FOREST HEALTH CONDITIONS IN THE BIOLOGICAL EDUCATION AND RESEARCH FOREST OF ANDALAS UNIVERSITY

BIOLOGY UNDERGRADUATE THESIS

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FACULTY OF MATHEMATICS AND NATURAL SCIENCE

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Undergraduate Thesis Presented As One Of The Requirement To Obtain Bachelor Of Science Degree In Biology Department

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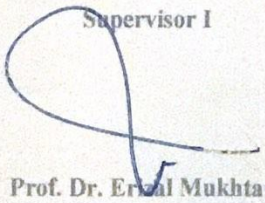
Padang, 26 December 2022

Approved by:

Supervisor I



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In Monday, December 26th 2022

No.	Nama	Jabatan	Tanda Tangan
1.	Dr. Solfiyeni	Chairman	
2.	Prof. Dr. Erizal Mukhtar	Secretary	
3.	Dr. Nurainas	Member	
4.	Prof. Dr. Syamsuardi	Member	

STATEMENT OF AUTHENTICITY

Here I declare that :

My undergraduate thesis is original and has never been submitted for a bachelor's degree at either Universitas Andalas or other collages. This thesis is purely of my own idea without any other asistence axpect the supervisors.

In this thesis there are no works or opinion that have been written or published by others, axpect stated in the bibliography. I made this statement based on the fact and if in the future there are deviation and untrustth in this statement, then I will accept academic sansactions in accordance with the applicable rules.

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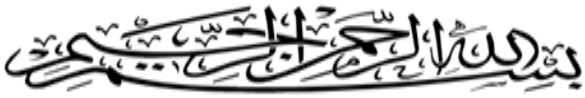

"Surely Allah will exalt those who believe among you and those who are given knowledge by degrees. And Allah is All-Knowing of what you do"
(QS. Al-MujJadilah: 11)
Alhamdulillahirabbil'alamiin…

Praise be to Allah SWT for the abundance of His mercy and grace so that this thesis can be completed properly. With Your blessing, I dedicate this thesis to the most extraordinary and valuable people in my life, to my parents, Father Martianus and Mother Hesti Yulianawati who have always supported me and prayed for me every step of the way in my life, as well as my brothers Indra Alexander, S.I.Kom and Raafi Alexander . I thank you for always giving prayer and encouragement.

Lastly, for the 2018 Falcon family, thank you for your time, for togetherness, for your kinship during the ups and downs of college, thanks also to uda uni who gave experience during college, and thank you to all parties who cannot be mentioned one by one . Hopefully this thesis is useful for all readers.

Last but not least, I wanna thank meI wanna thank me for believing in me
I wanna thank me for doing all this hard work I wanna thank me for having no days off
I wanna thank me for, for never quitting I wanna thank me for always being a giver
And tryna give more than I receive wanna thank me for tryna do more right than wrong
I wanna thank me for just being me at all times

Ayu Smarnia Putri, S.Si

PREFACE

Praises and thank to Allah SWT. who has given the help and permit so the writer can finish the thesis based on research under the title "**Forest health conditions in the Biological Education and Research Forest of Andalas University**". This thesis is one of requirements in order to finish the study in Biology Department, Faculty of Mathematics and Natural Science, Universitas Andalas.

For this opportunity the writer wants to say thank to Prof. Dr. Erizal Mukhtar as supervisor I who has given their valuable guidance, suggestion, motivation and help during the research and writing process. The writer also would like to say thank to everyone who given their hand to help the process of this thesis, they are:

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Hopefully all the guidance and assistance that has been given to the author can be a good deed and get a reward from Allah SWT. The author realizes that

everything he does is not without errors and is far from perfect, for this reason the author hopes that readers can provide input and suggestions regarding this thesis. Finally, the writer hopes that this thesis can be useful for the development of knowledge for the writer himself and the readers.

Padang, December 2022

Ayu Smarnia Putri

ABSTRAK

Penelitian tentang kondisi kesehatan hutan di hutan di area kampus universitas andalas atau yang plot permanen di Hutan Penelitian dan Pendidikan Biologi (HPPB) telah dilakukan pada bulan Desember hingga Maret 2022 di plot permanen. Penelitian ini bertujuan untuk mengetahui tutupan tajuk dan kondisi Kesehatan hutan di plot permanen HPPB. Penelitian ini menggunakan metode *purposive sampling*, dimana pengambilan foto tutupan tajuk sebagai titik pusat pada setiap subplot berukuran 10 x 10m pada seluruh plot permanen seluas 1 ha menggunakan metode *hemispherical photography*. Kesimpulan dari 100 subplot yang diamati ditemukan sebanyak 78 subplot yang mempunyai persentase tutupan tajuk diatas diatas 65 % sehingga dapat disimpulkan kondisi hutan ini dapat dikategorikan sebagai very close forest. Analisa kesehatan hutan menyimpulkan bahwa indek kesehatan hutan sebesar 45,22 % sehingga hutan ini dapat dikategorikan sebagai kondisi sedang.

Kata kunci : dbh, Glama, tutupan tajuk, indeks kesehatan hutan

ABSTRACT

Research on the condition of forest health in forests in the Andalas University campus area or in permanent plots in the Biological Education and Research Forest of Andalas University (HPPB) has been carried out from December 2021 to March 2022 on permanent plots. This study aims to determine the canopy cover and forest health conditions in HPPB permanent plots. This study used a purposive sampling method, in which a photo of crown cover was taken as the center point for each sub-plot measuring 10 x 10 m on the entire permanent plot of 1 ha using the hemispherical photography method. The conclusion of the 100 subplots observed was that 78 subplots had a percentage of canopy cover greater than 65%, indicating that the condition of this forest can be classified as very close. The forest health analysis concluded that the forest health index was 45,22%, indicating that this forest was in moderate condition.

Keywords : canopy cover, dbh, forest health index, glama.

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I. INTRODUCTION

1.1 Background

Indonesia is home to the nation's biggest tropical rain forestand the widest variety of plant species (Indrawan *et al.*, 2007). Forest is a unified system that takes the form of a swath of land dominated by trees, where the environment cannot be separated in nature (UU No. 41, 1999). The interaction of biotic and abiotic components that make up an ecosystem result of the formation of forests. The structure and composition of the vegetation reflect this interplay (Soerinegara and Indrawan, 2005).

Forest is one of several natural resources that strongly impact in human life. Forests as the world's lungs, providing water reserves and supporting in the maintenance of the world's ecosystems' balance and integrity. Sumatra is one of Indonesia's islands with a high level of biodiversity and endemicity (Susanti *et al.*, 2013). West Sumatra is one of the provinces on the island of Sumatra with a great amount of protected forest areas. Forest lands for conservation purposes, production forests, and protection forests make West Sumatra's forest area (KLHK, 2018).

There is secondary forest in addition to primary forest. Primary forest regenerates into secondary forest. In scientific terminology, the phrase secondary forest has been used since 1950 (Richards 1996). Many countries do not use the term secondary forest since they prefer to refer to a "area assemblage of various local tree species" as a forest or natural forest. Whether the forest is logged over original forest or regenerated forest, it is referred to as natural forest. As a result, the phrase secondary forest is unfamiliar. The phrase secondary forest is sometimes used interchangeably with the term primary forest in many countries.

At the Key Biodiversity Area determination workshop conducted by Conservation International (CI) in connection with Andalas University in January 2006, HPPB was identified as one of the key areas of significant biodiversity in Sumatra. HPPB has also been used as a location for biodiversity research since 1982. (Rahman, 1994). The HPPB has been recognized as a research area. HPPB is located in the Andalas Limau Manis University Campus area, which is categorized as a lowland tropical rain forest with an area of 150 hectares and is located at an altitude of 250-460 meters above sea level. This forest is classified as secondary forest because it has a lot of open regions with a lot of logged trees and pioneer vegetation. This area, according to Rahman (1994), has three types of communities: primary forest, secondary forest, and shrub community. There are 174 tree species and 96 plant species in HPPB, according to studies.

The Hemispherical Photography (HP) method is one of the new methods for describing the forest canopy and light regime in Indonesia (Baksir *et al.*, 2018). (Bianchi *et al.*, 2017). used to calculate the light environment above the canopy of the forest Individual plants' canopy structure and light environment can be sampled for demographic studies. The Mobile Application of Gap Light Analysis (GLAMA) is a new program that supports this technology (Rich 1990). The program, according to Tichý (2016), was recently built by the author and may be downloaded for free from the Google Play website. Hemispherical, wide-angle, and standard samples also can be analyzed with it.

