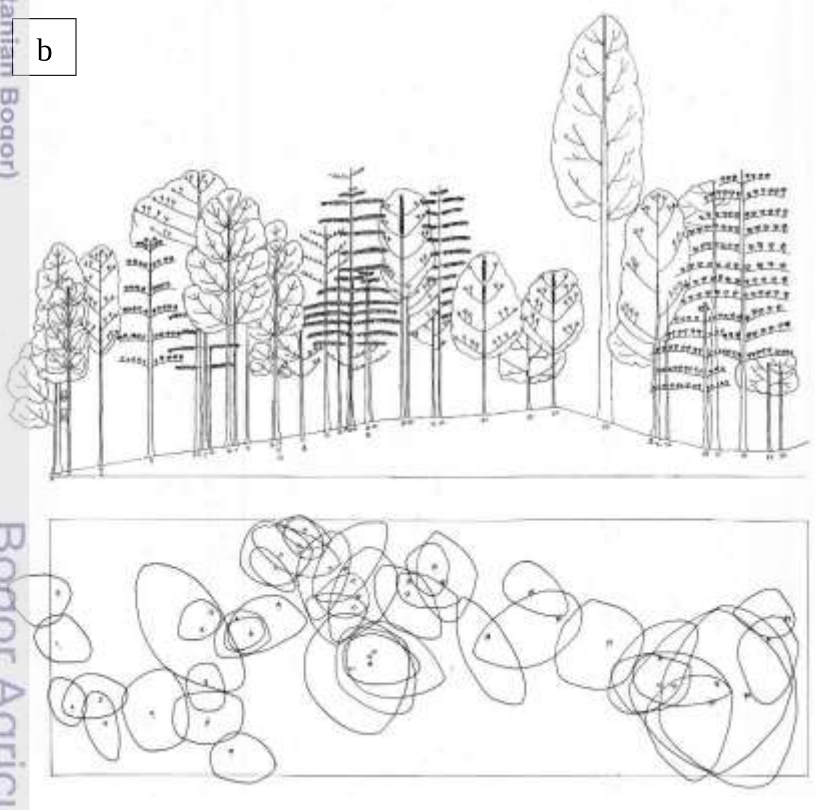
Figure 5 shows the canopy stratification at various altitudes in the Mount Galunggung forest. Canopy stratification formed at each altitude is dominated by trees with strata C. Canopy stratification is formed due to competition for light.

a



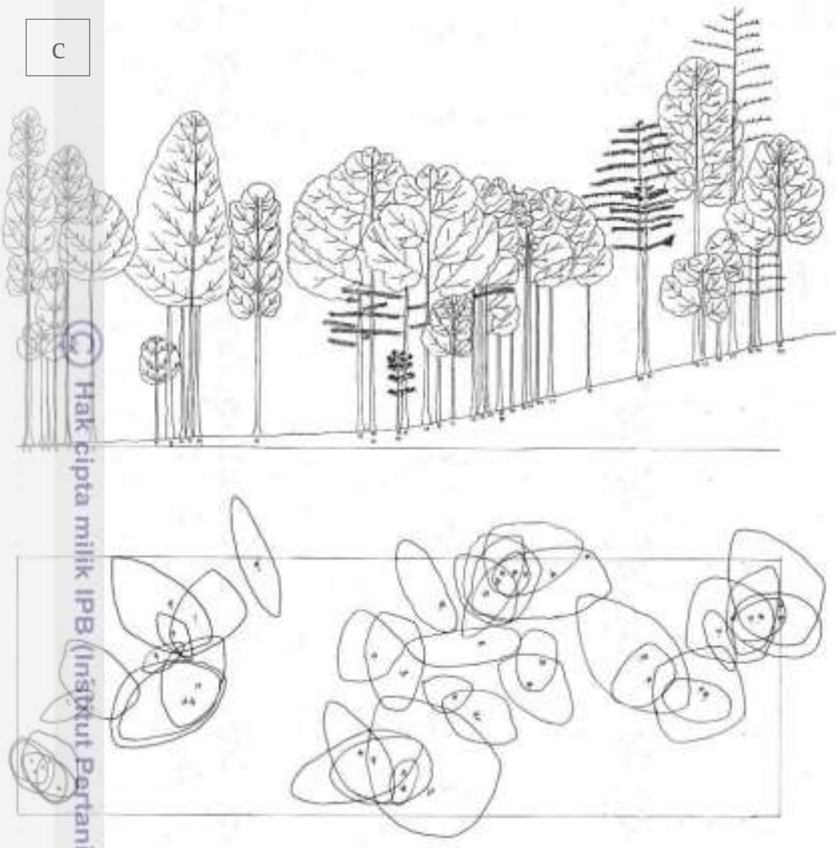
Description:
1, 8: Species A13
2, 14, 17, 24: *Ficus septica*
3, 15: *Macropanax dispermus*
4, 5: Family Lauraceae
6, 7: *Ficus cuspidata*
9, 39, 41, 42: *Eurya obovata*
10, 37,38, 40: *Ficus ribes*
11, 12, 20, 26, 27, 34: *Schima wallichii*
13, 16, 18, 21, 22, 29, 31: *Saurauia pendula*
19: Species A34
23: *Schfflera fastigiata*
28.30: *Antidesma minus*
32, 35: Species A14
33: *Syzygium* sp. 1
36: *Homalanthus populneus*

b



Description:
1, 10, 13, 14, 15: *Schima wallichii*
2, 6, 9, 12: Species O
3, 43: Species G1
4,36,39,40: *Macropanax Dispermus*
5, 7, 42: *Castanopsis javanica*
10: *Syzygium* sp. 1
11: *Turpinia* sp.
16: *Simplocos spicata*
17: *Eurya acuminata*
18, 19: Species Z10
20,21,22,26: *Simplocos costata*
25, 32: *Ficus ribes*
23,24,34,35: *Saurauia pendula*
33, 27, 28, 29, 30, 31: *Syzygium lineatum*
38, 41: *Homalanthus populneus*
37, 44: *Ficus septica*

c



Description:
1, 2, 3, 5, 6, 7, 10, 11, 12, 13, 14, 15, 48: *Schima wallichii*
4: *Myrsine avenis*
8: *Eurya acuminata*
9,18,46,47: *Macropanax Dispermus*
16, 19, 22, 23: Species A6
17, 20, 24, 25, 26, 27, 28,31,32,44: *Homalanthus populneus*
21,29,30: *Endiandra rubescens*
5, 7, 42: *Castanopsis javanica*
33, 34:*Meliosma ferruginea*
39, 40: *Syzygium* sp. 2
35, 36, 37, 38: *Ficus septica*
41: Species U2
42, 43: *Ficus ribes*
45: *Simplocos costata*

Figure 5 Diagram of the canopy profile at various altitudes: (a) 1300 m asl, (b) 1400 m asl, (c) 1600 m asl

Soil Quality

Soil texture data at various altitudes are presented in Table 14. Soil texture at all elevations is dominated by sand, with the highest percentage of sand found at an altitude of 1600 m asl at 84.73%. Soil texture at various altitudes belongs to the class of loamy sand.

Table 14 Soil texture at various altitudes

Altitude		Texture (%)			Texture class
		Sand	Dust	Clay	
1300 m asl	1	76.42	15.96	7.62	
	2	72.11	18.85	9.05	
	3	79.19	10.11	10.70	
Average		75.91	14.97	27.37	Loamy sand
1400 m asl	1	83.13	10.52	6.35	
	2	79.08	13.37	7.54	
	3	79.71	12.47	7.82	
Average		80.64	12.12	7.24	Loamy sand
1600 m asl	1	91.32	3.56	5.13	
	2	84.42	6.79	8.79	
	3	78.46	12.35	9.18	
Average		84.73	7.57	7.7	Loamy sand

Source: Hardjowigeno (2007)

Table 15 Chemical properties of soil at various altitudes

Altitude		pH	C-org (%)	N-Total (%)	P (ppm)	K (ppm)	CEC (cmol (+)/kg)
1300 m asl	1	5.28	4.40	0.28	25.12	22.55	16.60
	2	5.15	4.08	0.22	16.11	71.29	9.73
	3	5.21	6.36	0.32	20.62	34.13	22.11
Average		5.21 (Sour)	4.95 (High)	0.27 (Medium)	20.62 (Medium)	43.66 (Very high)	16.15 (Medium)
1400 m asl	1	5.11	1.47	0.17	17.59	12.88	9.40
	2	5.09	2.79	0.17	17.80	16.53	11.05
	3	4.97	2.65	0.25	13.83	26.56	15.24
Average		5.06 (Sour)	2.3 (Medium)	0.20 (Low)	16.40 (Low)	18.66 (Low)	11.9 (Low)
1600 m asl	1	4.86	3.68	0.33	15.91	24.05	13.11
	2	4.84	5.39	0.29	12.74	28.05	17.99
	3	5.44	5.53	0.29	17.51	17.78	19.33
Average		5.05 (Sour)	4.87 (High)	0.30 (Medium)	15.39 (Low)	23.29 (Medium)	16.81 (Medium)

Source: Soil Research Center Staff (1983) in Hardjowigeno (2007)

Based on the data in Table 15, it is known that the pH of the soil at each altitude is classified as acidic. The highest organic C content is found at an altitude of 1300 m asl at 4.95%. The highest total N content is found at an altitude of 1600 m asl at 0.30%. The highest P and K content was found at an altitude of 1300 m asl with a concentration of 20.62 ppm and , respectively 43.66 ppm. Then, the highest CEC is at an altitude of 1600 m asl of 16.81 cmol (+)/kg.

