Jurnal Biodjati 8(2):335–346, November 2023
e-ISSN : 2541-4208
p-ISSN : 2548-1606

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

The Existence of Undergrowth at Forest Garden Stands in Grand Forest Park, Lampung Province

Indriyanto*[1], Nurani Hardikananda Indriyanto[2]

Received: June 17, 2023
Revise from: June 26, 2023
Accepted: August 04, 2023

DOI: 10.15575/biodjati.v8i2.26777

[1]Department of Forestry, Faculty of Agriculture, Universitas Lampung, Jl. Prof. Dr. Soemantri Brojonegoro, Bandar Lampung, Indonesia, 35145, Indonesia, [2]PT. Meganesia Tirta Foresta, Bogor, West Java, Indonesia, 16117

e-mail:
[1*]*indriyanto.1962@fp.unila.ac.id*
[2] *nurani.hardikananda@gmail.com*

**Corresponding author*

Abstract. *The existence of undergrowth has an important role as an ecosystem both from an ecological and economic perspective. However, the composition and diversity of undergrowth in an area depends on the land use system. This research aimed to know the species composition and diversity of undergrowth at forest garden stands. Data collection was carried out with a vegetation survey using nested rectangular plots with a sampling intensity of 1%. The data collected included undergrowth species, the number of individuals for each species, and tree species as components of forest garden stands. Data were analyzed by calculating density, frequency, important value index, and Shannon diversity index. The results showed that the undergrowth that exists under forest garden stands were 38 species dominated by 12 species, namely Acalypha australis, Asystasia gangetica, Clidemia hirta, Starchytarpeta jamaicensis, Mikania micrantha, Peperomia pellucidia, Setaria barbata, Andropogon aciculatus, Alpinia galanga, Diplazium esculentum, Paederia foetida, and Crassocephalum crepidioides. The forest garden stands were composed of 43 tree species dominated by 4 tree species, namely Durio zibethinus, Aleurites moluccana, Myristica fragrans, and Gnetum gnemon. The level of undergrowth diversity was in the medium category with an H value of 1.540, indicating the diverse of undergrowth species.*

Keywords: *composition, diversity, undergrowth*

Citation
Indriyanto & Indriyanto, H. N. (2023). The Existence of Undergrowth at Forest Garden Stands in Grand Forest Park, Lampung Province. *Jurnal Biodjati*, 8(2), 335–346.

INTRODUCTION

The species of undergrowth is one component that has an important role in forest ecosystems as well as in land ecosystems with complex agroforestry (Widyastuti et al., 2018). The roles of undergrowth are to protect the soil from raindrops and erosion from surface runoff (Marfi, 2018), increase organic matter in the soil (Latifah et al., 2022; Marfi, 2018), contribute to increased biodiversity, play a role in driving the nutrient cycle (Fang et al., 2014), as well as controlling the microclimate (Sidabukke et al., 2021). In addition, the undergrowth has economic value because it can be used for traditional medicinal ingredients (Nguyen et al., 2019), and source of animal feed ingredients (Marfi, 2018). Given the critical role of undergrowth, both from an ecological and economic point of view, their existence must be preserved. The existence of undergrowth species depends on the land use system. The agroforestry system applied to land management can maintain biodiversity, including the diversity of undergrowth species (Sidabukke et al., 2021). According to

Jurnal Biodjati 8(2):335–346, November 2023

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

Fang et al. (2014), the composition of undergrowth species and their diversity determines the complexity of the vegetation structure in an ecosystem. The undergrowth in forest ecosystems plays a part in forming the vertical structure of forest vegetation so that it has a positive effect on the condition of the balance of the forest ecosystem (Marfi, 2018).

Preservation of undergrowth species is very possible with the application of agroforestry systems in forest areas, especially in conservation forest areas. One of the conservation areas in Lampung Province, Indonesia, is the Grand Forest Park (Tahura) of Wan Abdul Rachman where part of the area is managed by the community around the forest for traditional cultivation. The Tahura of Wan Abdul Rachman has an area of 22,245.50 ha (UPTD Taman Hutan Raya Wan Abdul Rachman, 2017). According to its function, a Tahura is a nature conservation area designated for the purpose of collecting natural or non-natural plants and/or animals, native and/or non-native species that are utilized for research, science, education, cultivation support, culture, tourism, and recreation (Undang-undang Nomor 5/1990). The uses Tahura by the local community include the collection of non-timber forest products and traditional cultivation (Peraturan Pemerintah Nomor 108/2015). Traditional cultivation by the community is carried out by applying MPTS (multipurpose tree species) agroforestry techniques to form to form a sustainable forest garden management in the area they cultivate (Indriyanto & Asmarahman, 2019). Such traditional cultivation has long been implemented by the community or forest farmers who live around Tahura of Wan Abdul Rachman, including farmers who are members of the Harapan Baru Forest Farmers Group (Gapoktanhut), who have been practicing traditional cultivation since 1998 with a total arable area of 225 ha (Gapoktanhut Harapan Baru, 2019).