Based on the above description, it is necessary to conduct research using this promising method of technological progress to know the current status and condition of the forest, whether it is in good, medium, or bad condition, using the GLAMA method has been conducted in the area. It is important to perform research on The Biological Education and Research Forest Of Andalas University (HPPB) By Using Glama Application as part of a long-term rehabilitation effort.

1.2 Problem Formulation

Based on the background described, the problem that can be formulated in this study: How is the forest condition by using GLAMA application in the Unand, Padang, West Sumatera Forest of Education and Research Forest (HPPB)?

1.3 Research Objectives

The objective of this research is:

To clarify the health condition of Forest of Education and Research Biology (HPPB) by using *GLAMA.*

1.4 Benefit of Research

It is hoped that the results of this study can be used as a guideline for forest conservation in the future.

II. LITERATUR REVIEW

2.1 Study of Ecology

Ecology is a part of biology that investigates how living organisms interact with their environments. Ecology is a basic science in environmental science that can be used to examine environmental interrelationships. There are two types of major components that drive these interactions: biotic and abiotic components. Humans apply ecological analysis to construct a sustainable environment in a way that can be held accountable for long-term viability and profitability. The study of the human environment, reforestation, germplasm conservation, and the collection of uncommon fruits and animals can all be done using ecological concepts. The balance and unity of interactions between ecosystem components that are connected are what give rise to ecological systems (Soerianegara and Indrawan, 2005; Rizal, dan Reda 2017; Kusmana *et al*., 2022).

Plant ecology is the study of all environmental factors that impact the presence of a plant species or a plant community in a given location. Plants, animals, microorganisms, and humans are all things that can have an environmental impact. Plant ecology is primarily concerned with the interaction or reciprocal relationship between plants and their environments (Jayadi, 2015, Kusmana *et al.*, 2022).

2.2 Forest

Forests are big areas of land with biological natural resources that are dominated by trees in a natural setting and are inextricably linked to one anotherr. A forest is a living community composed of relationships of trees, vegetation, and animals from an ecological and biological standpoint. Forests, more specifically, are plant ecosystems dominated by trees with dense crowns (Irianto, 2008).

Forests serve a variety of purposes, including production forests, which have been forest regions dedicated to the production of forest products. A protected forest is a forest that serves to protect life by regulating water systems, preventing flooding, controlling erosion, preventing seawater intrusion, and maintaining soil fertility. A conservation forest has several characteristics that help to preserve plant and animal diversity as well as the ecosystem. A nature reserve forest is a forest with specific characteristics that functions as a protected area for biodiversity. Forests are divided into primary and secondary forest. Primary forest, also known as natural forest, is a forest region composed of plants from a variety of local plant species, whereas secondary forest is forest that has been utilized by people for purposes such as wood and instead replanted, or forest that has been human intervention (Irwanto, 2006; Kusmana *et al.,* 2022).

2.3 Canopy Cover

Canopy, also known as a tree canopy, is a situation created by the overlapping branches and leaves of trees. The more dense the canopy, the more difficult it will be for sunlight to pass through. There are two fundamental approaches to measure the forest canopy, namely canopy cover and canopy closure (Jenning *et al.,* 1999). Based on Figure 1 canopy cover is always measured in the vertical direction, with canopy closure involving the angle of view. Canopy cover measurement integrates information through a segment of the celestial hemisphere above one point below the ground. Ideally, the entire hemisphere should be assessed, although the segment being measured varies with the instrument used. The size of the canopy cover measures the presence or absence of a canopy vertically above the sample point throughout the forest area (Jennings *et al*., 1999).

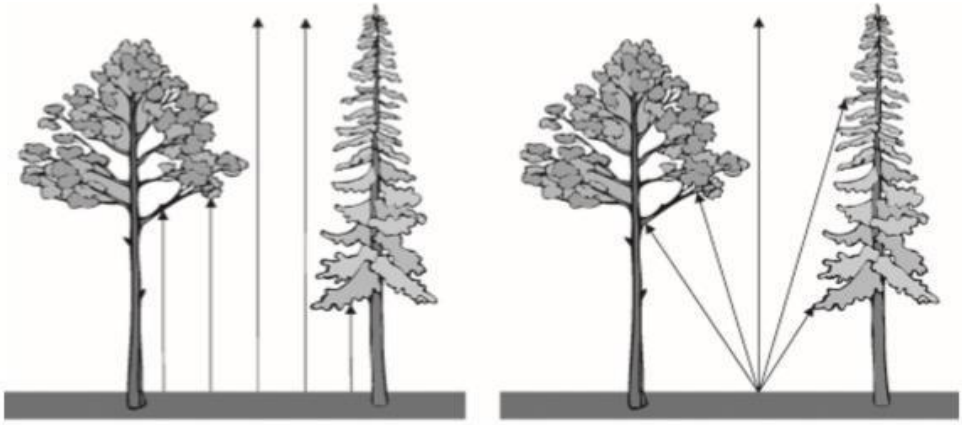

Figure 1. Canopy cover (left) and canopy closure (right) (Korhonen *et al.*, 2006)

Some of the methods that are thought suitable for measuring canopy cover are the GRS densitometer, visual estimation, and photo hemispherical (HP). To estimate canopy cover, spherical and HP densitometers with wide viewing angles are adjusted. The canopy cover tends to grow when using the wide viewing angle technique. They used line transect sampling, which provides a more precise and unbiased assessment than digital pictures or ocular estimates, which have more fluctuation and are biased. As a result, analyzing all hemispherical photos did not yield a reliable estimate of canopy cover (Korhonen *et al.* ,2006, Paletto and Tosi, 2009). CaCo in his research to describe it as a more precise and accurate proxy for estimating canopy cover in forest ecosystems, as well as a means of introducing technological advances that allow the CaCo index to be calculated from images taken from smartphone screens or other cameras that are free to access by the ap (Tichý, 2016)

2.4 Hemispherical Photograph

The method is known as "Hemispherical Photography," and it entails utilizing a camera to determine the canopy area from beneath the tree canopy (Mauludin ***et*** *al*., 2018). Hemispherical photography has been using in forest ecology. The specific limits connected with film cameras, on the other hand, have gradually stifled the broad adoption of this photographic medium. Advances in digital photography technology show great promise for overcoming hemispheric photography's major flaws, particularly in terms of field approaches and picture processing (Chianucci and Cutini, 2012). The more advanced technological improvements in hemispheric photography techniques will be more significant for research and particular studies, such as characterizing the structure of the forest canopy, connecting the forest canopy with animals, calculating the intensity of sunlight, etc (Paletto and Tosi, 2009).

2.5 GLAMA

Gap Light Analysis Mobile App (*GLAMA*) is a developed new program by the author which is freely accessible from the Google Play site. The GLAMA can be used to analyze hemispherical, wide-angle, and standard photos (within a known angle of view of the lens). The photo, which is analyzed directly from a smartphone or as a jpeg file on a computer, can be used directly in the field and taken with a digital camera. Most parameters need to be set only once, with subsequent photos being subject to most of the predefined ones (Tichý, 2016). This application can also be used to train students and plant ecologists to accurately estimate forest canopy cover in the field.

Based on previous research on canopy cover that has been carried out by Sukma (2021), in the PT. Tidar Kerinci Agung Solok Selatan, the estimated canopy cover was obtained using the Cleft Light Analysis Cellular Application. The highest

and lowest canopy cover indexes were 94.45 % and 82.77 %, respectively, with the highest value of canopy cover found in tree species consisting of *Shorea parvifolia, Popowia pisocarpa, Quercus argentata,* and *Gironniera nervosa*, while the lowest value of canopy cover was found in tree species consisting of *Helicia robusta, Shorea leprosula* and *Parashorea lucida*. Subsequent research on canopy cover by Permana (2017) using the GLAMA software showed that the condition of the forest in the 1 ha permanent plot of the Bukit Tengah Pulau, PT. Kencana Sawit Indonesia Solok Selatan, had an average canopy cover of 77.64 %. A similar study was also conducted by Hazrina (2020) at the biological education and research forest of andalas university, with the result that the average value of canopy cover on a 1 ha permanent plot was 77.66 %.