Discussion

Species Composition and Stand Structure

Part of the forest area of Mount Galunggung is a protected forest which is currently managed by KPH Tasikmalaya. After the eruption, Mount Galunggung experienced a secondary succession. Based on the results of the study, it was known that the number of species found at each growth stage and understorey did not show a very significant difference at each height. However, in general, the number of plant species found tends to decrease with increasing altitude. This is in accordance with Yamada (1976) and Ibadurrahmah (2016), which state that with increasing altitude of a place, the number of species found will decrease.Increasing the altitude of a place causes a decrease in the concentration of CO_2. This is in accordance with Muhdi (2004) which states that in areas with high elevations the CO_2 concentration is relatively smaller than in areas with lower elevations. CO_2 is needed by trees in large quantities for photosynthesis, so if the concentration is low, photosynthesis does not work well. This causes only certain tree species that are able to adapt to these conditions. Every kind of plant has certain prerequisites regarding environmental conditions that can support its growth and distribution.

At the level of poles and trees at an altitude of 1300 m asl, fewer species were found than at an altitude of 1400 m asl. This is thought to be caused by forest disturbances in the form of tree cutting activities carried out by the community around the forest, because the location of the forest at an altitude of 1300 m asl is more easily accessible by the community. This is in accordance with Smiet (1992), which states that tree felling in Java is strongly influenced by accessibility such as topographic conditions, where tree felling occurs more in flat locations and close to the outer forest boundary. In addition, this location is a route to tourist attractions that are often passed by the community, thus allowing disturbances to the forest ecosystem. The existence of forest disturbances by humans causes damage to forest ecosystems,

The highest number of understorey species was found at an altitude of 1300 m asl. Understorey is greatly affected by sunlight entering the forest floor. Hilwan *et al.* (2015) stated that abundant sunlight will trigger the growth and development of intolerant understorey. In addition, the presence of understorey is also strongly influenced by soil conditions such as pH.

Based on the data that has been obtained, it is known that the species that dominate at one growth level do not always dominate at the next growth level, in fact there are some plant species that are only found at a certain growth level. This is in accordance with Dendang and Handayani (2015), which states that not all species of vegetation are always found at every growth level. This is thought to be caused by disturbances that affect the regeneration process, causing changes in the composition of species occupying each growth stage.

At the research site, many pioneer species such as *Homalanthus populneus*, *Ficus* spp., and *Schima wallichii* were still found. The species of climax such as *Castanopsis javanica* and *Macropanax dispermus* also dominate at a certain height. *Homalanthus populneus* predominates at the seedling level at an altitude of 1300 m asl and at the pole level at an altitude of 1 600 m asl. This is due to a more open canopy cover, so that more sunlight enters the forest floor and then encourages seeds of this species to grow. According to van Valkenburg and Ketner (1994) in Zuhri *et al.* (2016), the species *Homalanthus* sp. predominate in stands undergoing secondary succession in montane forest.

Macropanax Dispermus dominates at the seedling and pole levels at an altitude of 1400 m asl because at that altitude the conditions are suitable for growth, where according to Backer and van den Brink (1965), *Macropanax dispermus* is found in moist forests with an altitude of 1000-2300 m asl. Furthermore, the dominant species of *Turpinia montana* at an altitude of 1600 m asl because this species is a species that can be easily found in western Java at an altitude of 750-2300 m asl (Steenis 1972).

Other pioneer species, such as *Ficus ribes*, were also found to dominate at the sapling level at an altitude of 1300 m asl. This species can grow to 15 m with a diameter of up to 30 cm, grows at an altitude of 100-1800 m asl and is very common in mountain forests (Heyne 1987). In addition, the species *Ficus septica* dominates at the pole level at an altitude of 1300 m asl. The species *Castanopsis javanica* was found to dominate at an altitude of 1300 m asl at tree level. Meanwhile, at an altitude of 1400 m asl and 1600 m asl, the dominant species is *Schima wallichii*. *Castanopsis javanica* and *Schima wallichii* are always found at every altitude. According to Heyne (1987), *Castanopsis javanica* can live at an altitude of 90-1650 m asl. *Schima wallichii* is found in rainforests, in the valleys to the mountains at an altitude of >700 m asl.

The understorey that dominates at an altitude of 1300 m asl and 1400 m asl is *Begonia robusta*, while at an altitude of 1600 m asl is *Pilea melastomoides*. *Begonia robusta* is found at all altitudes, although it does not dominate at an altitude of 1600 m asl. According to Steenis (1972), Begonia robusta is a typical species found in West Java at an altitude of 700-2400 m asl.

The high value of the important value index of a species is caused by its large density and its distribution evenly throughout the area. At the pole and tree level, the size of the trunk diameter is also very influential on the value of the important index. Kusmana and Susanti (2015), explain that the dominance of a plant species is caused by its better ability to utilize existing resources compared to other species.

The dominance index value obtained is low because it tends to be close to zero. This shows that at each level of growth and understorey at various altitude it is not controlled by one plant species, but is controlled by several plant species together and is also a picture of tropical forests even though the research location was carried out in disturbed forests (Mulyana *et al.* al.2017).

The diversity index is used to see the level of plant species diversity in a forest community. Based on the data presented in Table 9, it is known that the species diversity index obtained is classified as moderate (2 < H' < 3). The higher the species diversity, the more stable the community will be and have a higher ability to deal with forest disturbances (Irwan 2009). The diversity index value is strongly influenced by two things, namely the abundance of species and the evenness of species (Mulyasana 2008). If more and more species are found and the number of individuals in each species is evenly distributed, the diversity index value obtained will be higher.

Furthermore, the species richness index is used to determine the species richness in a community. Based on the research results presented in Table 10, it is known that the wealth index value is classified as low (R < 3.5) to high (R > 5.0). The value of the species richness index is directly proportional to the number of plant species in a community. The greater the number of plant species found, the greater the wealth index value (Oladoye *et al.* 2014). Overall, the highest wealth index value at each growth level and understorey are found at an altitude of 1400 m asl, 1300 m asl and 1600 m asl.

The evenness index value obtained tends to be close to 1. This indicates that almost all species at each growth stage and understorey at various altitude have an even number of individuals. Ludwig and Reynold (1988) stated that the addition of species in a community, especially species that have low individual values can have a significant effect on the value of the species evenness index.

The species similarity index shows the level of similarity in the species composition of several communities being compared. Based on the results of the study, it is known that the species composition at each growth stage and understorey at various altitude compared has a community similarity index value ranging from 21.76-67.30%, so that the species composition of community composition tends to be different to similar.

The composition of tree-level species at an altitude of 1300 m asl with 1400 m asl has the highest similarity index value of 62.50% and at an altitude of 1400 m asl with 1600 m asl has a similarity index value of 51.22%. So that the composition of tree species at the altitude compared is relatively similar. The composition of understorey species at an altitude of 1300 m asl with 1400 m asl is also relatively similar because it has a similarity index value of 67.30%. Differences in species composition in a community are caused by different environmental conditions (temperature, humidity, topography, and soil) and forest disturbances.

Kershaw (1964) in Mueller-Dumbois and Ellenberg (1974) distinguishes the components of vegetation structure into three, namely vertical structure (ie stratification into several layers), horizontal structure (ie distribution of population and individual species according to space) and quantitative structure (ie abundance of each species). species in the community). Individual density at various altitudes decreases with increasing growth rate, thus forming an inverted J curve which is a characteristic of non-age natural forest stands (Hilwan 2012).

Decreasing density along with increasing growth rate indicates that individuals at a certain growth level do not all grow to the next growth level. This is due to competition between individuals within the same species and competition between different species. This competition occurs in terms of obtaining light, groundwater, oxygen, nutrients, carbon dioxide, and space (Vickery 1984 in Indriyanto 2012; Soerianegara and Indrawan 2016).

Individual density at each growth stage at an altitude of 1300 m asl is lower when compared to an altitude of 1400 m asl. This is thought to be caused by forest disturbances in the form of tree cutting that occurred at an altitude of 1300 m asl. However, the felling of trees that occurred did not significantly affect the regeneration process that took place. This can be seen from the individual density at the level of seedlings, saplings, poles and trees at various altitude that in line with Wyatt-Smith (1963) criteria, where regeneration is considered sufficient if 40% or 1000 seedlings/ha are evenly distributed, at the sapling level. at least 60% or 240 saplings/ha evenly distributed, at the level of 75% or 75 piles/ha evenly distributed and at the level of 100% trees or 25 trees/ha spread evenly. The availability of seedlings, saplings and poles in a forest must be sufficient to ensure a natural regeneration process.

The horizontal stand structure can be seen from the relationship between tree density and the distribution of diameter classes. The highest tree density at various altitudes was found in the 20-30 cm diameter class and the lowest tree density was found in the >60 cm diameter class. This is in accordance with Daniel *et al.* (1987) and Oladoye *et al.* (2014) which states that the number of trees is spread out in the smallest diameter class and the number decreases with increasing tree diameter, so that only a few large diameter trees remain.

The vertical stand structure can be seen from the relationship between tree density and canopy height. The division of high class is carried out by following the tree strata according to Soerianegara and Indrawan (2016), namely stratum A with tree heigh >30 m, stratum B with a tree height of 20-30 m and stratum C with a tree height of 4-20 m. Based on Figure 3, trees in the 4-20 m high class have the highest density at various altitude. Tree density decreases with increasing tree height class.

The canopy stratification formed at various altitude was dominated by the C stratum (4-20 m high). Trees in stratum C have a continuous crown, the trees are low, small and have many branches (Soerianegara and Indrawan 2016). Based on the results of the study, it is known that the canopy stratification formed at an altitude of 1300 m asl and 1600 m asl consists of stratum B and C, while at an altitude of 1400 m asl consists of stratum A, B and C. Yamada (1976) states that with increasing altitude, place, the tree height will decrease and the canopy stratification formed will be simpler.