The formation of forest garden stands is able to maintain the economic function of the area for the community, and also maintain the ecological function of the forest park area, for example, to preserve plant diversity. This is in line with the opinion of Nair (1993) that the development of the MPTS group of woody plants can provide many benefits, both economic benefits for the community and ecological benefits for the land and the surrounding environment. Thus, the functions of land ecosystems with agroforestry systems are production functions, natural regulatory functions, ecosystem supporting functions, and cultural functions (Yulistyarini, 2013). The sustainability of these functions is also supported by the composition and diversity of the undergrowth (Fang et al., 2014) as well as the composition of the tree species (Yulistyarini, 2013). The practice of cultivating plants in forest areas may eliminate undergrowth, which farmers consider as useless wild plants. Loss of undergrowth can occur due to the clearing of plants which are understood by farmers as weeds at the beginning of the tree planting process. Indeed, undergrowth can become weeds at the start of tree planting, but of course, the control must be as friendly as possible because the composition and diversity of undergrowth or weeds also determine the structure of the forest and affect the ecological function of the forest (Widhyastini et al., 2012).

The loss of a undergrowth species can also occur due to the inability of these plants to grow together with the trees that make up the forest garden planted by farmers, due to the influence of shade (Kunarso & Azwar, 2013; Hilwan et al., 2013) or allelopathy from the trees (Latifah et al., 2022). However, once a forest garden stand has been formed, changes in environmental conditions will inevitably occur along with the development of a forest garden stand which can create habitat

conditions suitable for the needs of the flora and fauna under the stand (Kohli et al., 2020), then this allows the growth and development of undergrowth communities. In addition, ecologically the forest garden stands formed determine the presence of undergrowth species that are able to live naturally or wildly under the species of the forest garden stands. Hilwan et al. (2013) stated that the number of understorey species under pure plantation forest stands is generally 22 species with a total of 12 families. Understorey plants under mangium forest stand are 21 species (Goreti et al., 2021), under teak forest stands there are 15 species with 10 families, under superior teak forest stands there are 15 species of undergrowth (Widhyastini et al., 2012), in conservation forest there are 32 species of undergrowth with 21 families (Norris et al., 2020). It appears that the diversity of understorey species varies in different compositions of the tree species that make up the stand.

Therefore, this research was conducted with the aim of knowing the composition of undergrowth species and the level of diversity of undergrowth communities in forest garden stands at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances (Gapoktanhut) in Wan Abdul Rachman Grand Forest Park. This research provides information on whether forest gardens built by farmers being able to maintain the diversity of undergrowth so that the development of forest gardens within a grand forest park can maintain the function of a grand forest park in preserving tree species and undergrowth species.

MATERIALS AND METHODS

Place and Time of Research

The research was conducted from August to December 2020 in the area cultivated by members of Harapan Baru Forest Farmer Group Alliances in the Bandar Lampung Resort Traditional Block, Wan Abdul Rachman Grand Forest Park (Tahura), Lampung Province, Indonesia. Location of the research can be seen in Figure 1.

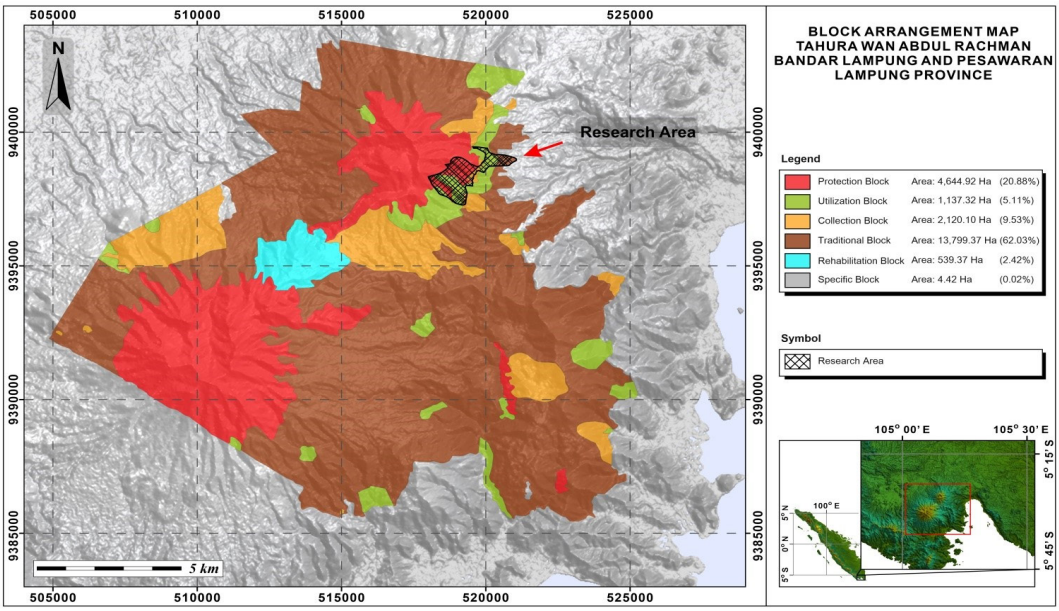

Figure 1. Map of the research site at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances in Wan Abdul Rachman Grand Forest Park, Lampung Province, Indonesia (Adapted from UPTD Taman Hutan Raya Wan Abdul Rachman, 2017; Gapoktanhut Harapan Baru, 2019)

