PROS SEM NAS MASY BIODIV INDON
Volume 9, Nomor 1, Juni 2023 ISSN: 2407-8050
Halaman: 170-177 DOI: 10.13057/psnmbi/m090126

Analisis vegetasi angiospermae di Zona Enklaf Paguyangan, Taman Hutan Raya Ir. H. Djuanda, Bandung

Vegetation analysis of angiosperms at Paguyangan Enclave Zone, Ir. H. Djuanda Forest Park, Bandung

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Manuskrip diterima: 4 September 2022. Revisi disetujui: 26 June 2023.

Abstrak. *Amalia C, Wulandari I. 2023. Analisis vegetasi angiospermae di Zona Enklaf Paguyangan, Taman Hutan Raya Ir. H. Djuanda. Pros Sem Nas Masy Biodiv Indon 9: 170-177.* Indonesia memiliki potensi flora yang cukup tinggi, sekitar 30.000 jenis tumbuhan, dimana kurang lebih 24.000 merupakan tumbuhan berbunga (angiospermae). Tingginya tingkat spesies tumbuhan di Indonesia, khususnya tumbuhan angiospermae, baik spesies endemik maupun asing memunculkan beberapa peluang strategis terkait flora, seperti strategi konservasi. Salah satu tempat konservasi tumbuhan yang dikembangkan di Indonesia adalah Taman Hutan Raya Ir. H. Djuanda yang memiliki potensi kekayaan flora yang melimpah. Penelitian ini beryujuan untuk mengetahui komposisi dan struktur vegetasi angiospermae yang terdapat di Taman Hutan Raya Ir. H. Djuanda; khususnya di zona enklaf Paguyangan. Metode yang digunakan adalah petak kuadrat bertingkat dengan mengamati semua fase pertumbuhan tanaman (herba, pancang, tiang, dan pohon). Hasil analisa menunjukkan bahwa komposisi vegetasi angiospermae di daerah penelitian terdiri dari 34 spesies dari 21 famili. Selanjutnya, analisa struktur vegetasi menunjukkan bahwa daerah penelitian didominasi oleh beberapa jenis tanaman angiospermae pada setiap fase pertumbuhannya, antara lain: bayam cacabean atau dempo (*Alternanthera philoxeroides*) pada fase herba; kaliandra putih (*Zapoteca portoricensis*) pada fase pancang; dan kihujan (*Albizia saman*) berada pada fase tiang dan pohon. Salah satunya, kaliandra putih, perlu diteliti lebih lanjut karena bersifat invasif dan berpotensi untuk mengeliminasi spesies tanaman lokal.

Kata kunci: Analisis vegetasi, angiospermae, Bandung, enklaf, taman hutan raya

Abstract. *Amalia C, Wulandari I. 2023. Vegetation analysis of angiosperms at Paguyangan Enclave Zone, Ir. H. Djuanda Forest Park. Pros Sem Nas Masy Biodiv Indon 9: 170-177.* Indonesia has high flora potential, about 30,000 plant species, of which approximately 24,000 are flowering plants (angiosperms). The high level of plant species in Indonesia, especially angiosperm plants, both endemic and foreign species, provide strategic opportunities for flora conservation. One of the plant conservation sites developed in Indonesia is Ir. H. Djuanda Forest Park, which has an abundant of flora. The purpose of this research is to determine the composition and structure of angiosperm vegetation in Ir. H. Djuanda Forest Park, especially in the Paguyangan enclave zone. The stratified quadratic plot method was used by observing all the growth plant phases (seedlings, saplings, poles, and trees). The analysis shows that the vegetation composition of the angiosperms group in the research area consists of 34 species from 21 families. Furthermore, the analysis shows the vegetation structure in the research area is dominated by several species of angiosperms within each growth phase, including *cacabean* or dempo spinach (*Alternanthera philoxeroides)* in the seedling phase; white calliandra (*Zapoteca portoricensis*) in the sapling phase; and *kihujan* (*Albizia saman*) in the pole and tree phases. White calliandra requires further research due to its invasive and potential and eliminate local plant species.