Based on the above vegetation conditions, the forest of Mount Galunggung is still undergoing a secondary succession process. The development of vegetation at the research site has not reached a climax. The secondary succession process that is currently taking place has been disrupted again, especially at an altitude of 1300 m asl. This causes pioneer species to still dominate, especially at an altitude of 1300 m asl. Sutanto (2002) stated that before the eruption in 1982-1983, the forest of Mount Galunggung had formed a climax forest community which was characterized by the composition of its constituent vegetation which was dominated by tides (Lithocarpus sp.) and saninten (Castanopsis sp.) from the Fagaceae family, jamuju (Podocarpus imbricatus) from the family Podocarpaceae, and huru (Litsea sp.) from the family Lauraceae.

Soil Quality

Based on the results of soil analysis, the soil texture at all altitude is dominated by the sand fraction with an average percentage of 75.91-84.73%, so that it is included in the clay sand texture class. Sand textured soil has a smaller surface area per unit weight because the grains are larger, making it difficult to absorb water and nutrients (Hardjowigeno 2007). Besides In addition, sandy textured soils have fast soil permeability, which causes water to escape quickly and cannot be absorbed by plant roots so that water needs for plants cannot be fulfilled (Nandini and Narendra 2011). Soil texture will affect the chemical properties of the soil such as CEC and the availability of nutrients.

The soil texture which is dominated by sand indicates that the location has experienced forest disturbances in the form of volcanic eruptions. According to Gunawan *et al.* (2015), post-eruption soil texture is dominated by volcanic ash and sand as found in Mount Merapi National Park. Nandini and Narendra (2011) also stated that the soil texture was dominated by sand with a percentage of 82-94.5% in the area after the eruption of Mount Batur.

Soil pH at various altitudes is acidic. Soil pH determines whether or not nutrients are easily absorbed by plants. In acidic soils, P nutrients cannot be absorbed by plants because they are bound by Al. This element of Al is also toxic to plants. Then, acidic soil pH also affects the development of microorganisms. At acidic soil pH the development of soil bacteria is very inhibited (Hardjowigeno 2007). According to Dong *et al.* (2009), pH has a positive correlation with CEC and availability of nutrients such as C-organic, total N, P and K. Where a high pH will cause CEC and nutrient content to also increase. Fauzie *et al.* (2015) explained that pH can change over time due to the presence of plants growing in the area.

C-organic indicates the amount of organic matter present in the soil. The organic matter is a pile of plant residues that play an important role in increasing soil pH, soil cation exchange capacity and soil nutrients (Hardjowigeno 2007). Soil with high organic C content is found at an altitude of 1300 m asl and 1600 m asl. The high content of organic C is caused by the high level of decomposition of organic matter on the forest floor. Decomposition of organic matter is strongly influenced by temperature, humidity, soil air system, tillage, pH, and the species of organic matter. At an altitude of 1300 m asl, the ambient temperature is higher (22o C), when compared to other altitudes, causing decomposition to take place more quickly (Hardjowigeno 2007). Then, at an altitude of 1600 m asl, The high C-organic is caused by the abundance of litter as a source of organic matter. This is in accordance with Wezel *et al.* (2000) which states that litter can affect the level of soil enrichment, where abundant litter will increase the organic matter content of the soil.

The content of N-total at the study site is low to moderate. The content of total N which is classified as moderate is found at an altitude of 1300 m asl and 1600 m asl. Soil organic matter is the main source of N in the soil (Hardjowigeno 2007). The higher the organic matter, the nitrogen in the soil will increase. In addition, nitrogen in the soil can also come from a symbiosis with leguminoceae plants and free-living bacteria, as well as rainwater.

Phosphorus has a very important role for plants. Phosphorus has a function in cell division, strengthens stems so they don't collapse easily, forms flowers, fruits and seeds, develops roots, builds RNA and DNA, and so on (Hardjowigeno 2007; Lakitan 2008). Based on the data presented in Table 15, it is known that the phosphorus content in the soil is classified as moderate at an altitude of 1300 m asl. The higher phosphorus content is found at an altitude of 1300 m asl. This is because at an altitude of 1300 m asl has a higher soil pH. In soils with low pH, elemental P is bound by elements of Al and Fe so it cannot be used by plants (Hardjowigeno 2007).

Elemental K in soil derived from primary soil minerals such as feldsar, mica and so on. The high K content is found at an altitude of 1300 m asl. Elemental K has a role in starch formation, activating various enzymes, regulating cell turgor pressure, influencing the absorption of other elements, increasing drought resistance, and root development (Hardjowigeno 2007; Lakitan 2008).

Cation exchange capacity (CEC) indicates the soil's ability to hold and exchange cations. Cation exchange capacity is a chemical property that is closely related to soil fertility (Hardjowigeno 2003). Based on the research results presented in Table 15, the CEC obtained is classified as low-medium. Soils with low CEC have the ability to absorb and have lower nutrient storage capacity. CEC is also strongly influenced by the content of organic matter in the soil. Soils with a high organic matter content will have a higher CEC. Soil at an altitude of 1300 m asl and 1600 m asl contains higher organic C than the altitude of 1400 m asl, causing the CEC to increase.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Total number of plant species found at the seedling level were 46 species, 41 species of sapling, 41 species of pole, 56 species of tree, and 52 species of understorey. The species composition at the research site was dominated by pioneer species such as Homalanthus populneus, Ficus ribes, Ficus septica, Ficus fistulosa, Ficus cuspidata, and Schima wallichii as well as climax species such as Castanopsis javanica and Macropanax dispermus. The quantitative and horizontal structure of the stand formed an inverted J curve. The vertical structure of the stand was dominated by trees at a height class of 10-20 m (strata C) at each altitude. Soil fertility in the study area is classified as low-medium.

Suggestion

It is necessary to carry out more intensive forest maintenance to prevent more severe damage to the protected forest of Mount Galunggung.

BIBLIOGRAPHY

Backer A, van den Brink RC. 1965. *Flora of Java (Spermatophytes Only) Vol. II*. Groningen (NE): NVP Noordhoff.

Daniel TW, Baker FS, Helms JA. 1979. Principles of Silviculture. Marsono D, translator; Soseno OH, editor. Yogyakarta (ID): Gajah Mada University Pr. Translation from: Principles of Silviculture. 2nd Ed.

Dendang B, Handayani W. 2015. Structure and composition of forest stands in Gunung Gede Pangrango National Park, West Java. Pros Sem Nas Masy Biodiv Indonesia. 1(4).

Dong XW, Zhang XK, Bao XL, Wang JK. 2009. Spatial distribution of soil nutrients after the establishment of sand-fixing shrubs on sand dune. Plant Soil Environment. 55(7):288-294.

Fauzie AK, Khudsar FA, Sreenivasa. 2015. Analysis of soil physico-chemical properties in various sites at Yamuna Biodiversity Park, Delhi, India. IJIRSET. 4(8).

Gunawan W, Basuni S, Indrawan A, Prasetyo LB, Soedjito H. 2011. Analysis of vegetation composition and structure on efforts to restore the forest area of Gunung Gede Pangrango National Park. JPSL. I1(2):93-105.

Gunawan H, Heriyanti NM, Subiandono E, Mas'ud E, Krisnawati H. 2015. Invasion of exotic species in post-eruption degraded areas in Mount Merapi National Park. Pros Sem Nas Masy Biodiv Indonesia. 1(5):1027-1033.

Hafazallah K. 2014. Plant Diversity in Protected Areas of IUPHHK-HT PT. Wana Hijau Pesaguan West Kalimantan Province [thesis]. Bogor (ID): Bogor Agricultural University.

Hardjowigeno S. 2003. Soil Classification and Pedogenesis. Jakarta (ID): CV Akademika Pressindo.

Hardjowigeno S. 2007. Soil Science. Jakarta (ID): Akademika Pressindo.

Heyne K. 1987. *Plants Useful Indonesia*. Volume II. Jakarta (ID): Forestry Research and Development Agency.

Hilwan I. 2012. Species composition and stand structure in logged-over areas at PT Salaki Summa Sejahtera, West Sumatra Province. Journal of Tropical Silviculture. 03(03): 155-16.

Hilwan I. 2013. Diversity of understorey species in stands of sengon buto (Enterolobium cyclocarpum Griseb.) and trembesi (Samanea saman Merr.) in post-coal mining area of PT Kitadin, Embalut, Kutai Kartanagara, East Kalimantan. Journal of Tropical Silviculture. 04(01): 6-10.

Hilwan I, Masyrafina I. 2015. Diversity of understorey species in the eastern part of Mount Papandayan, Garut, West Java. Journal of Tropical Silviculture. 6(2).

Ibaadurrahmah N. 2016. Distribution and regeneration patterns of puspa (Schima Wallichii (Dc.) Korth.) at Selabintana Resort Gunung Gede Pangrango National Park [essay]. Bogor (ID): Bogor Agricultural University.

Indriyanto. 2012. Forest Ecology. Jakarta (ID): PT Bumi Aksara.