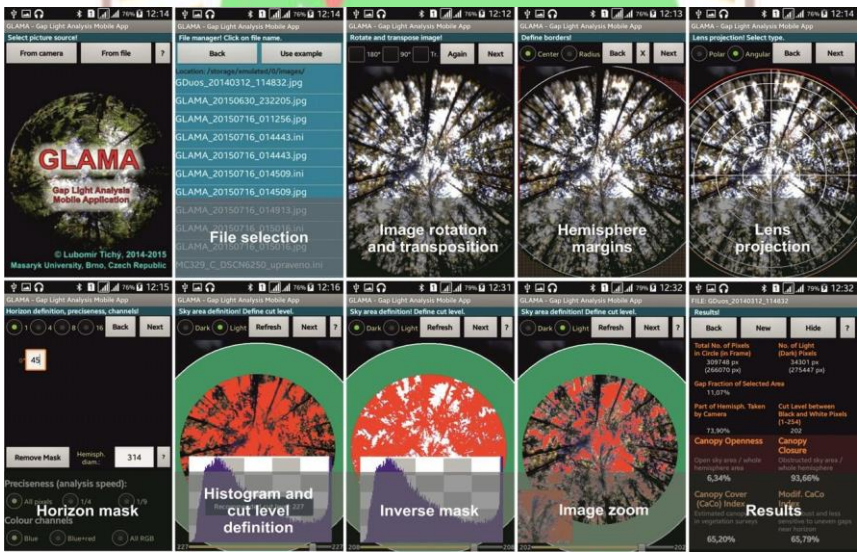

Figure 2. Screens descriptions of the GLAMA

2.6 Forest Health

Forest health and ecosystem health are interconnected and have a level of biological integration. The level of biological integration between the two will produce the same characteristics, but there are still fundamental differences. Ecosystem health has ecosystem aspects that are more related to the pattern of vegetation cover in a broad

ecology, while forest health is more emphasis on the condition of a stand in relation to the benefits obtained (Oladejo *et al.*, 2018).

Generally, forest health is defined as the perceived condition of a forest derived from concerns about such factors as age, structure, composition, function, vigour, presence of unusual levels of insects or diseases, and resilience to disturbance. Forest health is a measure of a forest ecosystem's capacity to supply and allocate water, nutrients and energy in ways that increase or maintain ecosystem productivity while maintaining resistance to biotic and abiotic stresses. Perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a given point in time.There are many factors that can cause the disruption of the health of forests. These can be categorised into living (biotic) and non-living (abiotic) factors. Biotic agents include fungi, bacteria, viruses, insects, mites, parasitic plants, weeds, and larger animals. Non-living factors are related to weather (e.g. fire, wind, snow, hail, and lightning); water (e.g. flooding, waterlogging and drought); soil conditions (e.g. deficiency of nutrients or poor drainage); mechanical agents and chemicals (FAO 2003, Putra *et al.*, 2019).

III. RESEARCH METHODOLOGY

3.1 Time and location

This research was carried out from December 2021 to March 2022. The research location is in a 1.0 ha permanent plot of Forest Education and Biological Research (HPPB) of Andalas University, Padang and West Sumatera. Sample management and data analysis were carried out at the Plant Ecology Research Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, Padang.

3.2 Description of Research Location

This research was carried out in the area of permanent plot located at the in a 1.0 ha permanent plot of The Biological Education and Research forest of Andalas University (HPPB), Padang, West Sumatera with a subplot. Size of 10 x 10 m as many as 100 subplots. The which is a secondary forest located at an altitude of 275 m above sea level which has an area of ± 1 hectare.

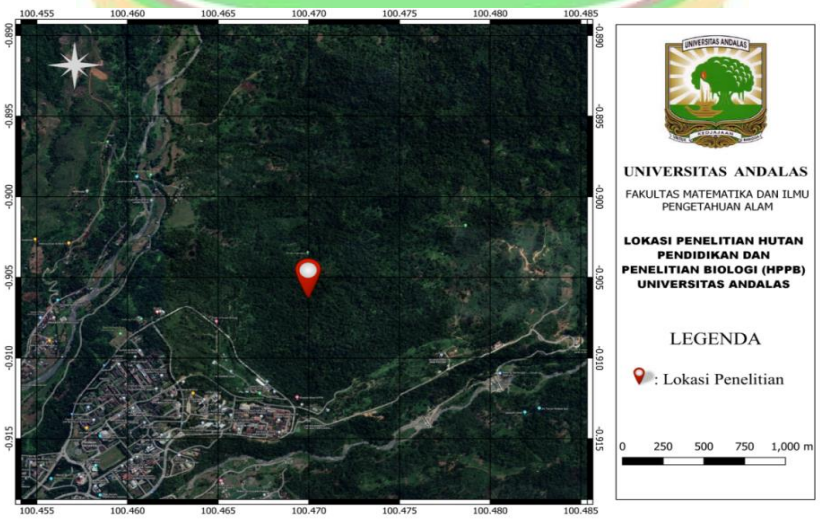

Figure 3. Description of The Biological Education and Research Forest of Andalas University (Source :Modified by Ayu,2022).

3.3 Research Methods

This research was carried out conducted used was purposive sampling, and measuring canopy cover using the hemispherical photography method with GLAMA software. where photo shoots of canopy cover were taken as subplot central points on each 10 x 10 subplot in 1 ha permanent plots.

3.4 Tools

The tools used in this research are smartphone with *Gap Light Analysis Mobile App* (GLAMA) installed, fisheye lens, DBH meter (*Diameter at Breats Height),* Global Positioning System (GPS), tripod, and stationery.

3.5 Working Procedure

3.5.1 Measuring Tree Diameter

On each tree, that has been determined at the coordinates of 10 m^2, Measure the diameter of the tree. The diameter of the tree measured was DBH (*Diameter at Breas Height),* which is the diameter of the trunk as high as 1.3 meters above the ground. Each subplot is to observe and measure its DBH in all trees, referring to the Biological Education And Research Forest Of Andalas University

3.5.2 Measurement Canopy Cover Photo with GLAMA

Before conducting research, a site survey must be conducted to determine the condition of the vegetation plot that will be used as the research location. Then, on a plot measuring 10x10m, photos are taken at the midpoint of each subplot and photos will be taken at a height of 1.5 m above ground level. The photo was taken using a smartphone with GLAMA installed and lens attached fisheye external. The recommended time to take this photo is when the sky is clear, around 10 am to 2 pm.

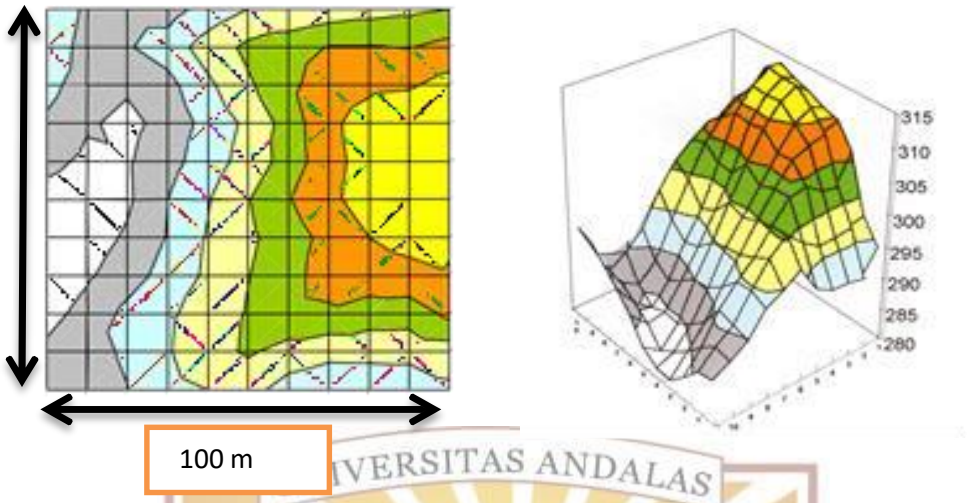

Figure 4. Scheme of The Biological Education And Research Forest Of Andalas University. (Mukhtar *et al*., ,2004).