Jurnal Biodjati 8(2):335–346, November 2023

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

Data Collection Method

The collection of research data was carried out by surveying forest vegetation to observe undergrowth and trees that make up forest garden stands in agroforestry systems. Data were collected on sample plots in the form of nested rectangular sample plots (nested plots) with a sampling intensity of 1%. Undergrowth was observed in the smallest plot (2 m x 2 m plot) of each nested plot. Each nested plot consists of a plot measuring 20 m x 20 m for the observation of trees phase, a plot measuring 10 m x 10 m for observation of poles phase, a plot measuring 5 m x 5 m for observation of the sapling phase, while a plot measuring 2 m x 2 m for observation of seedlings phase and undergrowth. A number of 58 nested sample plots representing 1% sampling intensity were placed systematically.. The design of the nested plots is presented in Figure 2.

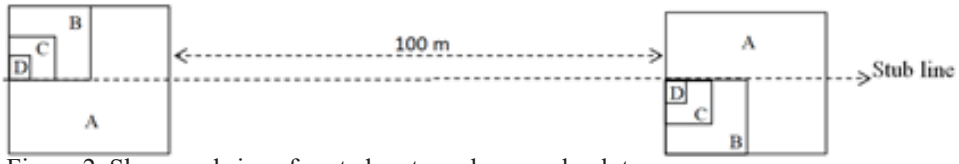

Figure 2. Shape and size of nested rectangular sample plots

Remark:

A= plot measuring 20 m x 20 m for observation of mature trees phase

B= plot measuring 10 m x 10 m for observation of poles phase

C= plot measuring 5 m x 5 m for observation of saplings phase

D= plot measuring 2 m x 2 m for observation of seedlings phase and undergrowth

The types of data collected include: names of undergrowth species, number of individual undergrowth, and names of tree species that make up forest garden stands. The altitude for each sample plot location and intensity of solar radiation that reaches the undergrowth under the forest garden stands were recorded. Each undergrowth and tree was identified to determine the name of the species and its family.

Data Analysis

The species of undergrowth observed under the stands were presented in tabular form containing local names, scientific names, and families, and a brief description of the benefits of the plants was provided. The species of trees that make up the stands were presented in tabular form containing local names, scientific names, and the commodities produced.

The dominance of plant species was analyzed by calculating the important value index or IVI (Indriyanto, 2021). Meanwhile, the dominance level was determined by making dominance class intervals using the formula according to Indriyanto (2021)., and Diversity was analyzed using the Shannon index of general diversity according to Odum (1971). The level of diversity based on the Shannon Index refers to the criteria by Fachrul (2012).

RESULTS AND DISCUSSION

Undergrowth Species

Under the stands of mixed forest gardens a total of 38 undergrowth species belonging to 37 genera and 21 families were found. Of the 38 species of undergrowth, 57.89% (22 species) were medicinal plants and 13.16% (5 species) had the potential as raw material for vegetable pesticides (Table 1).

Jurnal Biodjati 8(2):335–346, November 2023

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

Table 1. Species of undergrowth that found under forest garden stands at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances in Wan Abdul Rachman Grand Forest Park, Indonesia