Irwan TD. 2009. Species composition and structure of forest stands in Mount Ciremai National Park, West Java [thesis]. Bogor (ID): Bogor Agricultural

University.
Krebs C J. 1978. Ecology: The Experimental Analysis of Distribution and Abundance. Second Edition. New York (US): Harper and Row Publisher.
Kusmana C. 1997. Vegetation Survey Methods. Bogor (ID): PT Publisher Bogor Agricultural University.
Kusmana C, Susanti S. 2015. Composition and structure of natural forest stands in Gunung Walat Educational Forest, Sukabumi. Journal of Tropical Silviculture. 5(3):210-217. Lakitan B. 2008. Fundamentals of Plant Physiology. Jakarta (ID): PT Raja Grafindo
Homeland.
Ludwig JA, Reynolds JF. 1988. Statistical Ecology a Primer on Methods and Computing. New York (US): John Wiley & Sons, Inc.
Magurran AE. 1988. Ecological Diversity and its Measurement. London (UK): Chapman & Hall.
Muhdi. 2004. Effect of elevation on growth and quality of wood [thesis].
Medan (ID): University of North Sumatra.
Mueller-Dumbois D, Ellenberg H. 1974. Aims and Methods of Vegetation of Ecology. New York (US): John Willey & Sons, Inc.
Mulyasana D. 2008. Study of tree species diversity at various altitudes in Mount Ciremai National Park, West Java Province [thesis]. Bogor (ID): Bogor Agricultural University.
Mulyana D, Kusmana C, Budi SW, Wasis B. 2017. Species and structure composition of disturbed forest stand in Papandayan Mountain, West Java Indonesia. IJSBAR. 31(2):286-296.
Nandini R, Narendra BH. 2011. Characteristics of critical land after the eruption of Mount Batur in Bangli Regency, Bali. Journal of Forest Research and Nature Conservation. 9(3):199-211.
Oladoye AO, Aduradola AM, Adedire MO, Agboola DA. 2014. Composition and stand structure of regenerating tropical rainforest ecosystem in South-western Nigeria. International Journal of Biodiversity and Conservation. 6(11):765-776.
Smiet AC. 1992. Forest ecology on Java: human impact and vegetation of montane forest. Journal of Tropical Ecology. 8:129-152.
Smith AP. 1973. Stratification of temperate and tropical forests. The American Naturalists. 107(957):671-683.
Soerianegara I. Indrawan A. 2016. Indonesian Forest Ecology. Bogor (ID): Forest Ecology Laboratory, Faculty of Forestry, Bogor Agricultural University.
Suhendang E. 2002. Introduction to Forestry Science. Bogor (ID): Forestry Faculty Publishing Foundation.
Sutanto A. 2002. Succession of tree species and understorey vegetation after the eruption of Mount Galunggung (case study at BKPH Tasikmalaya. KPH Tasikmalaya PT. (Persero) Perhutani Unit III West Java) [thesis]. Bogor (ID): Bogor Agricultural University.
Steenis CGGJ van. 1972. Flora of the Javan Mountains. Kartawinata JA, translator. Bogor (ID): Bogor Research Center LIPI. Translation from: The Mountain Flora of Java.
Widodo W. 2014. Bird population and distribution patterns in the Galunggung Wanawisata Forest, Tasikmalaya, West Java. Bioscientific. 6(1):29-38.

Wezel A, Rajot JL, Herbrig C. 2000. Influence of shrubs on soil characteristic and their functional in Sahelian ecosystems in semi-arid Niger. Journal of Arid Environments. 44(4):383-398.

Whitmore TC. 1986. Tropical Rain Forest of the Far East. Oxford (UK): Oxford University Press.

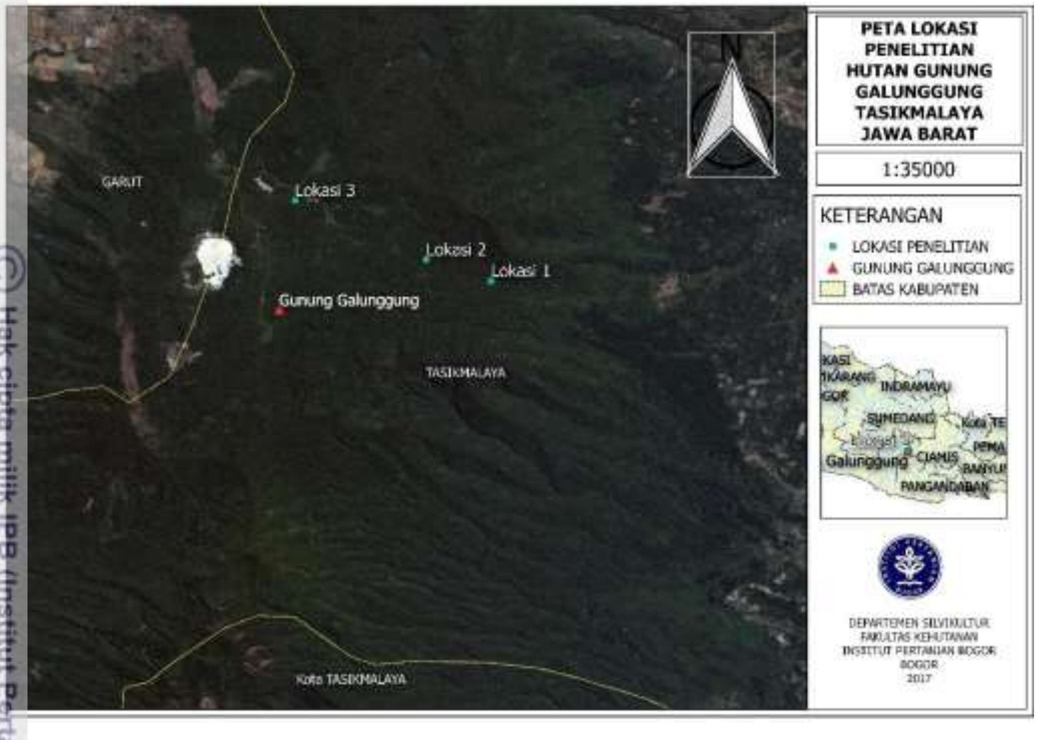
Wyatt-Smith J. 1963. Manual of Malayan silviculture for inland forests. Malayan Forest Records. 23(1).

Yamada I. 1976. Forest ecological studies of the montane forest of Mt. Pangrango, West Java : stratification and floristic composition of the forest vegetation of the higher part of Mt. Pangrango. South East Asian Studies. 13(2).

Zuhri M, Wiriadinata H, Astuti RS, Hadiwahuyo, Syamsudin. 2016. Botanical exploration and crater vegetation survey of Mt. Galunggung, West Java. Journal of Tropical Life Science. 6(2):69-78.

Zukhri M, Mutaqien Z. 2011. Changes in vegetation composition and tree structure in the Meijer plot (1959-2009) in Gunung Gede, West Java. Botanical Gardens Bulletin 14(1).

Appendix 1 Research site map



Appendix 2 Species of plants found at the research site

No.	Local Name	Species name	Family
1	Kareumbi	*Homalanthus populneus*	Euphorbiaceae
2	Jirak	*Symplocos spicata*	Symplocaceae
3	ki bancet	*Turpinia montana*	Staphyleaceae
4	Kukupaan	*Syzygium glomeriflorum*	Myrtaceae
5	Beunying	*Ficus fistulosa*	Moraceae
6	Darangdan	*Ficus cuspidata*	Moraceae
7	-	*Syzygium* sp. 2	Myrtaceae
8	Cempaka goiter	*Magnolia lilifera*	Magnoliaceae
9	Jungle tea	*Camellia lanceolata*	Theaceae
10	Ki leho rhino	*Saurauia nudiflora*	Actinidiaceae
11	Peanuts	*Phoebe Grandis*	Lauraceae
12	Tunggeureuk	*Castanopsis tungurrut*	Fagaceae
13	Ki peacock	*Eurya acuminata*	Theaceae
14	-	*litsea* sp. 2	Lauraceae
15	Huru buweuk	*litsea mappacea*	Lauraceae
16	Huru taleus	*Pyrenaria acuminata*	Theaceae
17	Ki leho canting	*Saurauia pendula*	Actinidiaceae
18	Roast	*Schefflera fastigiata*	Araliaceae
19	Occupy	*Antidesma minus*	Phyllanthaceae
20	Ki somang	*Sloanea sigun*	Elaeocarpaceae
21	Put the stone	*Lithocarpus elegans*	Fagaceae
22	-	*Macropanax sp.*	Araliaceae
23	-	Unident 1	Sapindaceae
24	-	*Syzygium sp.*1	Myrtaceae
25	Bake	*Macropanax Dispermus*	Araliaceae
26	Walen	*Ficus ribes*	Moraceae
27	warning	*Ficus septica*	Moraceae
28	jirak costa	*Symplocos costata*	Symplocaceae
29	Ki hiyur	*Castanopsis javanica*	Fagaceae
30	Ki leho	*Saurauia* sp.	Actinidiaceae
31	Ki bone	*Syzygium lineatum*	Myrtaceae
32	-	*litsea* sp. 1	Lauraceae
33	Ki hurang	*Pyrenaria serrata*	Theaceae
34	-	*Prunus grisea*	Rosaceae
35	-	*Urophyllum* sp.	Rubiaceae
36	-	*Archidendron clypearia*	Fabaceae
37	Jamuju	*Podocarpus koordersii*	Podocarpaceae
38	Puspa	*Schima wallichii*	Theaceae
39	Nancy	*Oreocnide rubescens*	Urticaceae
40	Ki orange	*Acronychia pedunculata*	Phyllantaceae
41	Huru	*Prunus arborea*	Rosaceae
42	Kahiutan	*Lasianthus inodorus*	Rubiaceae
43	-	*Maoutia setosa*	Urticaceae
44	rhino mirror	*Meliosma ferruginea*	Meliosmaceae
45	seuhang	*Ficus grossularioides*	Loganiaceae

Appendix 3 Species of plants found at the research site (continued 1)