3.6 Data Analysis

3.6.1 Grouping of Canopy Coverings

After the data was collected using a formula calculated immediately by the application once the photo was obtained. As a result, the canopy photos from each subplot were gathered and put together for further study, and the gaps were identified. The canopy cover index can then be determined.

3.6.2 Relationship between density and basal area with canopy cover.

Analysis of the effect of upright density and basal area on canopy cover using a simple linear regression analysis using MS.Excel.

3.6.3 Important Value Indices (IVI)

The effect of important values on canopy cover also uses simple linear regression using MS. Excel. According to Kusmana *et al.*, (2022) Important Value Index (INP), for the purposes of analyzing vegetation structure the following formula is used:

Density (D)	$D = \frac{\text{Number of individuals found}}{\text{area of plot m ^ 2}}$
Relative density (DR)	$DR = \frac{\text{density of a species}}{\text{density all types}} x100$
Frequency (F)	$F = \frac{\text{Number of plots found by one type}}{\text{Number of plots}}$
Relative Frequency (FR)	$FR = \frac{\text{Frequency of a type}}{\text{Total frequency}} x100$
Dominance (D)	$D = \frac{\text{Number of bases}}{\text{Area of plot sample}}$
Relative dominance (DR)	$DR = \frac{\text{Domination of a type}}{\text{Domination of all types}} x100$
Important Value Index	IVI = DenR + FR + DomR

3.6.3 Forest Health Index

Health Index is a measure that can show/describe/reflect the quality of forest ecosystems and the index can be compared between different locations or times (Safei *et al*., 2019);

$$HI\,(\%) = [(S_C + S_D + S_{Nsp})/3]*10$$

Information :

HI = Health Index (%)

C = Percentage of canopy cover (%)

D = diameter trees (cm)

Nsp = Number of stakes per area

S_C = 0.25 C – 13.06

S_D = 0.45 C + 1.42

S_{Nsp} = 100

Table 1. Forest Health Index (Safei *et al*., 2019)

FHI (%)	Criteria
< 33,33	Bad
33,34- 66,67	Medium
> 66,67	Good

BAB IV. RESULT AND DISCUSSION

4.1 Canopy Estimation Grouping

Based on the results of Canopy Estimation using the Hemispherical Photography method contained in the permanent plot of the Forest of Education and Biological Research at Andalas University, it was found that the Total average canopy cover was 66.82 % with the smallest cover being 47.60 % and the largest was 77.32 %. A more detailed description of the 1 ha permanent plot of the HPPB is shown in Table 2.

Table 2. Percentage of canopy cover in the biological education and research forest of Andalas University

Sub Plot	Canopy Cover (%)	Sub Plot	Canopy Cover (%)	Sub Plot	Canopy Cover (%)	Sub Plot	Canopy Cover (%)
1	65.50	26	73.83	51	61.40	76	63.55
2	72.76	27	71.45	52	70.31	77	65.04
3	66.40	28	69.26	53	68.89	78	69.14
4	64.82	29	62.87	54	72.83	79	73.01
5	68.49	30	58.00	55	69.89	80	60.42
6	66.63	31	67.66	56	70.01	81	65.62
7	70.33	32	71.49	57	69.06	82	68.91
8	66.06	33	72.84	58	67.90	83	67.34
9	69.51	34	73.91	59	67.09	84	70.21
10	47.60	35	70.60	60	75.26	85	62.96
11	59.86	36	67.30	61	61.86	86	64.22
12	63.80	37	66.83	62	71.35	87	66.62
13	65.65	38	62.03	63	62.60	88	62.47
14	66.23	39	70.01	64	69.53	89	71.17
15	71.31	40	58.93	65	57.98	90	65.34
16	64.57	41	71.31	66	71.48	91	66.67
17	68,55	42	69.87	67	67.76	92	71.70
18	64.84	43	67.67	68	68.44	93	73.75
19	65.24	44	70.95	69	65.12	94	70.45
20	71.33	45	66.42	70	64.99	95	77.32
21	63.87	46	74.28	71	58.00	96	70.51
22	58.46	47	70.51	72	67.00	97	68.61
23	70.37	48	70.37	73	72.84	98	64.41
24	70.81	49	69.10	74	70.95	99	70.53
25	65.73	50	72.59	75	69.14	100	65.05
Total average = 66,82 %							

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As displayed in the image below, canopy cover in biological education and research forests utilizing the Hemisperichal photographic method with the application of GLAMA varies in each sub-plot. More detailed description can be seen in Figure 5.

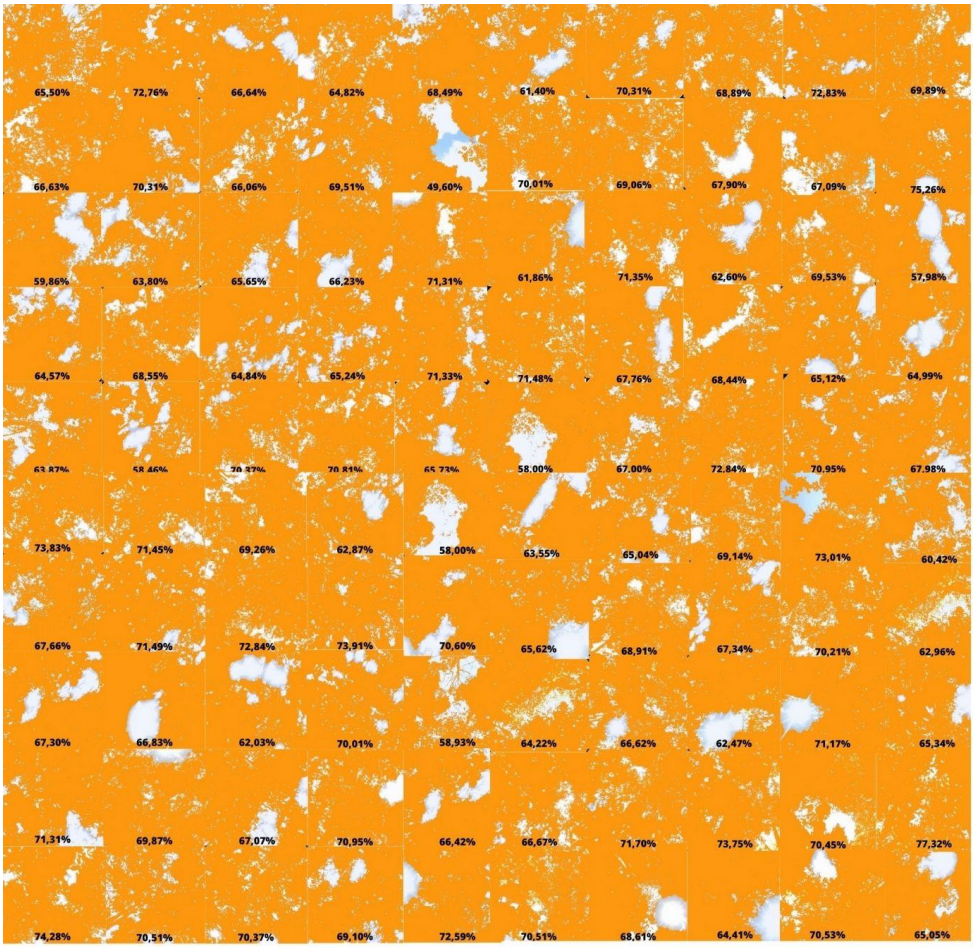

Figure 5. Canopy cover with *GLAMA* application in The Biological Education and Research Forest of Andalas University.

The canopy cover tends to grow when using the wide viewing angle technique.. They used line transect sampling, which provides a more precise and unbiased assessment than digital pictures or ocular estimates, which have more fluctuation and are biased. This metode can be used to analyze hemispherical, wide-angle, and standard photos. The photo, which is analyzed directly from a smartphone or as a jpeg file on a computer, can be used directly in the field and taken with a digital camera. Most parameters need to be set only once, with subsequent photos being subject to most of the predefined ones (Korhonen *et al*. 2006, Paletto and Tosi, 2009, Tichý, 2016). This application can also be used to train students and plant ecologists to accurately estimate forest canopy cover in the field.

Based on the results of the canopy estimation using the GLAMA application, it has more than 50% with a canopy percentage of 65%. Our results show that this forest can be estimated as a forest as close as shown in Table 3.