Local Name in Indonesia	Botanical Name	Family
Anting-anting +	*Acalypha australis* L.	Euphorbiaceae
Alang-alang +	*Imperata cylindrica* Beauv.	Gramineae
Ara sungsang	*Asystasia gangetica* (L.) T. Anderson	Acanthaceae
Babing	*Sauropus androgynus* Merr.	Phyllanthaceae
Bandotan + #	*Ageratum conyzoides* L.	Asteraceae
Blimbingan +	*Oxalis barrelieri* L.	Oxalidaceae
Cakar ayam +	*Selaginella doederleinii* Hieron	Selaginellaceae
Ceplukan +	*Physalis minima* L.	Solanaceae
Cepokak + #	*Solanum torvum* Swartz.	Solanaceae
Harendong bulu	*Clidemia hirta* D.Don.	Melastomataceae
Honje +	*Etlingera hemisphaerica* (Bl.) R.M. Smith	Zingiberaceae
Rumput empritan	*Cyrtococcum patens* (L.) A. Camus	Gramineae
Kecombrang +	*Etlingera elatior* (Jack.) R.M. Smith	Zingiberaceae
Kirinyuh	*Chromolaena odorata* (L.) King & H.E.Robins	Asteraceae
Jotang	*Synedrella nodiflora* (L.) J. Gaertn.	Asteraceae
Lengkuas +	*Alpinia galanga* Sw.	Zingiberaceae
Meniran +	*Phyllanthus urinaria* L.	Phyllanthaceae
Pacing +	*Cheilocostus speciosus*(J.Koenig) C.D.Specht.	Costaceae
Paku sayur + *	*Diplazium esculentum* Swartz.	Polypodiaceae
Patikan + *	*Euphorbia hirta* L.	Euphorbiaceae
Pecut kuda	*Starchytarpeta jamaicensis* (L.) Vahl.	Verbenaceae
Pulutan +	*Urena lobata* L.	Malvaceae
Putri malu +	*Mimosa pudica* L.	Mimosaceae
Rambusan	*Passiflora foetida* L.	Passifloraceae
Rumput jagung	*Setaria barbata* (Lam.) Kunth.	Gramineae
Rumput jarum	*Andropogon aciculatus* Retz.	Gramineae
Sembukan +	*Paederia foetida* L.	Rubiaceae
Sembung + #	*Blumea balsamifera* D.C.	Compositae
Sembung rambat	*Mikania micrantha* Kunth.	Asteraceae
Senggani	*Melastoma malabathricum* L.	Melastomataceae
Serai + #	*Cymbopogon citratus* (D.C.) Stapf.	Gramineae
Sintrong	*Crassocephalum crepidioides* (Benth.) S. Moore	Asteraceae
Sirihan	*Piper aduncum* L.	Piperaceae
Suruhan +	*Peperomia pellucidia* (L.) Kunth.	Piperaceae
Tapak liman #	*Elephantopus scaber* L.	Asteraceae
Teki +	*Cyperus rotundus* L.	Cyperaceae
Tembelekan +	*Lantana camara* L.	Verbenaceae
Tempuyung	*Sonchus arvensis* L.	Asteraceae

Remark: += medicinal plants (Indriyanto & Susanto, 1992; Indriyanto & Harianto, 2004; Soepardi, 1964; Sutomo & Fardila, 2013; Widhyastini et al., 2012).
*= endangered plants (Hamid 1987).
#= vegetable pestiside-producing plants (Asmaliyah et al., 2010).

The composition of undergrowth under forest garden stands was dominated by 12 species with an IVI (important value index) ranging from 7.07 to 9.61 (Table 2).

At the beginning of tree growth, the presence of undergrowth is identical to the presence of weeds because these plants can become competitors immensely through the allelopathic substances released and negatively affect tree growth. Thus, generally, the presence of weeds is not desirable. From an ecological point of view, it turns out that weeds have a role in determining the structure of forest ecosystems, even economically, many weeds have been used for traditional medicines (Widhyastini et al., 2012). Species of medicinal plants are all species of plants that are good for maintaining health and treating various diseases. Currently, people have a tendency to use medicinal plants to treat various diseases compared with chemical drugs (Mayangsari et al., 2019).

Jurnal Biodjati 8(2):335–346, November 2023

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

Table 2. The dominant species of undergrowth under forest garden stands at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances in Wan Abdul Rachman Grand Forest Park, Indonesia

Local Name in Indonesia	Botanical Name	IVI (%)	Density (Individual/ ha)	Frequency	Altitude (m Above Sea Level)	Solar Radiation Intensity (Lux)
Anting-anting	*Acalypha australis*	7.32	560	0.44 m	355—668	842—2.171
Ara sungsang	*Asystasia gangetica*	9.51	540	0.75 h	350—676	920—1.988
Harendong bulu	*Clidemia hirta*	7.48	373	0.64 m	350—674	1.028—4.132
Pecut kuda	*Starchytarpeta jamaicensis*	7.07	430	0.53 m	358—674	915—1.423
Sembung rambat	*Mikania micrantha*	7.10	320	0.64 m	436—642	2.481—5.251
Suruhan	*Peperomia pellucidia*	8.57	860	0.32 l	350—484	845—976
Rumput jagung	*Setaria barbata*	9.33	630	0.64 m	430—568	1.028—4.211
Rumput jarum	*Andropogon aciculatus*	7.71	520	0.53 m	436—668	1.013—4.262
Lengkuas	*Alpinia galanga*	8.57	860	0.32 l	350—533	845—4.132
Paku sayur	*Diplazium esculentum*	9.61	1.005	0.32 l	358—554	840—935
Sembukan	*Paederia foetida*	7.71	520	0.53 m	350—676	843—1.028
Sintrong	*Crassocephalum crepidioides*	7.21	450	0.53 m	358—668	915—1.423

Remark: Calculated based on the formula for determining the level of dominance (Indriyanto, 2021).
Dominant (high dominance), that is IVI> 6,98
Moderate dominance, that is IVI 4,34—6,98
Not dominant (low dominance), that is IVI< 4,34
High frequency (h), that is F> 0,67
Moderate frequency (m), that is F 0,33—0,67
Low frequency (l), that is F< 0,33