No.	Local Name	Species name	Family
46	-	*Tarenna polycarpa*	Rubiaceae
47	-	*Breynia vitis-idaea*	Phyllanthaceae
48	Ki hurang	*Perrottetia alpestris*	Dipentodontaceae
49	Huru	*Endiandra rubescens*	Lauraceae
50	-	*Sloanea* sp.	Elaeocarpaceae
51	Eurya	*Eurya obovata*	Theaceae
52	-	*Eurya* sp.	Theaceae
53	Barito Tabat	*Ficus deltoidea*	Moraceae
54	Bareubeuy	*Myrsine Avenis*	Myrsinaceae
55	-	*Turpinia* sp.	Staphyleaceae
56	-	Unident 2	Lauraceae
57	-	Unident 3	Sapotaceae
58	Huru	Unident 4	Lauraceae
59	-	Unident 5	-
60	-	Unident 6	-
61	Ell	*Alpinia sp.*	Zingiberaceae
62	-	*Athyrium sorzogonense*	Woodsiaceae
63	elephant spikes	*Angiopteris evecta*	Marattiaceae
64	Ordinary kadaka	*Asplenium nidus*	Aspleniaceae
65	Rendeu	*Argostemma uniflorum*	Rubiaceae
66	Rendeu	*Argostemma borragineun*	Rubiaceae
67	Bereum day	*Begonia robusta*	Begoniaceae
68	nail hejo	*Blechnum capense*	Blechnaceae
69	Taro	*Caladium sp.*	Araceae
70	Ki groan	*Chromolaena odorata*	Asteraceae
71	Harendong boy	*Clidemia hirta*	Melastomataceae
72	Rhino Rendeu	*Cyrtandra picta*	Gesneriaceae
73	-	*Decaspermum* sp.	Myrtaceae
74	-	*Decaspermum* sp. 2	Myrtaceae
75	-	*Dysporum cantoniense*	Colchicaceae
76	wood potion	*Elatostema* sp.	Urticaceae
77	wood potion	*Elatostema* sp. 2	Urticaceae
78	-	*Gonostegia hirta*	Urticaceae
79	Hujur butt	*Kadsura scandens*	Schisandraceae
80	-	*Macodes javanica*	Orchidaceae
81	-	*Malaxis oculata*	Orchidaceae
82	Nail	*Oleandra pistillaris*	Oleandraceae
83	Poh-pohan	*Pilea melastomoides*	Urticaceae
84	Nail	*Polypodium persicifolium*	Polypodiaceae
85	Big Hareeus	*Rubus molluccanus*	Rosaceae
87	Tangkur nails	*Selliguea heterocarpa*	Polypodiaceae
88	-	-	Orchidaceae
89	-	-	Rubiaceae
90	Nail	*Dysplazium esculentum*	Athyriaceae

Appendix 4 Species of plants found at the research site (continued 2)

No.	Local Name	Species name	Family
91	Nail 1	-	-
92	Nail 2	-	-
93	Nail 2	-	-
94	3 nails	-	-
95	4 nails	-	-
96	Nail 5	-	-
97	Grass	*Commelina diffuse*	Poaceae
97	Grass 2	-	Poaceae
99	Unident 7	-	-
100	Unident 8	-	-
101	Unident 9	-	-
102	Unident 10	-	-
103	Unident 11	-	-
104	Unident 12	-	-
105	Unident 13	-	-
106	Unident 14	-	-
107	Unident 15	-	-
108	Unident 16	-	-
109	Unident 17	-	-
110	Unident 18	-	-
111	Unident 19	-	-
112	Unident 20	-	-
113	-	-	Zingiberaceae

Appendix 3 IVI of seedling at an altitude of 1300 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Homalanthus populneus*	1100	10.09	0.24	12.50	22.59
2	*Symplocos spicata*	1000	9.17	0.16	8.33	17.51
3	*Turpinia montana*	1100	10.09	0.12	6.25	16.34
4	*Syzygium glomeriflorum*	700	6.42	0.16	8.33	14.76
5	*Ficus fistulosa*	600	5.50	0.16	8.33	13.84
6	*Ficus cuspidata*	800	7.34	0.12	6.25	13.59
7	*Syzygium* sp. 2	900	8.26	0.08	4.17	12.42
8	*Magnolia lilifera*	500	4.59	0.12	6.25	10.84
9	*Camellia lanceolata*	800	7.34	0.04	2.08	9.42
10	*Saurauia nudiflora*	300	2.75	0.08	4.17	6.92
11	*Phoebe Grandis*	500	4.59	0.04	2.08	6.67
12	*Castanopsis tungurrut*	200	1.83	0.08	4.17	6.00
13	*Syzygium lineatum*	400	3.67	0.04	2.08	5.75
14	*Eurya acuminata*	300	2.75	0.04	2.08	4.84
15	*litsea* sp. 2	300	2.75	0.04	2.08	4.84
16	*litsea mappacea*	200	1.83	0.04	2.08	3.92
17	*Pyrenaria acuminata*	200	1.83	0.04	2.08	3.92
18	*Saurauia pendula*	200	1.83	0.04	2.08	3.92
19	*Schefflera fastigiata*	200	1.83	0.04	2.08	3.92
20	*Antidesma minus*	100	0.92	0.04	2.08	3.00
21	*Sloanea sigun*	100	0.92	0.04	2.08	3.00
22	*Lithocarpus elegans*	100	0.92	0.04	2.08	3.00
23	*Macropanax sp.*	100	0.92	0.04	2.08	3.00
24	Unident 1	100	0.92	0.04	2.08	3.00
25	*Syzygium sp.*1	100	0.92	0.04	2.08	3.00
		10900	100	1.92	100	200

Appendix 4 IVI of seedling at an altitude of 1400 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Macropanax Dispermus*	2600	11.06	0.32	11.76	22.83
2	*Saurauia nudiflora*	4000	17.02	0.08	2.94	19.96
3	*Ficus ribes*	1700	7.23	0.32	11.76	19.00
4	*Ficus septica*	1700	7.23	0.28	10.29	17.53
5	*Symplocos spicata*	1800	7.66	0.20	7.35	15.01
6	*Symplocos costata*	2600	11.06	0.08	2.94	14.01
7	*Camellia lanceolata*	1100	4.68	0.16	5.88	10.56
8	*Saurauia pendula*	1100	4.68	0.16	5.88	10.56
9	*Castanopsis javanica*	1000	4.26	0.08	2.94	7.20
10	*Saurauia* sp.	600	2.55	0.12	4.41	6.96
11	*Homalanthus populneus*	700	2.98	0.08	2.94	5.92
12	*Turpinia montana*	600	2.55	0.08	2.94	5.49
13	*Syzygium* sp. 2	500	2.13	0.08	2.94	5.07
14	*Syzygium* sp. 1	400	1.70	0.08	2.94	4.64
15	*Syzygium glomeriflorum*	400	1.70	0.08	2.94	4.64
16	*Pyrenaria acuminata*	400	1.70	0.08	2.94	4.64
17	*Syzygium lineatum*	700	2.98	0.04	1.47	4.45
18	*litsea* sp. 1	500	2.13	0.04	1.47	3.60
19	*Pyrenaria serrata*	200	0.85	0.04	1.47	2.32
20	*Schefflera fastigiata*	200	0.85	0.04	1.47	2.32
21	*Prunus grisea*	100	0.43	0.04	1.47	1.90
22	*litsea* sp. 2	100	0.43	0.04	1.47	1.90
23	*Phoebe Grandis*	100	0.43	0.04	1.47	1.90
24	*Urophyllum* sp.	100	0.43	0.04	1.47	1.90
25	Unident 1	100	0.43	0.04	1.47	1.90
26	*Macropanax* sp.	100	0.43	0.04	1.47	1.90
27	*Archidendron clypearia*	100	0.43	0.04	1.47	1.90
		23500	100	2.72	100	200

Appendix 5 IVI of seedling at an altitude of 1600 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Turpinia montana*	5000	37.04	0.20	6.10	43.13
2	*Macropanax Dispermus*	1600	11.85	0.24	20.00	3185
3	*Symplocos spicata*	2200	16.30	0.16	13.33	29.63
4	*Syzygium lineatum*	700	5.19	0.12	10.00	15.19
5	*Urophyllum* sp.	800	5.93	0.08	6.67	12.59

Appendix 5 IVI of seedling at an altitude of 1600 m asl (continued)

No.	Species name	K	KR	F	FR	IVI (%)
6	*Podocarpus koordersii*	600	4.44	0.08	6.67	11.11
7	*Ficus ribes*	1000	7.41	0.04	3.33	10.74
8	*Castanopsis javanica*	300	2.22	0.08	6.67	8.89
9	*Schima wallichii*	600	4.44	0.04	3.33	7.78
10	*Saurauia* sp.	200	1.48	0.04	3.33	4.81
11	*Pyrenaria serrata*	200	1.48	0.04	3.33	4.81
12	*Saurauia pendula*	200	1.48	0.04	3.33	4.81
13	*Saurauia nudiflora*	100	0.74	0.04	3.33	4.07
		13500	100	1.2	100	200

Appendix 6 IVI of sapling at an altitude of 1300 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Ficus ribes*	448	15.82	0.44	13.10	28.91
2	*Ficus septica*	352	12.43	0.36	10.71	23.14
3	*Ficus fistulosa*	304	10.73	0.28	8.33	19.07
4	*Camellia lanceolata*	176	6.21	0.20	5.95	12.17
5	*Saurauia nudiflora*	224	7.91	0.12	3.57	11.48
6	*Symplocos costata*	128	4.52	0.16	4.76	9.28
7	*Turpinia montana*	128	4.52	0.16	4.76	9.28
8	Unident 1	96	3.39	0.16	4.76	8.15
9	*Syzygium glomeruliferum*	96	3.39	0.16	4.76	8.15
10	*Macropanax* sp.	96	3.39	0.12	3.57	6.96
11	*Oreocnide rubescens*	96	3.39	0.12	3.57	6.96
12	*Syzygium* sp. 1	80	2.82	0.12	3.57	6.40
13	*Magnolia lilifera*	64	2.26	0.12	3.57	5.83
14	*Homalanthus populneus*	80	2.82	0.08	2.38	5.21
15	*Saurauia pendula*	64	2.26	0.08	2.38	4.64
16	*Antidesma minus*	48	1.69	0.08	2.38	4.08
17	*Syzygium lineatum*	48	1.69	0.08	2.38	4.08
18	*Pyrenaria serrata*	32	1.13	0.08	2.38	3.51
19	*Phoebe Grandis*	48	1.69	0.04	1.19	2.89
20	*Schefflera fastigata*	48	1.69	0.04	1.19	2.89
21	*Acronychia pedunculata*	32	1.13	0.04	1.19	2.32
22	*Prunus arborea*	32	1.13	0.04	1.19	2.32
23	*Castanopsis javanica*	16	0.56	0.04	1.19	1.76
24	*Castanopsis tungurrut*	16	0.56	0.04	1.19	1.76
25	*Eurya acuminata*	16	0.56	0.04	1.19	1.76