Keywords: Angiosperms, Bandung, enclave, forest park, vegetation analysis

INTRODUCTION

Indonesia is known as a mega-biodiversity country. This condition is supported by the geographical condition of the Indonesian archipelago, which is located between two continents, Asian continent and Australian continent, and two oceans, the Pacific Ocean and the Indian Ocean. The geographical conditions mentioned before that support Indonesia's richness of animals and plants offer many chances for explorations and studies. For plants itself, Indonesia has around 30,000 species of plants (Maryanto et al. 2013; Retnowati et al. 2019), and 24,497 species of which are flowering plants (angiosperms) (Retnowati et al. 2019). The high level of plant species, especially flowering plants (angiosperms) in Indonesia, makes Indonesia have several strategic opportunities related to flora, for example for plant cultivation, medical field utilization, or conservation strategies.

Angiosperm is a seed plant that is also called flowering plant. The flower itself plays an important role in the plant as a reproductive organ that has two reproductive organs in the plant, consisting of stamens (male) and pistil (female) that allow pollination in the plant (Stoffel et al. 2013). It also functions as an organ that could improve plant pollination efficiency and success (Benton et al. 2021). Angiosperms' success is evidenced by their existence from the Cretaceous period to the present day. During this time, angiosperms have reached a total of 350,000 species worldwide and have successfully dominated terrestrial ecosystems (Keller 2015; Scutt 2018). The species of angiosperms spread widely and can be found in various types of ecosystems, with 67% of the population residing in the tropical zone. Angiosperms can also act as alien invasive species, rapidly establishing themselves in new areas and dominating the ecosystems they invade. This fact brings up a possibility of losing a local taxa through competition or population reduction (Krishnamurthy et al. 2015). On the other hand, angiosperm provides an important role in the food chain and provides niche requirements for other organisms (Hill and Khan 2022). Hence, the existence of an angiosperm plant inventory in an area, for example: city park, etc., can contribute to the angiosperm data contained in an area, as well as in Indonesia.

One of the plant conservation sites developed in Indonesia is the Grand Forest Park. Ir. H. Djuanda Forest Park Bandung is one of the many Grand Forest Parks in Indonesia. Based on searches related to plant data on Taman Hutan Raya Djuanda Bandung site (2019), the latest available plant inventory data is the inventory data that was conducted in 2017. Since then, There has been no publication of the latest plant data until now about angiosperms in the enclave zone in Ir. H. Djuanda Forest Park Bandung. Therefore, this research was carried out to add to the plant inventory data found in Ir. H. Djuanda Forest Park Bandung, especially in the enclave zone.

Enclave is a land that is located in a zone and has not yet been acquired (Fadli 2021). Based on Potensi Desa (Podes) 2008, enclave area is a third ownership in a forest zone in the form of human settlement or an arable land, or a village that is located in the middle or surrounded by forest areas (Djuita 2016). Paguyangan Enclave is a part of the 12 enclave areas in Grand Forest Park Ir. H. Djuanda Bandung. It has a 2.56 hectare area. Paguyangan Enclave is located at Buniwangi Pojok Sukamulya Block, Mekarwangi Village, at Lembang Sub-district (Susatiyo 2007). Mr. Sutisna, one of the Forest Police of Society Partner (*mitra masyarakat polisi hutan)*, highlighted that the enclave areas within Grand Forest Park Ir. H. Djuanda had previously lacked systematic and proper management before the establishment of the Forest Police of Society Partner.

MATERIALS AND METHODS

Study area

This study was conducted in June-August 2022 using several tools: stationery, worksheets, camera, Plant Net application, multi checker, Garmin GPS, and soil tester. The materials used consisted of raffia rope, stakes, 70% alcohol, newspapers, plastic bags, and paper labels. The research location was located at Paguyangan Enclave Zone of Djuanda Forest Park (Figure 1).

The method used was belt transect method (Figure 2). We determined 10 plots with a size per plot of 20 x 20 m^2, and the total length of the belt was 200 m so that there were 5 plots in each plot. The tree measurement area was 20 x 20 m^2, the pole measurement area was 10 x 10 m^2, the sapling and shrub measurement area was 5x5 m^2, and the herb and seedling measurement area was 2 x 2 m^2 (Ulfah and Sulistyawati 2018). Moreover, the first belt and the second belt were located at different heights: the first belt is located at 822 masl altitude and the second belt is located at 928 masl altitude.