The dominant undergrowth includes: *Acalypha australis*, *Asystasia gangetica*, *Clidemia hirta*, *Starchytarpeta jamaicensis*, *Mikania micrantha*, *Peperomia pellucidia*, *Setaria barbata*, *Andropogon aciculatus*, *Alpinia galanga*, *Diplazium esculentum*, *Paederia foetida*, and *Crassocephalum crepidioides* which are found at an altitude of 350-676 m above sea level, and the light intensity between 840-5,251 lux (Table 2). According to Silalahi (2015), one of the factors that influence the spread of plants is the altitude where they grow above sea level. The high intensity of solar radiation under the shade of forest garden stands where the undergrowth is found also illustrates the relative tolerance of plants to solar radiation and to the need for canopy shading from other plants (Indriyanto, 2017). Therefore, solar radiation reaching the soil surface under forest garden stands affects the diversity of undergrowth species (Hilwan et al., 2013). This is in accordance with the statement of Marfi (2018) and Goreti et al. (2021) that undergrowth plants survived under forest stands are generally plants tolerant or resistant to shade by the tree canopy. The denser the crown cover of the forest stand, the more abundant the undergrowth (Sutomo & Fardila, 2013). It is proven that the dominant undergrowth plants generally live under conditions of dense canopy shade with an average diffused solar radiation intensity of < 1,900 lux. In addition, the presence of undergrowth generally does not spread throughout the farmers' cultivated land, indicated by the frequency of the low and medium categories. Only one species of undergrowth had a high frequency (F = 0.75), namely *Asystasia gangetica*.

Jurnal Biodjati 8(2):335–346, November 2023

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

Trees Species that Make Up Forest Garden Stands

Forest garden stands at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances in Wan Abdul Rachman Grand Forest Park, Indonesia are mixed forest gardens of various species of trees cultivated by farmers.

Table 3. Dominant tree species in forest garden stands at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances in Wan Abdul Rachman Grand Forest Park, Indonesia

Local Name in Indonesia	Botanical Name	IVI (%)	Density (Individual/ha)	Frequency
Durian	*Durio zibethinus*	29.42	141.1	1.00 h
Kemiri	*Aleurites moluccana*	20.23	62.1	0.86 h
Pala	*Myristica fragrans*	23.94	105.7	0.91 h
Tangkil	*Gnetum gnemon*	24.72	107.0	1.00 h

Remark: Calculated based on the formula for determining the level of dominance (Indriyanto, 2021).
Dominant (high dominance), that is IVI> 19,91
Moderate dominance, that is IVI 10,39—19,91
Not dominant (low dominance), that is IVI< 10,39
High frequency (h), that is F> 0,67
Moderate frequency (m), that is F 0,33—0,67
Low frequency (l), that is F< 0,33

Among 43 tree species that make up the forest garden stand, there are 4 dominant tree species based on the results of the analysis of the important value index (IVI). The important value index describes the level of dominance of a tree population over other tree populations in a stand or plant community (Gopal & Bhardwaj, 1979). The important value index also indicates the level of dominance of a plant population over other plant populations in a plant community. The higher the IVI, the higher the dominance level, and conversely the smaller the IVI, the lower the dominance level (Indriyanto, 2019). Four species of trees dominated the forest garden stands, namely Durio zibethinus, Aleurites moluccana, Myristica fragrans, and *Gnetum gnemon* with an IVI of > 19.91.

Durio zibethinus, *Aleurites moluccana*, *Myristica fragrans*, and *Gnetum gnemon* trees have a wide distribution in the farmers' cultivated areas, which indicated by the high frequency (F> 0.67). The frequency values of the *Durio zibethinus* tree and the *Gnetum gnemon* tree are each 1.00. The frequency value of *Myristica fragrans* trees is 0.91 and *Aleurites moluccana* trees is 0.86. Based on the level of dominance and the wide distribution of trees, it shows that the four species of trees are the most preferred species by farmers compared with other tree species. In fact, it is suspected that the four tree species are the species that are favored by forest farmers.

Diversity

The condition of plant community diversity can be illustrated based on the number of life forms, the number of families, the number of genera, the number of species, and based on the diversity index (Indriyanto, 2021). According to Odum (1971), the real condition of the diversity of biota communities is determined by the number of species of biota that make up a biota community.

Based on this, the condition of the diversity of undergrowth found under the for-

Jurnal Biodjati 8(2):335–346, November 2023

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

est garden stands at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances in Wan Abdul Rachman Grand Forest Park is presented in Table 4 as follows.

Table 4. The diversity of undergrowth at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances in Wan Abdul Rachman Grand Forest Park

Undergrowth diversity	**Amount**
Diversity based on the number of plants species	38
Diversity based on the number of genera	37
Diversity based on the number of family	21
Diversity base on the Shannon Index (H)	1.540

Diversity index is important information about a biota community (Setiadi, 2005). Based on the diversity index (H) value, the undergrowth community has an H of 1.540. Thus, the diversity of undergrowth plants is in the moderate category (Fachrul, 2012). The diversity index value obtained in this research is almost the same as the diversity index of medicinal plants that found in secondary natural forests in the same forest area, which is 1.6681 (Indriyanto & Harianto, 2004). This indicates that the condition of the undergrowth community under the forest garden stand is quite good because there are various species of undergrowth that are able to adapt under the canopy of forest garden trees. From a conservation perspective, the development of forest gardens with heterogeneous tree species has a positive effect on preserving the diversity of undergrowth, so that the conservation process can run effectively. This is in accordance with the statement of Fang et al. (2014) that the diversity of undergrowth and other biodiversity indicates the effectiveness of forest conservation and restoration.