Appendix 6 IVI of sapling at an altitude of 1300 m asl (continued)

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
26	*Ficus cuspidata*	16	0.56	0.04	1.19	1.76
27	*Lasianthus inodorus*	16	0.56	0.04	1.19	1.76
28	*Maoutia setosa*	16	0.56	0.04	1.19	1.76
29	*Meliosma ferruginea*	16	0.56	0.04	1.19	1.76
		2832	100	3.36	100	200

Appendix 7 IVI of sapling at an altitude of 1400 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Turpinia montana*	624	19.31	0.44	12.64	31.95
2	*Ficus ribes*	288	8.91	0.44	12.64	21.55
3	*Symplocos costata*	304	9.41	0.32	9.20	18.60
4	*Ficus fistulosa*	272	8.42	0.28	8.05	16.46
5	*Camellia lanceolata*	256	7.92	0.24	6.90	14.82
6	*Macropanax* sp.	160	4.95	0.20	5.75	10.70
7	*Ficus septica*	192	5.94	0.32	9.20	15.14
8	*Lasianthus inodorus*	272	8.42	0.16	4.60	13.01
9	*Pyrenaria serrata*	112	3.47	0.12	3.45	6.91
10	*Oreocnide rubescens*	64	1.98	0.08	2.30	4.28
11	Unident 1	96	2.97	0.08	2.30	5.27
12	*Archidendron clypearia*	80	2.48	0.08	2.30	4.77
13	*rupestre geniostoma*	64	1.98	0.08	2.30	4.28
14	*Prunus grisea*	64	1.98	0.08	2.30	4.28
15	*Saurauia nudiflora*	32	0.99	0.08	2.30	3.29
16	*Castanopsis javanica*	64	1.98	0.04	1.15	3.13
17	*Syzygium* sp. 1	16	0.50	0.04	1.15	1.64
18	*Schima wallichii*	32	0.99	0.04	1.15	2.14
19	*Macropanax Dispermus*	64	1.98	0.04	1.15	3.13
20	*Saurauia pendula*	16	0.50	0.04	1.15	1.64
21	*Ficus grossularioides*	16	0.50	0.04	1.15	1.64
22	*Tarenna polycarpa*	16	0.50	0.04	1.15	1.64
23	*Syzygium lineatum*	16	0.50	0.04	1.15	1.64
24	*litsea mappacea*	16	0.50	0.04	1.15	1.64
25	*Symplocos spicata*	32	0.99	0.04	1.15	2.14
26	*Phoebe Grandis*	48	1.49	0.04	1.15	2.63
27	*Breynia vitis-idaea*	16	0.50	0.04	1.15	1.64
		3232	100	3.48	100	200

Appendix 8 IVI of sapling at an altitude of 1600 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Ficus septica*	512	23.19	0.40	16.67	39.86
2	*Perrottetia alpestris*	192	8.70	0.16	6.67	15.36
3	*Macropanax* sp.	144	6.52	0.20	8.33	14.86
4	*Saurauia* sp.	128	5.80	0.20	8.33	14.13
5	*Schefflera fastigiata*	112	5.07	0.20	8.33	13.41
6	*Camellia lanceolata*	112	5.07	0.16	6.67	11.74
7	*Pyrenaria serrata*	112	5.07	0.16	6.67	11.74
8	*Ficus ribes*	144	6.52	0.08	3.33	9.86
9	*Urophyllum* sp.	96	4.35	0.12	5.00	9.35
10	*Homalanthus populneus*	96	4.35	0.08	3.33	7.68
11	*Endiandra rubescens*	64	2.90	0.08	3.33	6.23
12	*Symplocos costata*	192	2.90	0.12	1.67	4.57
13	*Schima wallichii*	32	1.45	0.04	1.67	3.12
14	*Syzygium glomeruliferum*	32	1.45	0.04	1.67	3.12
15	*Syzygium lineatum*	192	1.45	0.24	1.67	3.12
16	*Acronychia pedunculata*	16	0.72	0.04	1.67	2.39
17	*Breynia vitis-idaea*	16	0.72	0.04	1.67	2.39
18	*Sloanea* sp.	16	0.72	0.04	1.67	2.39
		2208	100	2.4	100	200

Appendix 9 IVI of pole at an altitude of 1300 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	D (m2/ha)	DR (%)	IVI (%)
1	*Ficus ribes*	20	5.62	0.12	4.62	0.36	5.70	15.94
2	*Ficus septica*	64	17.9	0.32	12.31	1.04	16.57	46.85
3	*Ficus cuspidata*	24	6.74	0.20	7.69	0.45	7.09	21.52
4	*Antidesma minus*	44	12.3	0.28	10.77	0.83	13.18	36.31
5	*Macropanax Dispermus*	12	3.37	0.12	4.62	0.24	3.81	11.80
6	*Saurauia pendula*	36	10.1	0.28	10.77	0.63	9.98	30.86
7	*Schefflera fastigiata*	8	2.25	0.08	3.08	0.12	1.84	7.17
8	*Syzygium glomeruliferum*	4	1.12	0.04	1.54	0.06	0.98	3.64
9	*Schima wallichii*	12	3.37	0.12	4.62	0.14	2.29	10.28
10	*Simplocos costata*	24	6.74	0.20	7.69	0.45	7.19	21.62
11	*Syzygium* sp. 1	16	4.49	0.16	6.15	0.37	5.85	16.50
12	*Castanopisis javanica*	20	5.62	0.12	4.62	0.31	4.91	15.14
13	*Eurya obovata*	20	5.62	0.16	6.15	0.46	7.28	19.05
14	*Turpinia montana*	8	2.25	0.08	3.08	0.16	2.56	7.88

Appendix 9 IVI of pole at an altitude of 1300 m asl (continued)

No.	Species name	K	KR	F	FR	D	DR	IVI
15	*Meliosma ferruginea*	8	2.25	0.04	1.54	0.09	1.50	5.29
16	*Prunus grisea*	4	1.12	0.04	1.54	0.07	1.12	3.78
17	*Phoebe Grandis*	8	2.25	0.04	1.54	0.17	2.74	6.52
18	Unident 3	4	1.12	0.04	1.54	0.05	0.81	3.47
19	*Prunus grisea*	4	1.12	0.04	1.54	0.06	1.03	3.69
20	Unident 1	4	1.12	0.04	1.54	0.11	1.76	4.43
21	*Urophyllum* sp.	8	2.25	0.04	1.54	0.07	1.17	4.96
22	*Oreocnide rubescens*	4	1.12	0.04	1.54	0.04	0.66	3.32
		356	100	2.60	100	6.29	100	300

Appendix 10 IVI of pole at an altitude of 1400 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	D (m2/ha)	DR (%)	IVI (%)
1	*Ficus ribes*	36	8.49	0.20	7.94	0.75	9.25	25.68
2	*Ficus septica*	12	2.83	0.16	6.35	0.21	2.65	11.83
3	*Ficus fistulosa*	4	0.94	0.04	1.59	0.05	0.57	3.10
4	*Homalanthus populneus*	20	4.72	0.08	3.17	0.42	5.23	13.12
5	*Antidesma minus*	24	5.66	0.16	6.35	0.40	4.89	16.90
6	*Macropanax Dispermus*	104	24.53	0.48	19.05	1.92	23.79	67.37
7	*Saurauia pendula*	12	2.83	0.04	1.59	0.31	3.89	8.31
8	*Symplocos costata*	12	2.83	0.08	3.17	0.22	2.67	8.68
9	*Eurya acuminata*	8	1.89	0.08	3.17	0.12	1.51	6.57
10	*Schima wallichii*	28	6.60	0.20	7.94	0.55	6.76	21.30
11	*Syzygium* sp. 1	12	2.83	0.12	4.76	0.26	3.20	10.79
12	*Syzygium* sp. 2	4	0.94	0.04	1.59	0.09	1.07	3.60
13	*Castanopsis javanica*	16	3.77	0.08	3.17	0.32	3.91	10.85
14	*Castanopsis tungurrut*	8	1.89	0.04	1.59	0.13	1.65	5.12
15	Unident 1	16	3.77	0.08	3.17	0.31	3.86	10.80
16	Unident 2	12	2.83	0.12	4.76	0.21	2.54	10.13
17	*Prunus grisea*	8	1.89	0.04	1.59	0.17	2.12	5.60
18	*Syzygium lineatum*	20	4.72	0.08	3.17	0.38	4.70	12.59
19	*Turpinia* sp.	8	1.89	0.08	3.17	0.21	2.65	7.71
20	Unident 5	8	1.89	0.04	1.59	0.09	1.14	4.61
21	*Oreocnide rubescens*	4	0.94	0.04	1.59	0.04	0.45	2.98
22	*Eurya* sp.	8	1.89	0.04	1.59	0.20	2.42	5.89
23	*litsea* sp.	12	2.83	0.04	1.59	0.19	2.41	6.82
24	Unident 4	16	3.77	0.08	3.17	0.32	3.91	10.86
25	*Eurya* sp. 2	12	2.83	0.08	3.17	0.22	2.77	8.78
		424	100	2.52	100	8.08	100	300