Figure 1. Map and route from Djuanda Forest Park gate to the research site (Pin 1 coordinate: 1. Top left: 6°51'18.32"S 107°38'1.91"E, 2. Bottom left: 6°51'19.61"S 107°38'2.20"E, 3. Top right: 6°51'15.63"S 107°38'4.20"E, 4. Bottom right: 6°51'17.16"S 107°38'4.61"E)

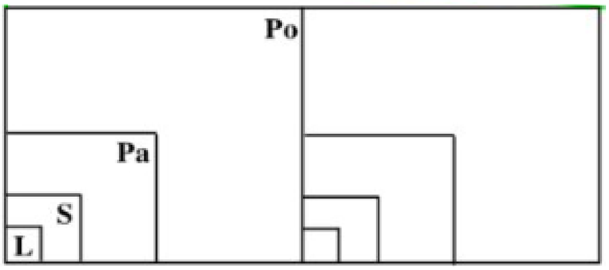

Figure 2. Plot design (Winarti 2011). Note: L: Seedling observation area, S: Sapling and shrub observation area, Pa: Pole observation area, Po: Tree observation area

Procedures

Field survey

Before conducting the research, a route tracking survey was conducted from the starting point of departure (gate) to the location on June 23th, 2022. The route to the research point and recommendations for the enclave zone were recommended by Ir. H. Djuanda Forest Park employees.

Data collection

Data collection was conducted 4 days that was on June 26th-28th, and on July 4th, 2022. The study commenced at 8:00 in the morning and continued until approximately 3:00 in the afternoon. The data collection procedure began with installing stakes and raffia rope as plot boundaries, then measuring abiotic parameters; such as, temperature, light intensity, and pH, then collecting plant data and identifying them using the Plant Net application. For plants that are not registered or not specifically identified in the application, we used an alternative source, Flora of Java book written by Backer and Brink (1968). The research was supervised by Mr. Sutisna as the Forest Police of Society Partner (*mitra masyarakat polisi hutan*) who also assisted in the plant identification process on the field. The plants which had been identified are recorded on the worksheet.

Data analysis

Data analysis was performed by calculating relative density (KR), relative frequency (FR), relative dominance (DR), and important value index (IVI). The following formula is used to find the value of KR, FR, DR, and IVI:

Density

Density is calculated to get an idea of the number of individuals from a similar population (Farhan et al. 2019). Density is obtained by the following formula:

$$\text{Absolute Density (AD)} = \frac{\textit{Total amount of species}}{\textit{Sample plot area}}$$

$$\text{Relative density (RD)} = \frac{\textit{Absolute density of a species}}{\textit{Total density of all species}} \times 100\%$$

(English et al. 1994; Parmadi et al. 2016)

Frequency

Frequency is calculated to obtain an overview of the distribution of the population in a certain area (Farhan et al. 2019). Frequency is obtained by the following formula:

$$\text{Absolute Frequency (AF)} = \frac{\textit{Number of occupied sample plots}}{\textit{Number of sample plots}}$$

$$\text{Relative Frequency (RF)} = \frac{\textit{Absolute frequency of species}}{\textit{Total frequencies of all species}} \times 100\%$$

(English et al. 1994; Parmadi et al. 2016)

Dominance

Dominance is the canopy cover area of an individual species on observation plots at the study site (Farhan et al. 2019). Dominance is obtained by the following formula:

Absolute Dominance (AD):

$$\text{ADM} = \frac{\textit{Total species base area}}{\textit{Total area of sample plots}}$$

Relative Dominance (RDM):

$$\text{RDM} = \frac{\textit{Absolute dominance}}{\textit{Total dominance of all species}} \times 100\%$$

(English et al. 1994; Parmadi et al. 2016)

Important Value Index

The Important Value Index (IVI) is the total number of relative density, relative frequency, and relative dominance (Farhan et al. 2019). IVI is obtained by the following formula:

IVI Seedlings and Sappling Plants Phase = RD + RF (English et al. 1994; Parmadi et al. 2016)

IVI of Poles and Trees Plants Phase = RD + RF + RDM (Cox 1978)

RESULTS AND DISCUSSION

Based on the research that has been done, data were obtained for 34 species from 21 families along with the environmental parameter values (Table 1).

Environmental parameters

The environmental parameters measured consisted of temperature, humidity, light intensity, and soil pH. In belt 2, data obtained on the average temperature was higher and the light intensity was relatively higher while in belt 1 the average humidity and average pH were higher.