The agroforestry system in the form of a forest garden is beneficial not only in conservation but also in socio-economics. This is in line with the statement of Senoaji (2012) that land management with an agroforestry system has the aim of maintaining the quantity and variety of commodities produced so that it has the potential to provide social, economic, and environmental benefits for land users. It is hoped that by planting the various species of MPTS, these goals can be achieved, and the forest built is expected to be a support for life systems. As stated by Dwiprabowo et al. (2011), forests are life supporting systems that have the ability to support food supply. In addition to food provision, other needs can also be obtained from the forest, such as the need for traditional medicines for the community which can be met by the presence of undergrowth.

The richness of biodiversity in Indonesia has an important role in human life, from an economic, cultural, and ecological point of view. Diversity is the total number of living things. Diversity itself can be seen at various levels, namely species, genes, and ecosystems (Putri & Dharmono, 2018) so the benefits of diversity for human life will increase along with the development of human civilization.

It should be noted that the conditions for the development of young plant communities towards mature plant communities can be characterized by increased diversity (Indri-

yanto, 2019; Hu et al., 2022). Plant diversity will increase as the community grows, and can reach its highest when the community is in ecological balance (Putri & Indriyanto, 2021). Therefore, the diversity index continues to change until the plant community reaches a state of balance or equilibrium (Hu et al., 2022). Ecological balance will be achieved in a long process with various processes that occur in plants, both competition, aggregation, adaptation, and regeneration processes (Indriyanto, 2019), the composition and structure of plant communities are becoming increasingly complex (Chang et al., 2014).

Considering that the forest garden built in the area cultivated by the Harapan Baru forest farmer group in the Wan Abdul Rachman Grand Forest Park was able to preserve the existence of undergrowth species, the form of this forest garden needs to be maintained. This is important because the function of the forest park as a conservation area for plant diversity can be well maintained. Then, another aspect that needs attention here is the knowledge of the people around the forest about the benefits of undergrowth, and how they use the undergrowth.

CONCLUSION

The undergrowth that lives under the forest garden stands at the farmers' cultivated area, members of Harapan Baru Forest Farmer Group Alliances have a heterogeneous species composition with a total of 38 species. As much as 57.89% of these undergrowth species have the potential as medicinal plants and as much as 13.16% have the potential as vegetable pesticide ingredients. The condition of diversity of undergrowth is quite good as seen from the number of plant groups based on the taxon hierarchy with a total of 38 species, 37 genera, and 21 families. The diversity level of the undergrowth community based on the Shannon Index is in the moderate category with an H value of 1.540.

AUTHOR CONTRIBUTION

I. designed the research, collected and analyzed the data, and wrote the manuscript, N.H.I. analyzed the data.

ACKNOWLEDGMENTS

The Authors would like to thank the Institute for Research and Community Service, Universitas Lampung, which has facilitated research funding. The Authors also would like to thank the farmers from members of Harapan Baru Forest Farmer Group Alliances in Batu Putuk Village, Teluk Betung Barat District, and to the Forestry Police, UPTD (regional technical implementation unit) of Wan Abdul Rachman Grand Forest Park who accompanied during observations and data collection in the field.

CONFLICT OF INTEREST

There is no conflict of interest.

REFERENCES

Asmaliyah, Wati, E. E. H., Utami, S. Mulyadi, K., Yudhistira & Sari, F. W. (2010). *Pengenalan Tumbuhan Penghasil Pestisida Nabati dan Pemanfaatannya Secara Tradisional*. Edited by I. Anggraeni. Palembang: Pusat Penelitian dan Pengembangan Produktivitas Hutan.

Chang, L., He, Y., Yang, T., Du, J., Niu, H. & Pu, T. (2014). Analysis of Herbaceous Plant Succession And Dispersal

Mechanisms in Deglaciated Terrain on Mt. Yulong, China. *The Scientific World Journal*, (154539), 1–13. DOI: 10.1155/2014/154539.

Dwiprabowo, H., Effendi, R., Hakim, I. & Bangsawan, I. (2011). Kontribusi Kawasan Hutan dalam Menunjang Ketahanan Pangan: Studi Kasus Provinsi Jawa Barat. *Jurnal Analisis Kebijakan Kehutanan*, 8(1), 47–61. DOI: 10.20886/jakk.2011.8.1.47-61.

Fachrul, M. F. (2012). *Metode Sampling Bioekologi*. Jakarta: PT Bumi Aksara.

Fang, Z. Q., Bao, W. K., Yan, X, & Liu, X. (2014). Understory Structure and Vascular Plant Diversity in Naturally Regenerated Deciduous Forests and Spruce Plantations on Similar Clear-Cuts: Implications for Forest Regeneration Strategy Selection. *Forests,* 5, 715–743. DOI: 10.3390/f5040715.