Table 3. Percentage of canopy cover conditions in forest trees (Korhonen *et al*., 2006)

No	Forest condition	Canopy Percentage	Total of Subplot
1	Rarely	0%-30%	0
2	Close forest	30%-65%	22
3	Very Close Forest	65%-100%	78

The forest canopy, defined as the sum of all crowns in a forest stand (Gill et al. 2000), is an important indicator for predicting woody plant composition, leaf area index (LAI) or vegetation area index, tree volume and net primary production, and assessing tree crown condition or forest pest damage and wildlife microhabitat.The literature focus on the many purposes of assessing forest cover is substantial, as are the papers reporting on various methodologies and devices used to assess it. This parameter has an impact on a variety of ecological processes in forest communities (and it's a key variable in studies of natural hazards dynamics like as landslides, rockfalls, snow slippage, and avalanches (forest protective function assessment models understorey vegetative productivity and forest management (Motta and Haudemand, 2000). Furthermore, forest cover is an important ecological parameter of the forest ecosystem for its relationship with species richness, ecological habitat, and behavior and watershed protection (Crookston and Stage, 1999). Furthermore, one of the Forest Resources Assessment factors used to distinguish between "forest" and "other woody terrain" is canopy cover. In this context, land with a tree crown cover of >10% in an area of >0.5 ha and trees with (or capable of reaching) a minimum height of 5 m is considered a "forest." While land with a crown cover of 5–10 percent of trees able to

reach a height of 5 m (at maturity in situ) or a crown cover of >10 percent of trees not able to reach a height of 5 m, or with shrub or bush cover of >10 percent, is classified as 'other wooded land.' Many European National Forest Inventories (Motta and Haudemand, 2000).

4.2 Diameter Distributions

Based on the results of tree DBH measurements, 10 dominant tree species were found, including *Pternandra echinata* up to 32 individuals, *Symplocos cochinchinensis* up to 18 individuals, *Macaranga triloba* up to 15 individuals, *Lasianthus oblongus* up to 14 individuals, *Ficus* sp up to 11 individuals, *Pithecellobium jiringa* to 10 individuals, *Callerya atropurpurea* up to 9 individuals, *Artocarpus borneensis* up to 7 individuals, *Aglaia trichostemon* up to 7 individuals, and *Eurya acuminata* up to 7 individuals. Figure 6 below offers a more detailed explanation. Several tree species were found to be classified as young trees such as *Pternandra echinata, Symplocos cochinchinensis* and *Croton argyratum.*

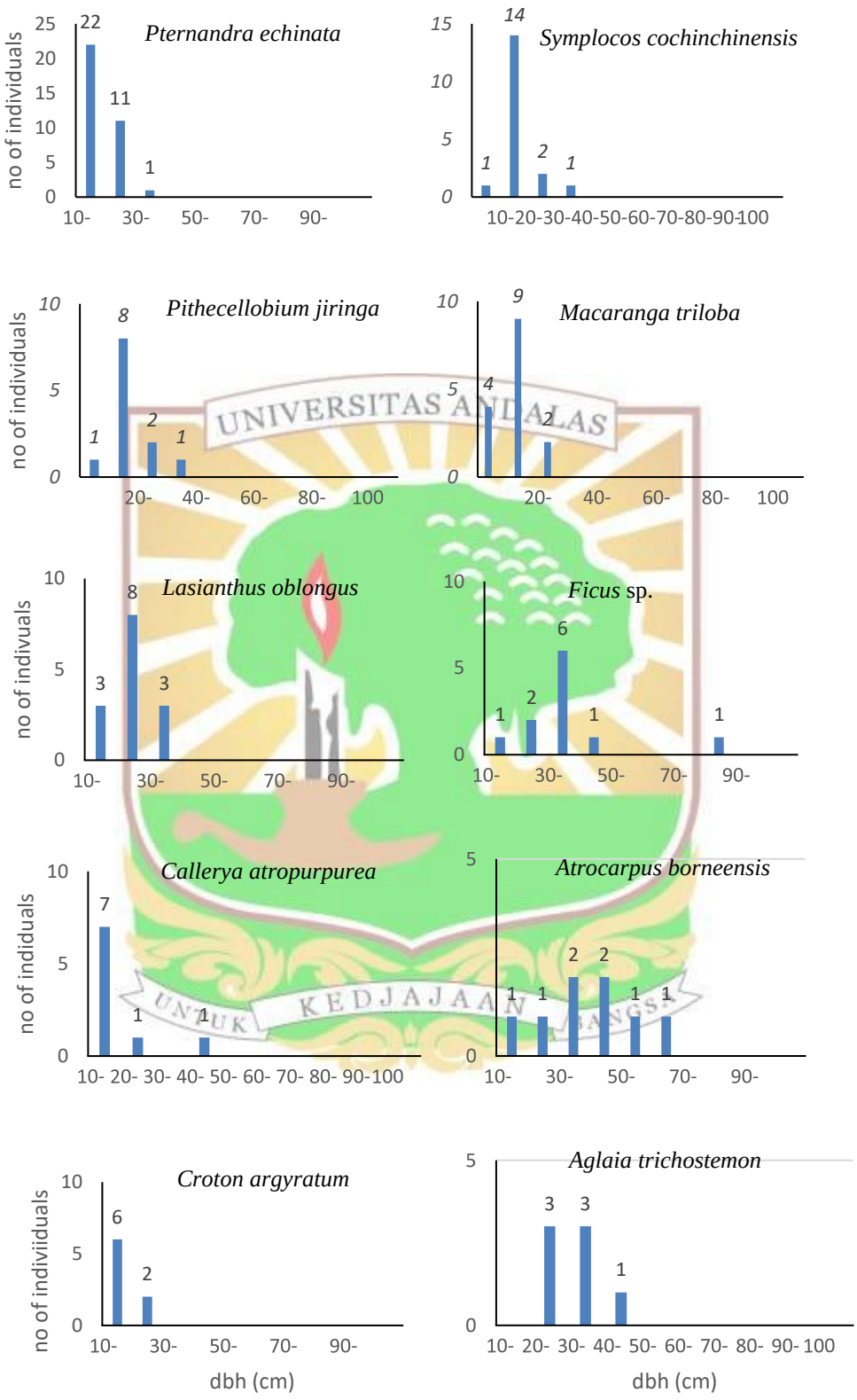

Figure 6. Diameter distribution of 10 dominant trees In the biological education and research forest of Andalas University.

4.3 Important Value Index

Based on research on forest health conditions that have been carried out in the Permanent Plot, The Biological Education and Research Forest of Andalas University (HPPB), the values obtained with the parameters of Relative Density (KR), Relative Frequency (FR), Relative Dominance (DR) and INP. Through the results of the research that has been carried out, it is found that the significant value index of the 10 highest values ranges from 6.21% - 24.21. The highest significance index was found in the *Pternandra echinate species,* while the lowest significance index was found in the *Aglaia trichostemon,* for detailed it can be seen in Table 4.

Table 4. Important Value Index

No.	Spesies	Family	DenR (%)	FR (%)	DomR (%)	IVI
1	*Pternandra echinata*	Melastomataceae	10.27	9.46	4.46	24.21
2	*Ficus* sp	Moraceae	3.32	4.16	6.64	14.13
3	*Ixonanthes icosandra*	Ixonantaceae	2.11	2.65	9.19	13.96
4	*Pithecellobium jiringa*	Leguminosae	4.83	5.30	2.28	12.42
5	*Lasianthus oblongus*	Rubiaceae	4.22	4.16	3.24	11.64
6	*Symplocoscochinchinensis*	Symplocaceae	5.43	4.16	1.85	11.45
7	*Macaranga triloba*	Euphorbiaceae	4.53	4.54	1.24	10.31
8	*Artocarpus borneensis*	Moraceae	2.41	2.27	5.15	9.84
9	*Croton argyratus*	Euphorbiaceae	2.41	3.03	0.82	6.27
10	*Aglaia trichostemon*	Meliaceae	2.11	1.51	2.58	6.215

4.4 Forest Health Index

Based on research that has been carried out in the permanent plot of the in the biological education and research forest of Andalas University. The forest health index value was obtained with an average of 45.22%. The parameters used to determine the value of the forest health index here are the percentage of canopy cover, trunk diameter (DBH) and the number of saplings per area. For more details can be seen in Appendix 4.