Vegetation composition analysis

During the four days of the study, observations were obtained in the form of data on 34 species and there were 21 families. Based on the number of individuals, 1.197 individuals were recorded in the study area (Table 2). The phase of plant growth with the highest number of individuals was at the seedling level as many as 597 individuals from 24 species. The pole became the lowest growth phase in the study area since only 5 individuals from 2 species were found. Furthermore, the high seedling; especially, for herbaceous species (for example: *kihurip* (*Syngonium podophyllum*) which was abundant in the seedling phase). The dominance of these seedlings and herbs is thought to have resulted in only 1 individual seedling being found, with the dominant species result is beunying and no seedling phase of other tree species found. In addition, saplings dominate the research area, with white calliandra being the most commonly found.

The most common families found were Fabaceae (beans), with the species *Calliandra calothyrsus*, *Z. portoricensis*, *Bauhinia purpurea*, *Arachis* sp., and *Albizia saman*. The graph of the distribution of the family composition is shown in Figure 3.

Species structure analysis

Vegetation analysis of angiosperm plants in this study was carried out at each growth phase, namely seedlings, poles, saplings, and trees. Based on the analysis that has been carried out, it is known that the species that dominate in each growth phase, namely *cacabean* or dempo spinach (*Alternanthera philoxeroides*) in the seedling phase, white calliandra (*Z. portoricensis*) in the sapling phase, and *kihujan* (*A. saman*) in the pole and tree phases.

Seedlings vegetation structure analysis

In Table 3, the results of the analysis of angiosperms at the seedling stage are shown. Based on the frequency or encounters in each plot, it is known that the largest RF values are *kihurip* (Figure 4.A) and white calliandra (*Z. portoricensis*) (Figure 4.B) species with RF values of 12.245 each.

Table 1. Environmental parameter

Environmental parameters	Belt		Average
	1	2	
Temperature (°C)	23.04°C	24.92°C	23.98°C
Humidity(%)	78.75%	76.85%	77.8%
Light intensity	519.2	1363.5	941.25
pH	7.5	7.0	7.25

Table 2. Number of species and individuals per plant level

Level	Total species	Total individuals
Seedling	24	597
Saplings	13	585
Pole	2	5
Pohon	3	10
Total		1.197

Table 3. Data on seedling angiosperms in the Paguyangan Enclave Zone

Famili	Local name	Scientific name	AD	RD	AF	RF	IVI
Cucurbitaceae	*Baduyut*	*Trichosanthes villosa*	0,10	2,041	25,0000	0,168	2
Asteraceae	*Baluntas*	*Pluchea indica*	0,10	2,041	25,0000	0,168	2
Amaranthaceae	*Bayam pasir*	*Amaranthus spinousus*	0,10	2,041	100,0000	0,670	3
Moraceae	*Beunying*	*Ficus fistulosa*	0,10	2,041	25,0000	0,168	2
Fabaceae	*Bunga kupu-kupu*	*Bauhinia purpurea*	0,10	2,041	25,0000	0,168	2
Amaranthaceae	*Cacabean*	*Alternanthera philoxeroides*	0,40	8,163	6475,0000	43,384	52
Lauraceae	*Cinnamomum sp.*	*Cinnamomum* sp.	0,10	2,041	25,0000	0,168	2
Melastomaceae	*Harendong*	*Clidemia hirta*	0,10	2,041	100,0000	0,670	3
Amaranthaceae	*Jarong*	*Achyranthes aspera*	0,10	2,041	100,0000	0,670	3
Rutaceae	*Jerukan*	*Citrus* sp.	0,10	2,041	75,0000	0,503	3
Fabaceae	*Kakacangan*	*Arachis* sp.	0,10	2,041	25,0000	0,168	2
Fabaceae	*Kaliandra merah*	*Calliandra calothyrsus*	0,50	10,204	575,0000	3,853	14
Fabaceae	*Kaliandra putih*	*Zapoteca portoricensis*	0,60	12,245	700,0000	4,690	17
Zingiberaceae	*Honje*	*Etlingera elatior*	0,10	2,041	25,0000	0,168	2
Araceae	*Kihurip*	*Syngonium podophyllum*	0,60	12,245	3300,0000	22,111	34
Asteraceae	*Kirinyu*	*Chromolaena odorata*	0,20	4,082	50,0000	0,335	4
Piperaceae	*Kiseureuh*	*Piper aduncum*	0,40	8,163	100,0000	0,670	9
Rubiaceae	*Kopi robusta*	*Coffea canephora*	0,30	6,122	150,0000	1,005	7
Zingiberaceae	*Laja gowah*	*Alpinia malaccenesis*	0,10	2,041	75,0000	0,503	3
Cucurbitaceae	*Paria gengge*	*Momordica charantia*	0,10	2,041	175,0000	1,173	3
Acanthaceae	*Pecah beling*	*Strobilanthes crispa*	0,20	4,082	75,0000	0,503	5
Poaceae	*Rumput gajah*	*Pennisetum purpureum*	0,40	8,163	2625,0000	17,588	26
Malvaceae	*Sadagori*	*Sida rhombifolia*	0,10	2,041	50,0000	0,335	2
Myrtaceae	*Sowang*	*Xanthostemon novoguineensis*	0,10	2,041	25,0000	0,168	2
Total			5	100	14.875,00	100	200