Gapoktanhut Harapan Baru. (2019). *Profil Kelompok Tani Hutan Harapan Baru*. Bandar Lampung: Desa Batu Putuk Kecamatan Teluk Betung Barat.

Gopal, B. & Bhardwaj, N. (1979). *Elements of Ecology*. 1st Ed. Sahibabad: Vikas Publishing House PVT LTD.

Goreti, T., Muin, A. & Burhanuddin. (2021). Keanekaragaman Jenis Tumbuhan Bawah Tanaman Akasia (Acacia mangium Willd.) di Bukit Penghijauan Mandor Kabupaten Landak. *Jurnal Hutan Lestari,* 9(1), 14–24. DOI: 10.26418/jhl.v9i1.45320.

Hamid, A. (1987). Plasma Nutfah Tanaman Industri. *Bulletin*, (1), 6–21.

Hilwan, I., Mulyana, D. & Pananjung, W. G. (2013). Keanekaragaman Jenis Tumbuhan Bawah Pada Tegakan Sengon buto (*Enterolobium cyclocarpun* Griseb.) dan Trembesi (*Samanea saman* Merr.) di Lahan Pascatambang Batubara PT Kitadin, Embalut, Kutai Kartanagara, Kalimantan Timur. *Jurnal Silvikultur Tropika*, 04(01), 6–10. https://journal.ipb.ac.id/index.php/jsilvik/issue/view/1043.

Hu, X., Shu, Q., Shang, Z., Guo, W. & Qi, L. (2022). Secondary Succession in The Tropical Lowland Rainforest Reduced The Stochasticity of Soil Bacterial Communities Through The Stability of Plant Communities. *Forests*, 13(348), 1–14. DOI: 10.3390/f13020348.

Indriyanto. (2017). *Ekologi Spesies Pohon. 1st Ed*. Yogyakarta: Plantaxia.

Indriyanto. (2019). *Ekologi Hutan.* 7th Ed. Jakarta: PT Bumi Aksara.

Indriyanto. (2021). *Metode Analisis Vegetasi dan Komunitas Hewan*. 2nd Ed. Yogyakarta: Graha Ilmu.

Indriyanto & Asmarahman, C. (2019). *Jenis Tanaman Penyusun Tegakan Sebagai Sumber Pangan di Areal Garapan Petani Gabungan KPPH Sumber Agung dalam Taman Hutan Raya Wan Abdul Rachman*. Pp. 372–382 in Prosiding Seminar Nasional Perhimpunan Biologi Indonesia XXV. Bandar Lampung: Perhimpunan Biologi Indonesia Cabang Lampung.

Indriyanto & Harianto, S. P. (2004). Kondisi Jenis Tumbuhan Liar Berkhasiat Obat di Kawasan Hutan Register 19 Gunung Betung Propinsi Lampung. *Media Medika Indonesiana*, 23–27.

Indriyanto & Susanto, H. (1992). Inventarisasi Tumbuhan Bawah (Tumbuhan Obat) di kawasan Calon Taman Hutan Raya Gunung Betung, Lampung. *Jurnal Penelitian dan Pengembangan Kehutanan*, VIII(3), 18–21.

Kohli, R. K., Singh, H. P., Batish, D. R. & Jose, S. (2020). Ecological Interactions in Agroforestry: An Overview.” *Re-*

search Gat, 1–14.

Kunarso, A. & Azwar, F. (2013). Keragaman Jenis Tumbuhan Bawah pada Berbagai Tegakan Hutan Tanaman di Benakat, Sumatera Selatan. *Jurnal Penelitian Hutan Tanaman,* 10(2):85–98. DOI: 10.20886/jpht.2013.10.2.85-98.

Latifah, S., Sani, M. A., Simorangkir, A. J. F. &. Muhdi. (2022). Species Diversity and Carbon Storage of Undergrowth and Litter in The Agroforestry System of North Sumatera-Indonesia. *International Journal of Conservation Science*, 13(3), 1.003-1.014.

Marfi, W. O. E. (2018). Identifikasi dan Keanekaragaman Jenis Tumbuhan Bawah pada Hutan Tanaman Jati (*Tectona grandis* L.f.) di Desa Lamorende Kecamatan Tonkuno Kabupaten Muna. *Jurnal Agribisnis Perikanan*, 11(1), 71–82. DOI: 10.29239/j.agrikan.11.1.71-82.

Mayangsari, A., Indriyanto, Bintoro, A. &. Surnayanti. (2019). Identifikasi Jenis Tumbuhan Obat di Areal Garapan Petani KPPH Talang Mulya Tahura Wan Abdul Rachman. *Jurnal Sylva Lestari*, 7(1), 1–9. DOI: 10.23960/jsl171-9.

Nair, P. K. R. (1993). *An Introduction to Agroforestry*. Netherlands: Kluwer Academic Publishers.