Appendix 11 IVI of pole at an altitude of 1600 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	D (m2/ha)	DR (%)	IVI (%)
1	*Ficus rebes*	8	2.35	0.04	1.67	0.14	2.27	6.28
2	*Ficus septica*	40	11.76	0.28	11.67	0.72	11.49	34.92
3	*Ficus fistulosa*	16	4.71	0.16	6.67	0.20	3.21	14.58
4	*Simplocos spicata*	8	2.35	0.04	1.67	0.17	2.71	6.73
5	*Ficus deltoidea*	4	1.18	0.04	1.67	0.09	1.48	4.33
6	*Macropanax*	28	8.24	0.24	10.00	0.45	7.14	25.38
7	*Saurauia pendula*	4	1.18	0.04	1.67	0.04	0.70	3.54
8	*Schefflera fastigiata*	12	3.53	0.04	1.67	0.29	4.61	9.80
9	*Schima wallichii*	36	10.59	0.20	8.33	0.69	10.96	29.89
10	*Homalanthus*	44	12.94	0.20	8.33	0.93	14.80	36.07
11	*Perrottetia alpestris*	4	1.18	0.04	1.67	0.07	1.08	3.92
12	*Eurya acuminata*	20	5.88	0.16	6.67	0.27	4.30	16.84
13	*Podocarpus*	4	1.18	0.04	1.67	0.08	1.27	4.12
14	*Syzygium lineatum*	12	3.53	0.08	3.33	0.25	3.97	10.84
15	*Castanopsis javanica*	8	2.35	0.08	3.33	0.14	2.24	7.93
16	*Syzygium* sp. 2	8	2.35	0.08	3.33	0.14	2.17	7.86
17	*Myrsine Avenis*	8	2.35	0.08	3.33	0.18	2.88	8.57
18	Unident 2	16	4.71	0.08	3.33	0.24	3.82	11.86
19	*Sloanea* sp.	4	1.18	0.04	1.67	0.11	1.83	4.68
20	*Endiandra rubescens*	12	3.53	0.04	1.67	0.19	3.10	8.30
21	*Meliosma ferruginea*	36	10.59	0.32	13.33	0.72	11.52	35.44
22	*Pyrenaria serrata*	4	1.18	0.04	1.67	0.08	1.32	4.17
23	Unident 3	4	1.18	0.04	1.67	0.07	1.12	3.97
		340	100	2.40	100	6.26	100	300

Appendix 12 IVI of tree at an altitude of 1300 m asl

No.	Species name	K (Ind /Ha)	KR (%)	F	FR (%)	D (m2/ha)	DR (%)	IVI (%)
1	*Ficus ribes*	17	7.59	0.44	8.46	1.56	6.73	22.78
2	*Ficus septica*	18	8.04	0.40	7.69	1.55	6.67	22.40
3	*Ficus cuspidata*	11	4.91	0.24	4.62	0.98	4.23	13.75
4	*Homalanthus populneus*	10	4.46	0.24	4.62	1.56	6.72	15.80
5	*Antidesma minus*	19	8.48	0.40	7.69	1.73	7.43	23.61
6	*Macropanax Dispermus*	12	5.36	0.28	5.38	1.03	4.42	15.16
7	*Saurauia pendula*	14	6.25	0.20	3.85	1.24	5.35	15.44
8	*Simplocos costata*	13	5.80	0.36	6.92	1.33	5.71	18.44
9	*Eurya acuminata*	5	2.23	0.16	3.08	0.40	1.72	7.03
10	*Schefflera fastigiata*	5	2.23	0.16	3.08	0.64	2.77	8.07
11	*Schima wallichii*	19	8.48	0.40	7.69	2.90	12.48	28.65
12	*Acronychia pedunculata*	2	0.89	0.04	0.77	0.14	0.59	2.25
13	*Syzygium glomeruliferum*	3	1.34	0.08	1.54	0.31	1.34	4.22
14	*Eurya obovata*	9	4.02	0.20	3.85	1.06	4.55	12.41
15	*Syzygium* sp. 1	6	2.68	0.20	3.85	0.54	2.31	8.84
16	*Castanopsis javanica*	35	15.63	0.64	12.31	3.31	14.23	42.16
17	*Turpinia montana*	7	3.13	0.20	3.85	0.81	3.47	10.44
18	*Phoebe Grandis*	1	0.45	0.04	0.77	0.03	0.14	1.36
19	Unident 2	1	0.45	0.04	0.77	0.26	1.10	2.31
20	*Urophyllum* sp.	3	1.34	0.08	1.54	0.24	1.04	3.92
21	*Meliosma ferruginea*	1	0.45	0.04	0.77	0.11	0.47	1.68
22	Unident 3	1	0.45	0.04	0.77	0.04	0.18	1.39
23	*litsea* sp. 4	2	0.89	0.04	0.77	0.52	2.24	3.90
24	*Pyrenaria serrata*	2	0.89	0.08	1.54	0.26	1.12	3.55
25	*Turpinia* sp.	4	1.79	0.12	2.31	0.38	1.62	5.71
26	Unident 4	2	0.89	0.04	0.77	0.23	1.00	2.66
27	Unident 5	2	0.89	0.04	0.77	0.09	0.38	2.04
		224	100	5.20	100	23.23	100	300

Appendix 13 IVI of tree at an altitude of 1400 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	D (m2/ha)	DR (%)	IVI (%)
1	*Ficus ribes*	21	8.68	0.40	7.35	1.93	8.21	24.24
2	*Ficus septica*	8	3.31	0.28	5.15	1.38	5.88	14.33
3	*Ficus fistulosa*	4	1.65	0.16	2.94	0.23	1.00	5.59
4	*Ficus deltoidea*	1	0.41	0.04	0.74	0.04	0.17	1.32
5	*Homalanthus populneus*	17	7.02	0.32	5.88	1.77	7.56	20.46
6	*Antidesma minus*	8	3.31	0.24	4.41	061	2.60	10.32
7	*Macropanax Dispermus*	44	18.18	0.64	11.76	2.62	11.17	41.12
8	*Saurauia pendula*	7	2.89	0.20	3.68	0.53	2.26	8.83
9	*Simplocos costata*	12	4.96	0.32	5.88	1.51	6.43	17.27
10	*Simplocos spicata*	2	0.83	0.08	1.47	0.14	0.60	2.90
11	*Eurya acuminata*	2	0.83	0.08	1.47	0.13	0.57	2.87
12	*Schefflera fastigiata*	1	0.41	0.04	0.74	0.27	1.14	2.29
13	*Syzygium*	2	0.83	0.08	1.47	0.16	0.69	2.99
14	*Schima wallichii*	39	16.12	0.60	11.03	5.12	21.82	48.96
15	*Eurya* sp.	2	0.83	0.04	0.74	0.12	0.51	2.08
16	*Archidendron clypearia*	1	0.41	0.04	0.74	0.04	0.18	1.33
17	*Syzygium* sp. 1	8	3.31	0.20	3.68	0.67	2.84	9.82
18	*Castanopsis javanica*	26	10.74	0.48	8.82	2.77	11.82	31.38
19	*Castanopsis tungurrut*	2	0.83	0.08	1.47	0.09	0.38	2.68
20	Unident 1	2	0.83	0.08	1.47	0.14	0.60	2.89
21	*Urophyllum* sp.	2	0.83	0.04	0.74	0.32	1.37	2.93
22	Unident 3	6	2.48	0.16	2.94	1.07	4.55	9.97
23	*Eurya obovata*	1	0.41	0.04	0.74	0.08	0.33	1.48
24	*litsea* sp. 1	1	0.41	0.04	0.74	0.06	0.25	1.39
25	*Meliosma ferruginea*	1	0.41	0.04	0.74	0.07	0.28	1.43
26	*Turpinia* sp.	1	0.41	0.04	0.74	0.10	0.42	1.45
27	Unident 5	1	0.41	0.04	0.74	0.04	0.18	1.57
28	Unident 4	1	0.41	0.04	0.74	0.04	0.18	1.32
29	*Prunus grisea*	2	0.83	0.08	1.47	0.16	0.66	2.96
30	Unident 2	1	0.41	0.04	0.74	0.08	0.34	1.49
31	*litsea* sp. 2	2	0.83	0.08	1.47	0.10	0.43	2.72
32	*Syzygium lineatum*	2	0.83	0.04	0.74	0.12	0.52	2.08
33	*Syzygium* sp. 2	1	0.41	0.04	0.74	0.20	0.85	2.00
34	*Phoebe Grandis*	1	0.41	0.04	0.74	0.14	0.58	1.73
35	Unident 7	2	0.83	0.04	0.74	0.06	0.27	1.84
36	*Eurya* sp. 2	1	0.41	0.04	0.74	0.13	0.55	1.70
37	*Turpinia montana*	4	1.65	0.08	1.47	0.24	1.02	4.15
38	*Pyrenaria serrata*	1	0.41	0.04	0.74	0.05	0.23	1.38
39	*Tarenna polycarpa*	2	0.83	0.08	1.47	0.10	0.43	2.72