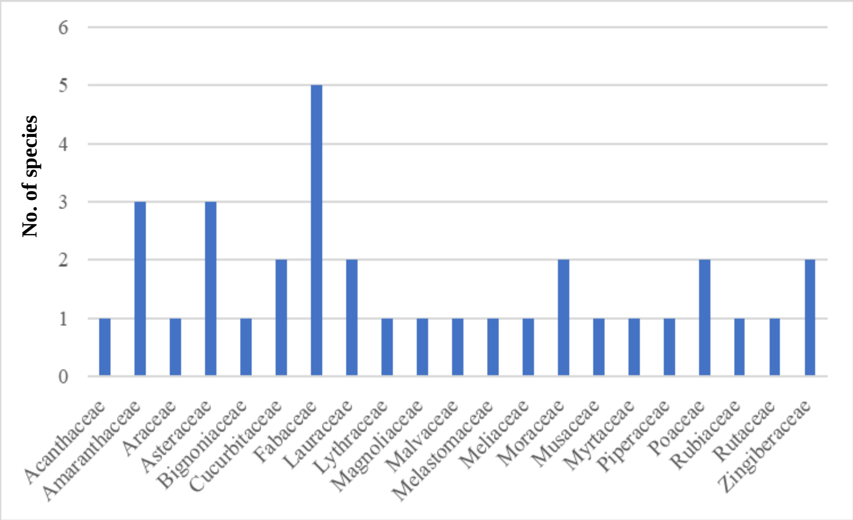

Figure 3. Frequency of angiosperm family occurrence

Figure 4. A. *Kihurip* (*Syngonium podophyllum*), B. White calliandara (*Zapoteca portoricensis*), C. *Kihujan* trunk with *Kihurip*'s vines

Saplings vegetation structure analysis

The results of the analysis of saplings angiosperms in the Paguyangan enclave zone are listed in Table 4. Based on the analysis, it is known that white calliandra (*Z. portoricensis*) was recorded to have the largest RD value with a value of 32.258, the highest RF value with a value of 66.496, and the highest IVI value with a value of 99. The species with the next highest RD, RF, and IVI values, namely red calliandra (*C. calothyrsus*) with successive values of 25,806, 20,171, and 46.

Pole vegetation structure analysis

The results of the analysis of pole level angiosperms in the Paguyangan Enclave Zone are listed in Table 5. Based on the analysis, it is known that *kihujan* (*A. saman*) has the largest RD value with a value of 66.67, RF of 80, RDM of 82.41, and the highest IVI of 229.

Tree vegetation structure analysis

The results of the tree angiosperm plant analysis in Paguyangan Enclave Zone is listed in Table 6. Based on the analysis, it is known that the largest RD result is in the *kiacret* plant (*Spathodea campanulata*) with a value of 50. Kiacret has the potential to invade agricultural areas and natural forests that were previously closed because kiacret has the characteristic of invasive (Yuliana and Lekito 2018). Among the variables RF, RDM, and IVI, the highest values were observed in the *kihujan* species (Figure 4.C), with values of 60 for RF, 67 for RDM, and 161 for IVI.The distribution of *kihujan* was also estimated due to its invasive nature. In addition, *kihujan* plants can grow well in shady and hot sunlight conditions, and can survive in warm and dry climatic conditions (Ravenscroft 2022).