The forest health assessment is intended to determine the current forest condition, changes, and trends that may occur. Information about the health condition of forest ecosystems in many countries has become the goal of forest management, such as in the United States, which has become a national program, namely by conducting periodic forest health monitoring so that a comprehensive forest health assessment is carried out (Bianchi *et al.*, 2017). In Indonesia, awareness about the importance of forest health in achieving sustainable forest management is still lacking, especially in various types of forest so that forest health problems have so far not received serious attention. Whereas forest health is an effort to control the level of forest destruction that remains below the economic threshold that is still acceptable thus ensuring the security of investment, protection, production and conservation as well as forest functions that are sustainable. other types of forest can be realized (Safe'i *et al.*, 2014),

One of the forest health criteria for is the condition of the tree canopy. Canopy cover is the percentage of the land surface area covered by a vertical projection canopy of the vegetation canopy. Canopy is the topmost layer in a collection of vegetation, the canopy is formed by a collection of plant leaves and covers the layer below it. Canopy size is an important component in growth and there is a close relationship between canopy size and tree growth potential (Assmann, 1970)

BAB V. CONCLUSION AND SUGGESTIONS

5.1 Conclusion

Based on the results of research the health condition In the biological education and research forest of Andalas University by using GLAMA, it conluded as follows :

The conclusion of the 100 subplots observed was that 78 subplots had a percentage of canopy cover greater than 65%, indicating that the condition of this forest can be classified as very close. The forest health analysis concluded that the forest health index was 45.22%, indicating that this forest was in moderate condition.

5.2 Suggestions

Because the forest canopy cover is in good condition and the forest health index is moderate, efforts are needed to protect it from degradation and illegal logging threats so that the forest's condition can be sustained.

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APPENDIX

Appendix 1. Calculate of Important Value Index

For example the calculation on the species *Pternandra echinata* :

$$\text{Density (D)} = \frac{\text{Number of individuals found}}{\text{area of plot m ^ 2}}$$

$$= \frac{34}{10000}$$

$$= 0.0034$$

$$\text{Density Relative (DR)} = \frac{\text{density of a species}}{\text{density all types}} x100\%$$

$$= \frac{0.0034}{0.0331} x100\%$$

$$= 10.271\ \%$$

$$\text{Frequency (F)} = \frac{\text{Number of plots found by one type}}{\text{Number of plots}}$$

$$= \frac{25}{100}$$

$$= 0.25$$

$$\text{Frequency Relative (FR)} = \frac{\text{Frequency of a type}}{\text{Total frequency}} x100\%$$

$$= \frac{0.25}{2.64} x100\%$$

$$= 9.4697\ \%$$

$$\text{Dominance (D)} = \frac{\text{Number of bases}}{\text{Area of plot sample}}$$

$$= \frac{10578.59}{10000}$$

$$= 1.0579$$

$$\text{Dominane Relative (DR)} = \frac{\text{Domination of a type}}{\text{Domination of all types}} x100\%$$

$$= \frac{1.0579}{23.6682} x100\%$$

$$= 4.4695\ \%$$

Appendix 1 continued

Important Value Index = DenR + FR + DomR

= 10.271 % + 9.4697 % + 4.4695 %

= 24.21 %

Appendix 2. Important Value Indices In The Biological Education And Research Forest Of Andalas University

	Nama of Spesies	Family	KR	FR	DR	INP
1	*Adenanthera pavonina*	Leguminosae	0.3021	0.3788	0.0325	0.7134
2	*Adinandra dumosa*	Theaceae	1.2085	1.1364	0.5969	2.9417
3	*Aglaia glabriflora*	Meliaceae	0.9063	0.7576	0.5977	2.2616
4	*Aglaia* sp	Meliaceae	0.9063	0.7576	1.1787	2.8427
5	*Aglaia trichostemon*	Meliaceae	2.1148	1.5152	2.5815	6.2115
6	*Alstonia scholaris*	Apocynaceae	0.9063	0.7576	1.8502	3.5141
7	*Aporosa benthamiana*	Euphorbiaceae	0.6042	0.7576	0.2186	1.5804
8	*Aporosa prainiana*	Phyllanthaceae	0.3021	0.3788	0.4967	1.1776
9	*Aporosa* sp	Euphorbiaceae	0.3021	0.3788	2.8686	3.5495
10	*Artocarpus borneensis*	Moraceae	2.4169	2.2727	5.1599	9.8495
11	*Artocarpus communis*	Moraceae	0.6042	0.7576	0.9391	2.3009
12	*Artocarpus dadah*	Moraceae	0.3021	0.3788	0.7172	1.3981
13	*Artocarpus elasticus*	Moraceae	0.6042	0.7576	1.0789	2.4407
14	*Artocarpus* sp	Moraceae	0.3021	0.3788	0.5935	1.2744
15	*Baccaurea retilculata*	Euphorbiaceae	0.3021	0.3788	0.4516	1.1325
16	*Baccaurea* sp	Euphorbiaceae	0.6042	0.3788	0.7140	1.6970
17	*Baccaurea velutina*	Euphorbiaceae	0.3021	0.3788	0.3396	1.0205
18	*Baccaurea wellichii*	Euphorbiaceae	0.9063	1.1364	0.7928	2.8355
19	*Baringtonia* sp	Lecythidaceae	0.6042	0.7576	0.6759	2.0377
20	*Baringtonia speciosa*	Lecythidaceae	0.3021	0.3788	0.2347	0.9156
21	*Beilschmiedia pahangensis*	Lauraceae	0.6042	0.3788	0.1918	1.1748
22	*Buchanania* sp	Anacardiaceae	0.3021	0.3788	0.1261	0.8070
23	*Callerya atropurpurea*	Leguminosae	2.7190	1.8939	1.5522	6.1652

24	*Callicarpa longifolia*	Verbenaceae	0.3021	0.3788	0.0416	0.7225
25	*Callophylum* sp	Guttiferae	0.6042	0.3788	0.6063	1.5894
26	*Canarium commune*	Burseraceae	0.3021	0.3788	0.1327	0.8136
27	*Canarium* sp	Burseraceae	1.8127	1.1364	1.3469	4.2959
28	*Castanopsis costata*	Fagaceae	0.9063	1.1364	0.2620	2.3047
29	*Castanopsis wallichii*	Fagaceae	0.3021	0.3788	0.4040	1.0849
30	*Cleidion javanicum*	Euphorbiaceae	0.3021	0.3788	0.6247	1.3056
31	*Cleidion* sp	Euphorbiaceae	0.3021	0.3788	0.9317	1.6126
32	*Clorodendron deflexum*	Verbenaceae	0.6042	0.3788	0.3226	1.3056
33	*Clorodendron* sp	Verbenaceae	0.3021	0.3788	0.0697	0.7506
34	*Commersonia bartramia*	Malvaceae	0.3021	0.3788	0.1724	0.8533
35	*Croton argyratus*	Euphorbiaceae	2.4169	3.0303	0.8281	6.2753
36	*Dalbergia balansae*	Leguminosae	0.6042	0.3788	1.5796	2.5626
37	*Dillenia indica*	Dilleniaceae	0.3021	0.3788	0.3045	0.9854
38	*Dillenia* sp	Dilleniaceae	0.9063	1.1364	0.9651	3.0079
39	*Dipterocarpus* sp	Dipterocarpaceae	0.3021	0.3788	0.1087	0.7896
40	*Durio zibethinus*	Bombacaceae	0.6042	0.7576	2.1871	3.5489
41	*Elaeocarpus* sp	Elaeocarpaceae	0.6042	0.7576	0.2421	1.6039
42	*Elateriospermum* tapus	Euphorbiaceae	1.8127	0.7576	0.6113	3.1816
43	*Eugenia garcinifolia*	Myrtaceae	0.3021	0.3788	0.3187	0.9996
44	*Eugenia* sp	Myrtaceae	1.5106	1.5152	2.0490	5.0747
45	*Eugenia syzygloides*	Myrtaceae	0.6042	0.7576	0.1125	1.4743
46	*Eurya acuminata*	Theaceae	2.1148	1.8939	0.8229	4.8317
47	*Eurycoma longifolia*	Sterculiaceae	0.3021	0.3788	0.0299	0.7108
48	*Fagraea racemosa*	Leguminosae	0.3021	0.3788	0.0470	0.7279
49	*Ficus chartacea*	Moraceae	0.3021	0.3788	0.0281	0.7090
50	*Ficus elastica*	Moraceae	0.3021	0.3788	0.1300	0.8109
51	*Ficus hispida*	Moraceae	0.3021	0.3788	0.0416	0.7225
52	*Ficus lepicarpa*	Moraceae	0.3021	0.3788	0.2382	0.9191