Appendix 14 IVI of tree at an altitude of 1600 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	D (m2/ha)	DR (%)	IVI (%)
1	*Perrottetia alpestris*	5	1.59	0.08	1.27	0.42	1.65	4.51
2	*Ficus septica*	18	5.71	0.48	7.64	1.37	5.36	18.72
3	*Ficus fistulosa*	8	2.54	0.28	4.46	0.70	2.73	9.73
4	*Ficus cuspidata*	1	0.32	0.04	0.64	0.10	0.38	1.33
5	*Ficus deltoidea*	5	1.59	0.12	1.91	0.26	1.03	4.52
6	*Simplocos costata*	6	1.90	0.12	1.91	0.36	1.43	5.24
7	*Macropanax Dispermus*	43	13.65	0.56	8.92	3.47	13.60	36.17
8	*Saurauia pendula*	3	0.95	0.12	1.91	0.19	0.75	3.62
9	*Schefflera fastigiata*	11	3.49	0.16	2.55	0.67	2.62	8.66
10	*Schima wallichii*	49	15.56	0.60	9.55	3.64	14.28	39.39
11	*Syzygium glomeruliferum*	9	2.86	0.20	3.18	0.87	3.40	9.44
12	*Homalanthus populneus*	35	11.11	0.44	7.01	2.94	11.52	29.64
13	*Acronychia pedunculata*	12	3.81	0.32	5.10	1.07	4.20	13.11
14	*Myrsine Avenis*	10	3.17	0.20	3.18	0.69	2.71	9.07
15	*Eurya acuminata*	8	2.54	0.20	3.18	0.66	2.59	8.32
16	*Simplocos spicata*	2	0.63	0.08	1.27	0.22	0.85	2.76
17	*Eurya* sp.	1	0.32	0.04	0.64	0.07	0.28	1.24
18	*Podocarpus koordersi*	2	0.63	0.40	6.37	0.07	0.27	7.27
19	*Syzygium lineatum*	8	2.54	0.12	1.91	0.69	2.71	7.16
20	*Castanopsis javanica*	2	0.63	0.04	0.64	0.08	0.31	1.59
21	*Castanopsis tungurrut*	6	1.90	0.12	1.91	0.51	1.99	5.80
22	*Syzygium* sp. 1	1	0.32	0.04	0.64	0.05	0.21	1.16
23	*Syzygium* sp. 2	7	2.22	0.16	2.55	0.54	2.13	6.90
24	*Meliosma ferruginea*	32	10.16	0.56	8.92	2.14	8.41	27.48
25	*Pyrenaria serrata*	12	3.81	0.32	5.10	1.31	5.13	14.03
26	*Urophyllum* sp.	1	0.32	0.04	0.64	0.09	0.35	1.31
27	*Saurauia* sp.	1	0.32	0.04	0.64	0.06	0.24	1.19
28	Unident 5	2	0.63	0.08	1.27	0.08	0.31	2.22
29	Unident 2	2	0.63	0.08	1.27	0.13	0.51	2.42
30	Unident 3	3	0.95	0.12	1.91	0.19	0.73	3.59
31	*Sloanea* sp.	5	1.59	0.08	1.27	1.16	4.54	7.40
32	*litsea* sp. 1	4	1.27	0.04	0.64	0.42	1.64	3.55
33	*antidesma* sp.	1	0.32	0.04	0.64	0.29	1.13	2.08
		315	100	6.28	100	25.51	100	300

Appendix 15 IVI of understorey at an altitude of 1300 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Begonia robusta*	8300	19.08	0.92	17.16	36.24
2	*Elatostema* sp. (2)	4800	11.03	0.52	9.70	20.74
3	*Athyrium sorghinense*	2800	6.44	0.64	11.94	18.38
4	*caladium* sp.	4900	11.26	0.32	5.97	17.23
5	*Blechnum capense*	3900	8.97	0.4	7.46	16.43
6	*Alpinia* sp.	3200	7.36	0.44	8.21	15.57
7	*Pilea melastomoides*	3700	8.51	0.32	5.97	14.48
8	Zingiberaceae	2100	4.83	0.4	7.46	12.29
9	Unident 7	1900	4.37	0.2	3.73	8.10
10	*Cyrtandra picta*	2300	5.29	0.12	2.24	7.53
11	*Angiopterist evecta*	600	1.38	0.16	2.99	4.36
12	Nail 1	400	0.92	0.12	2.24	3.16
13	*Kadsura scandens*	300	0.69	0.12	2.24	2.93
14	*Argostemma borragineun*	1000	2.30	0.04	0.75	3.05
15	Unident 9	600	1.38	0.08	1.49	2.87
16	4 nails	500	1.15	0.08	1.49	2.64
17	Unident 10	400	0.92	0.08	1.49	2.41
18	*Gonostegia hirta*	300	0.69	0.04	0.75	1.44
19	Nail 2	300	0.69	0.04	0.75	1.44
20	*Clidemia hirta*	200	0.46	0.04	0.75	1.21
21	*Maccodes javanica*	200	0.46	0.04	0.75	1.21
22	*Malaxis oculata*	200	0.46	0.04	0.75	1.21
23	*rubus molluccanus*	200	0.46	0.04	0.75	1.21
24	Unident 12	100	0.23	0.04	0.75	0.98
25	*Argostemma uniflorum*	100	0.23	0.04	0.75	0.98
26	*Polypodium persicifolium*	100	0.23	0.04	0.75	0.98
27	*Commelina diffuse*	100	0.23	0.04	0.75	0.98
		43500	100	5.36	100	200

Appendix 16 IVI of understorey at an altitude of 1400 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Begonia robusta*	5600	11.84	0.56	14.74	26.58
2	*Athyrium sorgonense*	4900	10.36	0.56	14.74	25.10
3	*Blechnum capense*	4500	9.51	0.44	11.58	21.09
4	*Alpinia* sp.	2900	6.13	0.40	10.53	16.66
5	*caladium* sp.	4300	9.09	0.24	6.32	15.41
6	Unident 8	3700	7.82	0.28	7.37	15.19
7	*Elatostema* sp. (2)	5000	10.57	0.12	3.16	13.73
8	*Pilea melastomoides*	3000	6.34	0.20	5.26	11.61
9	*Elatostema* sp.	1700	3.59	0.08	2.11	5.70
10	Zingiberacea	900	1.90	0.12	3.16	5.06
11	Unident 11	1700	3.59	0.04	1.05	4.65
12	*Dysporum cantoniense*	1100	2.33	0.08	2.11	4.43
13	Unident 7	1000	2.11	0.08	2.11	4.22
14	*Angiopteris evecta*	500	1.06	0.08	2.11	3.16
15	*Argostemma uniflorum*	700	1.48	0.04	1.05	2.53
16	Grass 2	600	1.27	0.04	1.05	2.32
17	*Oleandra pistillaris*	600	1.27	0.04	1.05	2.32
18	Unident 13	500	1.06	0.04	1.05	2.11
19	*Polypodium persicifolium*	300	0.63	0.04	1.05	1.69
20	3 nails	200	0.42	0.04	1.05	1.48
21	Orchidaceae	200	0.42	0.04	1.05	1.48
22	Unident 10	100	0.21	0.04	1.05	1.26
23	Nail 1	100	0.21	0.04	1.05	1.26
24	*Decaspermum* sp.	3000	6.34	0.08	2.11	8.45
25	4 nails	100	0.21	0.04	1.05	1.26
26	Nail 5	100	0.21	0.04	1.05	1.26
		47300	100	3.8	100	200

Appendix 17 IVI data for understorey at an altitude of 1600 m asl

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
1	*Pilea melastomoides*	13500	30.20	0.56	17.07	47.27
2	*Athyrium sorgonense*	2500	5.59	0.56	17.07	22.67
3	*Rubus molluccanus*	3200	7.16	0.32	9.76	16.91
4	*Begonia robusta*	2000	4.47	0.40	12.20	16.67
5	*Alpinia* sp.	2700	6.04	0.24	7.32	13.36
6	*Chromolaena odorata*	3500	7.83	0.08	2.44	10.27
7	*Decaspermum* sp. 2	2300	5.15	0.16	4.88	10.02
8	*Gonostegia hirta*	4000	8.95	0.04	1.22	10.17
9	*Cyrtandra picta*	2100	4.70	0.12	3.66	8.36
10	Rubiaceae	1800	4.03	0.08	2.44	6.47
11	*Clidemia hirta*	1500	3.36	0.04	1.22	4.58

Appendix 17 IVI of understorey at an altitude of 1600 m asl (continued)

No.	Species name	K (Ind/ha)	KR (%)	F	FR (%)	IVI (%)
12	*Elatostema* sp.	800	1.79	0.08	2.44	4.23
13	*Decaspermum* sp.	1000	2.24	0.04	1.22	3.46
14	Unident 14	1000	2.24	0.04	1.22	3.46
15	*Angiopteris evecta*	300	0.67	0.08	2.44	3.11
16	Unident 15	800	1.79	0.04	1.22	3.01
17	*Asplenium nidus*	200	0.45	0.08	2.44	2.89
18	Unident 16	400	0.89	0.04	1.22	2.11
19	Unident 17	200	0.45	0.04	1.22	1.67
20	Unident 18	200	0.45	0.04	1.22	1.67
21	Unident 19	200	0.45	0.04	1.22	1.67
22	Unident 20	200	0.45	0.04	1.22	1.67
23	Orchidaceae	100	0.22	0.04	1.22	1.44
24	6 . nail	100	0.22	0.04	1.22	1.44
25	*Selliguea heterocarpa*	100	0.22	0.04	1.22	1.44
		44700	100	3.28	100	200

BIOGRAPHY

The author was born in Cilacap, Central Java Province on December 23, 1995. The author is the eldest of two children from Dede Rusmana and Dariyah. The author underwent elementary school education at SDN 1 Cibeunying and SD Negeri III Cisaruni in 2001-2007. Junior High School at SMP Negeri 1 Padakembang in 2007-2010. and Senior High School at SMA Negeri 1 Singaparna in 2010-2013. In the same year the author was accepted as a student of the Silviculture Study Program, Faculty of Forestry, Bogor Agricultural University through the Invitation route (SNMPTN).

During his studies, the author was active in various student organizations. including a member of Commission II of the Fahutan IPB Student Representative Council for the period 2014/2015, staff of SI (Scientific Improvement) Tree Grower Community 2014/2015, member of TSG group (Tree Species Group) Tree Grower Community 2014/2015, and Deputy Chair II of Administration Section and Finance of the Faculty of Forestry Student Representative Council of IPB for the 2015/2016 period. The author is also active in several committees, namely the Treasurer of the 2016 IPB Student Family General Election Commission, Secretary of Exploration Tree Grower Community 2016 and several other committees. The author is also active as a practical assistant for the Forest Ecology course in 2016-2017 and an assistant for the Islamic Religious Education course in 2016-2017.

While studying at the Faculty of Forestry, the author has attended the Forest Ecosystem Introduction Practice (P2EH) in Papandayan-Sancang Barat in 2015. Forest Management Practices (P2H) in the Gunung Halimun Salak National Park (TNGHS) and Gunung Walat Educational Forest in 2016 and Professional Work Practices at KPH Tasikmalaya, West Java in 2016.

As one of the requirements to obtain a bachelor's degree in forestry, the author completed a thesis entitled "The Composition of Vegetation and Structure of Stands with Soil Quality in the Forest of Mount Galunggung, Tasikmalaya" under the guidance of Dr. Ir Iwan Hilwan. MS.