Table 4. Data on sapling angiosperms in the Paguyangan Enclave Zone

Famili	Local name	Scientific name	AD	RD	AF	RF	IVI
Poaceae	*Bambu haur*	*Bambusa vulgaris*	0,100	3,226	1.800,00	7,692	11
Poaceae	*Bambu tamiang*	*Schizostachyum blumei*	0,100	3,226	120,00	0,513	4
Moraceae	*Beunying*	*Ficus fistulosa*	0,100	3,226	40,00	0,171	3
Meliaceae	*Cedar honduras*	*Cedrela odorata*	0,200	6,452	80,00	0,342	7
Fabaceae	*Kaliandra merah*	*Calliandra calothyrsus*	0,800	25,806	4.720,00	20,171	46
Fabaceae	*Kaliandra Putih*	*Zapoteca portoricensis*	1,000	32,258	15.560,00	66,496	99
Fabaceae	*Kihujan*	*Albizia saman*	0,100	3,226	120,00	0,513	4
Magnolia-ceae	*Manglid*	*Manglietia glauca*	0,100	3,226	40,00	0,171	3
Musaceae	*Pisang kole*	*Musa* sp.	0,300	9,677	240,00	1,026	11
Asteraceae	*Yakon*	*Smallanthus sonchifolius*	0,300	9,677	680,00	2,906	13
Total			3	100	23.400	100	200

Table 5. Data on pole-level angiosperms in the Paguyangan Enclave Zone

Famili	Local name	Scientific name	AD	RD	AF	RF	ADM	RDM	IVI
Lythraceae	*Bungur*	*Louger-stroemia loudonii*	0,100	33,33	10	20,00	7185,51	17,59	71
Fabaceae	*Kihujan*	*Albizia saman*	0,200	66,67	40	80,00	33654,25	82,41	229
Total			0,300	100	50	100	40.839,76	100	

Table 6. Data on tree-level angiosperm plants in the Paguyangan Enclave Zone

Famili	Local name	Scientific name	AD	RD	AF	RF	ADM	RDM	IVI
Fabaceae	*Kihujan*	*Albizia saman*	0,20	33,33	0,0006	60	0,90	67,43	161
Bignoniaceae	*Kiacret*	*Spathodea campanu-lata*	0,30	50	0,0003	30	0,25	18,66	99
Moraceae	*Nangka*	*Artocarpus hetero-phyllus*	0,10	16,6	0,0001	10	0,19	13,92	41
Total			0,60	100	0,0010	100	1,34	100	300

Discussion

From the research results, the vegetation composition has been identified in the form of 34 species from the angiosperm group with the number of species per growth phase consists of: 24 species at the seedling level, 13 species at the sapling level; 2 pole-level species, and 3 tree-level species. The vegetation structure in the enclave zone of Paguyangan Ir. H. Djuanda Forest Park is dominated by several species in each growth phase: *kihujan* (*A. saman*), is in the pole and tree phases. The high distribution of *kihujan* is estimated based on the field pH conditions of 7.25 which corresponds to the optimal pH conditions for raindrops, which are neutral with moderate acid tolerance limits (Orwa et al. 2009); white calliandra (*Z. portoricensis*) is in the sapling level. Adequate habitat factors are expected to support high distribution of calliandra, namely in areas around rivers or damper woodlands (Lusweti et al. 2011). The altitude factor has also been quite optimal for calliandra which is at an altitude of 822-928 meters above sea level; are within the range of 200-1800 masl, and the temperature factor is in the range of 22-28°C (Chamberlain 2000), and *kihurip* (*S. podophyllum*) is in the seedling phase. According to Chowdhury (2021), *S. podophyllum* is invasive and can grow massively in forest areas and agricultural areas. In the Pacific Islands Ecosystems at Risk (PIER) Project, *S. podophyllum* is known to grow well in humid and shady conditions. This plant, which originated from Central America, can grow at an altitude above sea level up to 1000 meters above sea level, but is more abundant at lower altitudes. This is in accordance with data from the field, especially in belt 1 (822 masl) (Global Invasive Species Database, 2022). The number of *kihurip* individuals was found to be as high as 106 individuals, which is significantly more abundant compared to the number of kihurip individuals found in belt 2 (928 masl), where only 26 individuals were found.