53	*Ficus magnoliifolia*	Moraceae	0.3021	0.3788	0.5019	1.1828
54	*Ficus racemosa*	Moraceae	1.5106	0.7576	2.1322	4.4004
55	*Ficus scortechinii*	Moraceae	0.9063	1.1364	0.3909	2.4336
56	*Ficus* sp	Moraceae	3.3233	4.1667	6.6436	14.1335
57	*Ficus vasculosa*	Moraceae	0.6042	0.3788	0.5543	1.5373
58	*Flacourtia* sp	Salicaceae	0.3021	0.3788	0.0227	0.7036
59	*Galearia finlaysonii*	Euphorbiaceae	0.3021	0.3788	0.0669	0.7478
60	*Garcinia forbesii*	Gutthiferae	0.3021	0.3788	0.4443	1.1252
61	*Garcinia cowa*	Guttiferae	0.6042	0.3788	0.1140	1.0970
62	*Glochidion* sp	Euphorbiaceae	0.6042	0.7576	0.7464	2.1082
63	*Horsfieldia wallichii*	Myristicaceae	0.3021	0.3788	0.3333	1.0142
64	*Ixonanthes icosandra*	Ixonantaceae	2.1148	2.6515	9.1956	13.9619
65	*Knema intermedia* .	Myristicaceae	0.6042	0.3788	0.1498	1.1328
66	*Knema kunstleri*	Myristicaceae	0.3021	0.3788	0.0828	0.7637
67	*Knema laurina*	Myristicaceae	0.3021	0.3788	0.3249	1.0058
68	*Knema* sp	Myristicaceae	0.3021	0.3788	2.2247	2.9056
69	*Lasianthus oblongus*	Rubiaceae	4.2296	4.1667	3.2496	11.6459
70	*Lasianthus stipularis*	Rubiaceae	0.3021	0.3788	0.0596	0.7405
71	*Litsea* sp	Lauraceae	0.3021	0.3788	0.0401	0.7210
72	*Macaranga canaria*	Euphorbiaceae	0.6042	0.7576	1.6127	2.9745
73	*Macaranga gigantea*	Euphorbiaceae	1.5106	1.1364	1.5002	4.1471
74	*Macaranga hypoleuca*	Euphorbiaceae	0.3021	0.3788	0.1340	0.8149
75	*Macaranga obovata*	Euphorbiaceae	0.3021	0.3788	0.3546	1.0356
76	*Macaranga triloba*	Euphorbiaceae	4.5317	4.5455	1.2414	10.3186
77	*Mallotus* sp	Euphorbiaceae	0.3021	0.3788	2.4359	3.1168
78	*Mallotus subpeltatus*	Euphorbiaceae	0.6042	0.7576	0.6770	2.0388
79	*Mangifera* sp	Anacardiaceae	0.6042	0.7576	1.1711	2.5329
80	*Milletia atropurpurea*	Leguminosae	0.9063	1.1364	0.1624	2.2051
81	*Milletia erientha*	Leguminosae	0.3021	0.3788	0.1016	0.7825

82	*Myristica wallichii*	Myristicaceae	0.3021	0.3788	0.4942	1.1751
83	*Myroxylon balsamum*	Leguminosae	0.3021	0.3788	0.1185	0.7994
84	*Nephelium* sp	Sapindaceae	0.3021	0.3788	0.3418	1.0227
85	*Parkia speciosa*	Leguminosae	0.6042	0.7576	1.2316	2.5934
86	*Pavetta* sp	Rubiaceae	0.3021	0.3788	0.1605	0.8414
87	*Pithecellobium jiringa*	Leguminosae	4.8338	5.3030	2.2878	12.4247
88	*Poliatia* sp	Annonaceae	0.3021	0.3788	0.8968	1.5777
89	*Pshycotria angulata* .	Rubiaceae	0.3021	0.3788	0.0797	0.7606
90	*Pternandra echinata*	Melastomataceae	10.2719	9.4697	4.4695	24.2111
91	*Pternandra galeata*	Melastomataceae	0.6042	0.3788	0.1405	1.1235
92	*Quercus* sp	Fagaceae	0.9063	1.1364	3.6528	5.6955
93	*Radermachera gigantea*	Bignoniaceae	0.3021	0.3788	0.0299	0.7108
94	*Rinorea anguifera*	Violaceae	0.3021	0.3788	0.1185	0.7994
95	*Sapium jamaicense*	Euphorbiaceae	0.3021	0.3788	0.2294	0.9103
96	*Shorea* sp	Dipterocarpaseae	1.8127	1.5152	2.2388	5.5667
97	*Shorea sumatrana*	Dipterocarpaceae	1.8127	1.5152	2.4484	5.7763
98	*Sterculia laevis*	Sterculiaceae	0.3021	0.3788	1.2140	1.8949
99	*Sterculia rubiginosa*	Sterculiaceae	0.6042	0.7576	0.2169	1.5787
100	*Sterculia* sp	Sterculiaceae	1.5106	1.1364	0.3983	3.0453
101	*Symplocos cochinchinensis*	Symplocaceae	5.4381	4.1667	1.8520	11.4567
102	*Urophyllum griffithianum*	Rubiaceae	0.3021	0.3788	0.3085	0.9894
103	*Vitex coriacea*	Lamiaceae	0.6042	0.7576	0.2762	1.6380
104	*Vitex negundo*	Lamiaceae	0.3021	0.3788	0.0312	0.7121
105	*Vitex pinnata*	Lamiaceae	1.5106	1.8939	0.5478	3.9523
Total	105 spesies					

Appendix 3. Observation of Enviromental Factor In The Biological Education And Research Forest Of Andalas University

No	Waktu Pengamatan	Enviromental Factor	Unit (avarage)
1.	Day 1 (March 10th , 2022)	Temperature	23,7 ◦ C
		Moisture	76 %
		Light Intensity	22,4 %
2.	Day 2 (March 12th , 2022)	Temperature	24,8 ◦ C
		Moisture	79 %
3.	Day 3 (March 13th ,2022)	Temperature	24 ◦ C
		Moisture	76 %

Apppendix 4. Calcutate of Forest Health Index

$$HI\,(\%) = [(S_C + S_D + S_{Nsp})/3]*10$$

No Plot	Canopy Cover	Basal Area (cm)	0.25*C	(-)13.06	0.45*C	(+)1.42	sum	FHI (%)
1	65.5	1172.34	16.38	3.32	29.48	30.90	134.21	44.74
2	72.76	216.31	18.19	5.13	32.74	34.16	139.29	46.43
3	66.4	188.60	16.60	3.54	29.88	31.30	134.84	44.95
4	64.82	1060.16	16.21	3.15	29.17	30.59	133.73	44.58
5	68.49	823.94	17.12	4.06	30.82	32.24	136.30	45.43
6	66.63	315.20	16.66	3.60	29.98	31.40	135.00	45.00
7	70.33	717.56	17.58	4.52	31.65	33.07	137.59	45.86
8	66.06	1435.47	16.52	3.46	29.73	31.15	134.60	44.87
9	69.51	2473.39	17.38	4.32	31.28	32.70	137.02	45.67
10	47.6	1910.32	11.90	-1.16	21.42	22.84	121.68	40.56
11	59.86	535.29	14.97	1.91	26.94	28.36	130.26	43.42
12	63.8	727.26	15.95	2.89	28.71	30.13	133.02	44.34
13	65.65	404.85	16.41	3.35	29.54	30.96	134.32	44.77
14	66.23	329.90	16.56	3.50	29.80	31.22	134.72	44.91
15	71.31	121.91	17.83	4.77	32.09	33.51	138.28	46.09
16	64.57	216.42	16.14	3.08	29.06	30.48	133.56	44.52
17	68,55	480.05	17.14	4.01	30.85	32.27	136.28	45.43
18	64.84	469.78	16.21	3.15	29.18	30.60	133.75	44.58
19	65.24	775.12	16.31	3.25	29.36	30.78	134.03	44.68