Nguyen, T. S., Xia, N. H., Chu, T. V. & Sam, H. V. (2019). Ethnobotanical Study on Medicinal Plants in Traditional Markets of Son La Province, Vietnam. *Forest and Society*, 3(2), 171–192. DOI: 10.24259/fs.v3i2.6005.

Norris, M., Wiryono & Yansen. (2020). Analisis Keanekaragaman Jenis Tumbuhan Bawah pada Tiga Ketinggian di Taman Wisata Alam Bukit Kaba Provinsi Bengkulu. *NATURALIS – Jurnal Penelitian Pengelolaan Sumberdaya Alam dan Lingkungan*, 9(2), 51–57.DOI: 10.31186/naturalis.9.2.13506.

Odum, E. P. (1971). *Fundamentals of Ecology*. 3rd Ed. Philadelphia: W. B. Saunders Company.

Peraturan Pemerintah Nomor 108/2015. (2015). Tentang Perubahan Atas Peraturan Pemerintah No. 28 Tahun 2011 Tentang Pengelolaan Kawasan Suaka Alam dan Kawasan Pelestarian Alam. Retrived from https://peraturan.bpk.go.id/Details/5157.

Putri, A. I. &. Dharmono. (2018). *Keanekaragaman Genus Tumbuhan dari Famili Fabaceae di Kawasan Hutan Pantai Tabanio Kabupaten Tanah Laut Kalimantan Selatan*. Pp. 209–213 in Prosiding Seminar Nasional Lingkungan Lahan Basah. Banjarmasin: Lembaga Penelitian dan Pengabdian kepada Masyarakat Universitas Lambung Mangkurat. https://snllb.ulm.ac.id/prosiding/index.php/snllb-lit/article/view/45.

Putri, S. M. & Indriyanto. (2021). Keanekaragaman Tumbuhan Penyusun Vegetasi Hutan Lindung Bengkunat di Resor III KPH Unit I Pesisir Barat. J*urnal Hutan Tropis*, 9(1), 212–21. DOI: 10.20527/jht.v9i1.10496.

Senoaji, G. (2012). Pengelolaan Lahan Dengan Sistem Agroforestry oleh Masyarakat Baduy di Banten Selatan. Jurnal Bumi Lestari, 12(2), 283–293.

Setiadi, D. (2005). Keanekaragaman spesies tingkat pohon di Taman Wisata Alam Ruteng, Nusa Tenggara Timur. *Biodiversitas*, 6(2), 118–122. DOI: 10.13057/biodiv/d060210.

Sidabukke, S., Barus, T. A., Utomo, B. &. Delvian. (2021). The Undergrowth Composition and Distribution in Different Forest Area Utilization. *Biodiversitas*, 22(12), 5255–5261. DOI: 10.13057/biodiv/d221203.

Silalahi, M. (2015). Kajian Ekologi Tumbu-

han Obat di Agrofores Desa Surung Mersada Kabupaten Phakpak Bharat Sumatera Utara. *Jurnal Biologi*, 19(2), 89–94.

Soepardi, R. (1964). *Apotik Hijau. 1st Ed*. Surakarta: PT Purna Warna. In Indonesian.

Sutomo & Fardila, D. (2013). Autekologi Tumbuhan Obat *Selaginella doederleinii* Hierson di Sebagian Kawasan hutan Bukit Pohen Cagar Alam Batukahu, Bedugul Bali. *Jurnal Penelitian Hutan dan Konservasi Alam,* 10(2):153–161. DOI: 10.20886/jphka.2013.10.2.153-161.

Undang-undang Nomor 5/1990. (1990). Tentang Konservasi Sumber Daya Alam Hayati dan Ekosistemnya. Retrived from http://repository.lppm.unila.ac.id/16849/1/TAMAN%20HUTAN%20RAYA.pdf.

UPTD Taman Hutan Raya Wan Abdul Rachman. (2017). *Blok Pengelolaan Taman Hutan Raya Wan Abdul Rachman Provinsi Lampung*. Bandar Lampung: Dinas Kehutanan Provinsi Lampung.

Widhyastini, I. G. A. M., Yuliani, N., & Nurilmala, F. (2012). Identifikasi dan Potensi Gulma di Bawah Tegakan Jati Unggul Nusantara (Jun) di Kebun Percobaan Universitas Nusa Bangsa, Cogreg, Bogor. *Jurnal Sains Natural Universitas Nusa Bangsa*, 2(2), 186–200. DOI: 10.31938/jsn.v2i2.48.

Widyastuti, S. M., Hadi, E. E. W. & Wahyuono, S. (2018). Dominant Understorey Plants Producing Herbal Medicine Materials on Homegarden Agroforestry System in Menoreh Hills, Kulon Progo District." *AGRIVITA Journal of Agricultural Science*, 40(2), 212–221. DOI: 0.17503/agrivita.v40i0.657.

Yulistyarini, T. (2013). A*groforestri Kopi dan Pengaruhnya Terhadap Layanan Ekosistem di Daerah Resapan Air Krisik, Ngantang, Kabupaten Malang*. Pp. 242–249 in Prosiding Seminar Nasional Agroforestri.