The most common family found was Fabaceae (beans), with 16% of the individuals found in the area. Examples of Fabaceae species found in the study area included *C. calothyrsus, Z. portoricensis, B. purpurea, Arachis sp., and A. saman*. Fabaceae is the third most diverse angiosperm family in the world, with over 700 genera and 20,000 species, following Orchidaceae and Asteraceae (Britannica 2019). It is widely distributed in tropical and subtropical areas, and its species have a cosmopolitan distribution pattern (Sidanand and Kotreshka 2011; Oxford Reference 2022). The second most common families found in the study area were Amaranthaceae and Myrtaceae, comprising a total of 9% of the individuals found. Overall, a total of 21 plant families were identified in Paguyangan Enclave.

The phase of plant growth with the highest number of individuals was the seedling level, with as many as 597 individuals from 24 species, while the pole phase had the lowest number of individuals, with only 5 individuals from 2 species found in the study area. The high number of seedling plants found in Paguyangan Enclave could potentially be attributed to past illegal logging activities, as reported by the Police Community Partners. Kunarso and Azwar (2015) state that illegal logging causes canopy coverage to decrease, resulting in herbs and grasses dominating the forest floor. The highest and lowest plant growth levels in this study are similar to those reported by Putri et al. (2019) in their study on vegetation diversity in an area adjacent to the enclave in National Park Bantimurung Bulusaraung. They found that the seedling phase had the highest number of species, totaling 32, while the pole phase had the least number of species, totaling 24. In their study area, they also identified disturbance factors in the forest zone around the enclave. These disturbance factors include human activities such as high utilization of trees for construction materials and the clearing of forests by locals to convert the land into farms.

According to Mr. Sutisna, the Forest Police Community Partner of Ir. H. Djuanda Forest Park, the Paguyangan enclave area was previously under private ownership and managed by local residents before being taken over by Ir. H. Djuanda Forest Park. During its time under private management, this area did not receive systematic management. Instead, it was used by the community for pine production. From the time of land purchase until around 2017-2018, illegal logging and poaching activities, such as hunting birds and wild boars, were frequently observed. These activities caused significant damage to the ecosystem of the enclave area. Consequently, Ir. H. Djuanda Forest Park established the Society Partner of Forest Police (MMP) community in collaboration with the local community. The MMP's main responsibilities include patrolling and monitoring the forest and visitors on a daily basis. A similar problem was encountered in Minggi's enclave village community in Makassar, as reported by Putri et al. (2019). The local enclave village community heavily relied on forest resources, including the consumption of various birds to meet their protein needs.

In the context of this study, it is known that areas which have previously experienced disturbances can encourage an increase in the growth of invasive plants, as stated by Funk (2013). Disturbances in an area indirectly facilitate the reproduction of invasive plants by providing favorable conditions. There are a few hypotheses about this phenomenon. According to Huebner (2020), native plants may lack biotic resistance in disturbed areas based on his study, but more research is needed to explore how the threshold of invasion could impact the abundance of native species. Leprieur et al. (2006) estimated that the experience of disturbance was beyond the evolutionary experience of native plants, and invasive plants could dominate due to their fast-growing characteristics. Consequently, invasive plants exhibit increased adaptability to the new environment, as noted by Blumenthal et al. (2009).

In this case, the disturbance found in the research area was illegal logging. According to Wahyuni's (2016) research, it was observed that abiotic factors and the reduced canopy resulting from tree cutting had an impact on the distribution of invasive plants, as supported by Huebner's (2020) statement in the previous paragraph. Wahyuni (2016) mentioned that a more open canopy, the more diverse invasive plant species in the research area. In relation to this, Lanta et al. (2022) research indicated that abiotic factors and canopy cover influence the growth of invasive plants. When the canopy cover is sparse, invasive plants can exploit available resources from abiotic factors that penetrate through to the forest floor. As a result, patches of invasive plant species can flourish and expand on the forest floor. Therefore, Huebner (2020) stated that the removal of the source of disturbance can lead to a reduction in the abundance of invasive plants. Reducing the abundance of invasive plants can promote the growth of native plant species in the area.

ACKNOWLEDGEMENTS

The authors express their gratitude to the Head of Tahura Ir. H. Djuanda and the staff who granted permission to conduct this research. Special thanks are extended to Mr. Sutisna, Forest Police Community Partner (MMP) of Tahura Ir. H. Djuanda, for accompanying the field exploration and providing valuable assistance, including plant identification during data collection. Additionally, the authors would like to thank Mr. Dicky, an ecosystem expert for Ir. H. Djuanda Forest Park, for providing research guidance and references related to plant research at Ir. H. Djuanda Forest Park.

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