20	71.33	218.11	17.83	4.77	32.10	33.52	138.29	46.10
21	63.87	378.47	15.97	2.91	28.74	30.16	133.07	44.36
22	58.46	1256.48	14.62	1.56	26.31	27.73	129.28	43.09
23	70.37	296.68	17.59	4.53	31.67	33.09	137.62	45.87
24	70.81	1495.26	17.70	4.64	31.86	33.28	137.93	45.98
25	65.73	638.56	16.43	3.37	29.58	31.00	134.37	44.79
26	73.83	1037.73	18.46	5.40	33.22	34.64	140.04	46.68
27	71.45	736.93	17.86	4.80	32.15	33.57	138.38	46.13
28	69.26	528.56	17.32	4.26	31.17	32.59	136.84	45.61
29	62.87	328.91	15.72	2.66	28.29	29.71	132.37	44.12
30	58	74.15	14.50	1.44	26.10	27.52	128.96	42.99
31	67.66	245.63	16.92	3.86	30.45	31.87	135.72	45.24
32	71.49	237.47	17.87	4.81	32.17	33.59	138.40	46.13
33	72.84	655.98	18.21	5.15	32.78	34.20	139.35	46.45
34	73.91	1243.47	18.48	5.42	33.26	34.68	140.10	46.70
35	70.6	226.96	17.65	4.59	31.77	33.19	137.78	45.93
36	67.3	321.43	16.83	3.77	30.29	31.71	135.47	45.16
37	66.83	2349.45	16.71	3.65	30.07	31.49	135.14	45.05
38	62.03	335.23	15.51	2.45	27.91	29.33	131.78	43.93
39	70.01	289.38	17.50	4.44	31.50	32.92	137.37	45.79
40	58.93	1342.03	14.73	1.67	26.52	27.94	129.61	43.20
41	71.31	822.58	17.83	4.77	32.09	33.51	138.28	46.09
42	69.87	249.29	17.47	4.41	31.44	32.86	137.27	45.76
43	67.67	494.45	16.92	3.86	30.45	31.87	135.73	45.24
44	70.95	181.21	17.74	4.68	31.93	33.35	138.03	46.01
45	66.42	334.67	16.61	3.55	29.89	31.31	134.85	44.95
46	74.28	317.46	18.57	5.51	33.43	34.85	140.36	46.79

47	70.51	3856.13	17.63	4.57	31.73	33.15	137.72	45.91
48	70.37	1066.97	17.59	4.53	31.67	33.09	137.62	45.87
49	69.1	565.48	17.28	4.22	31.10	32.52	136.73	45.58
50	72.59	470.43	18.15	5.09	32.67	34.09	139.17	46.39
51	61.4	475.05	15.35	2.29	27.63	29.05	131.34	43.78
52	70.31	306.12	17.58	4.52	31.64	33.06	137.58	45.86
53	68.89	348.18	17.22	4.16	31.00	32.42	136.58	45.53
54	72.83	155.62	18.21	5.15	32.77	34.19	139.34	46.45
55	69.89	224.77	17.47	4.41	31.45	32.87	137.28	45.76
56	70.01	930.15	17.50	4.44	31.50	32.92	137.37	45.79
57	69.06	257.81	17.27	4.21	31.08	32.50	136.70	45.57
58	67.9	1285.21	16.98	3.92	30.56	31.98	135.89	45.30
59	67.09	2025.80	16.77	3.71	30.19	31.61	135.32	45.11
60	75.26	584.74	18.82	5.76	33.87	35.29	141.04	47.01
61	61.86	1032.40	15.47	2.41	27.84	29.26	131.66	43.89
62	71.35	574.58	17.84	4.78	32.11	33.53	138.31	46.10
63	62.6	227.68	15.65	2.59	28.17	29.59	132.18	44.06
64	69.53	444.24	17.38	4.32	31.29	32.71	137.03	45.68
65	57.98	294.33	14.50	1.44	26.09	27.51	128.95	42.98
66	71.48	472.04	17.87	4.81	32.17	33.59	138.40	46.13
67	67.76	1117.65	16.94	3.88	30.49	31.91	135.79	45.26
68	68.44	2026.82	17.11	4.05	30.80	32.22	136.27	45.42
69	65.12	1080.92	16.28	3.22	29.30	30.72	133.94	44.65
70	64.99	471.52	16.25	3.19	29.25	30.67	133.85	44.62
71	58	1079.71	14.50	1.44	26.10	27.52	128.96	42.99
72	67	820.95	16.75	3.69	30.15	31.57	135.26	45.09
73	72.84	271.72	18.21	5.15	32.78	34.20	139.35	46.45

74	70.95	263.32	17.74	4.68	31.93	33.35	138.03	46.01
75	69.14	439.77	17.29	4.23	31.11	32.53	136.76	45.59
76	63.55	415.55	15.89	2.83	28.60	30.02	132.85	44.28
77	65.04	183.66	16.26	3.20	29.27	30.69	133.89	44.63
78	69.14	384.42	17.29	4.23	31.11	32.53	136.76	45.59
79	73.01	230.61	18.25	5.19	32.85	34.27	139.47	46.49
80	60.42	2391.48	15.11	2.05	27.19	28.61	130.65	43.55
81	65.62	1959.93	16.41	3.35	29.53	30.95	134.29	44.76
82	68.91	455.94	17.23	4.17	31.01	32.43	136.60	45.53
83	67.34	1748.85	16.84	3.78	30.30	31.72	135.50	45.17
84	70.21	5538.96	17.55	4.49	31.59	33.01	137.51	45.84
85	62.96	5671.63	15.74	2.68	28.33	29.75	132.43	44.14
86	64.22	808.29	16.06	3.00	28.90	30.32	133.31	44.44
87	66.62	126.61	16.66	3.60	29.98	31.40	134.99	45.00
88	62.47	525.58	15.62	2.56	28.11	29.53	132.09	44.03
89	71.17	493.14	17.79	4.73	32.03	33.45	138.18	46.06
90	65.34	254.47	16.34	3.28	29.40	30.82	134.10	44.70
91	66.67	540.99	16.67	3.61	30.00	31.42	135.03	45.01
92	71.7	236.14	17.93	4.87	32.27	33.69	138.55	46.18
93	73.75	163.88	18.44	5.38	33.19	34.61	139.99	46.66
94	70.45	725.24	17.61	4.55	31.70	33.12	137.68	45.89
95	77.32	549.16	19.33	6.27	34.79	36.21	142.48	47.49
96	70.51	406.11	17.63	4.57	31.73	33.15	137.72	45.91
97	68.61	6789.47	17.15	4.09	30.87	32.29	136.39	45.46
98	64.41	765.63	16.10	3.04	28.98	30.40	133.45	44.48
99	70.53	0.00	17.63	4.57	31.74	33.16	137.73	45.91
100	65.05	660.27	16.26	3.20	29.27	30.69	133.90	44.63

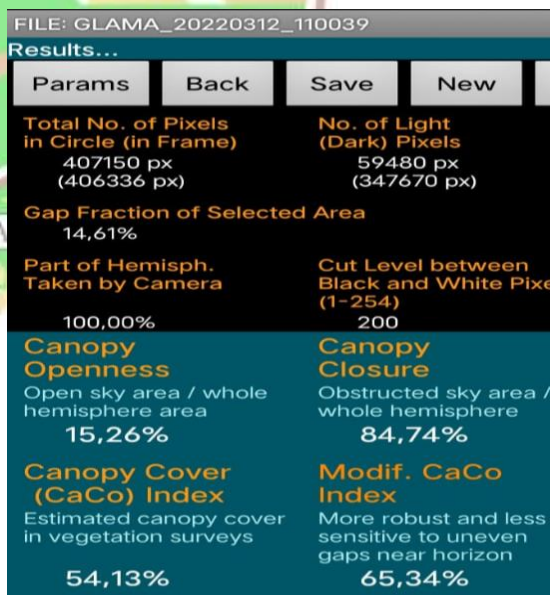
TOTAL	4521.59
Avarage	45.22 %

Appendix 5 . Field Documentation

a. Taking the Canopy picture from GLAMA

b. Measurment of Tree DBH in anoter plot.Application in Permanen plot.

c. the picture with Camera Phone GLAMA application in Android



d. The screenshoot number of GLAMA Application

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